Biodegradable homo and co-polymers of L-lactide, D,L-lactide, glycolide, caprolactone, dioxanone for various medical device applications:

- Orthopedic and soft tissue fixation devices
- Regenerative scaffolds
- 3-D printing/laser sintering

Highly qualified labs in Shanghai (China) and Darmstadt (Germany) provide:

- Product development support
- Manufacturing of technical samples for feasibility studies

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Chan Hun Park

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FBPS’2017
Frontiers in Biomedical Polymers
12th International Symposium on Frontiers in Biomedical Polymers
in Honor of Professors Allan Hoffman and Raphael M. Ottenbrite

July 11-14, 2017
Johnson Auditorium & International Cooperation Building, KIST, Seoul
Welcome to FBPS2017!!

On behalf of Organizing Chair of International Symposium on Frontiers in Biomedical Polymer (FBPS’17) on July 11–14, 2017, International Cooperation Building, KIST, Seoul, South Korea, we are cordially invite you.

FBPS Meetings was started from 1995 in S. Margherita Ligure (Italy, 1995) and followed by the other meetings in Eilat (Israel, 1997), Lake Biwa (Japan, 1999), Williamsburg (USA, 2001), Ischia (Italy, 2003), Granada (Spain, 2005), Ghent (Belgium, 2007), Mishima (Japan, 2009), Madeira (Portugal, 2011), Vancouver (Canada, 2013) and Riva del Garda (Italy, 2015). This Seoul Meeting will be 12th Conference on 2017. We had already a Pre-FBPS Conference on April 29th, 2016 with ~400 registrants. This conference is the Gordon Style Conference with biannually.

Permanent International Organizing Committee had selected at KIST (Korea Institute of Science and Technology), Seoul Korea for 12th FBPS2017 Conference since KIST is very special birthplace for the Korean Science and Industry with wonderful scenery in the heart of Seoul City. 12thFBPS2017 Conference would provide enormous exposure to the young scientists and students across the globe to the unique world of tissue engineering, regenerative medicine, stem cell, biomaterials and their innovative applications. Also you can have a wonderful experience for food and culture of Seoul and Dynamic Korea.

Also, we are planning to dedicate to Special Edition for Prof Allan Hoffman and Raphael Ottenbrite to “Journal Biomaterials Science, Polymer Edition (IF; 1.733) on July 2017.

With the beautiful scenery of KIST, the Gangnam style of Seoul and Dynamic Korea, we will prepare the Historical Conference in the area of tissue engineering, DDS, bioimaging, gene therapy, regenerative medicine and stem cell with over 50 Plenary Speakers. This legendary symposium will give an opportunity to overview to young scientist and students, especially.

Please enjoy Korean culture and science and technology!

Thanking you and with best regards,
Sincerely,
12th FBPS 2017 Conference Organizing Chair
Gilson Khang, PhD
FBPS would like to thank the following support:

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**GOLD**

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![Logos](image)
FBPS would like to thank the following supporters:

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- Ministry of Health & Welfare
## GENERAL INFORMATION

All the information contained in this book is accurate at the time of its publication. The Symposium organizers reserve the right to make alterations to the programme and the associated events as circumstances dictate.

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**DIRECTIONS TO KIST’S NORTH GATE ENTRANCE**
**Useful Information**

**Food**

Eating out is one of the great pleasures of visiting Korea, a country famous for its diverse native dishes. Korean cuisine is nutritious, well balanced and low in calories as it involves a wide variety of vegetables and fermented foods. Bulgogi (Marinated, barbecued beef) and Bibimbap (Boiled rice mixed with vegetables) are the most famous.

**Climate**

Korea lies in the temperate zone and has four distinct seasons. Spring begins around early March; cherry blossom and flower festivals around the entire country signal the official coming of spring. The summer months can get quite hot and humid, but be ready for random spurts of coldness when stepping into a subway car, bus, or any other air-conditioned facilities in Seoul. For about a month starting from mid-July is the rainy season. Autumn start around September and boasts beautiful scenery as leaves begin to turn into fall colors. The winters in Seoul can get quite harsh. The temperature can drop as low as 15 degrees below zero (Celsius) during the coldest days.

**Currency**

The unit of Korean currency is the Won. One U.S. dollar was equivalent to about KRW 1,144. Credit cards, including VISA, American Express, Diners Club, Master Card and JCB, are widely accepted.

**Business Hour**

<table>
<thead>
<tr>
<th>Business</th>
<th>Weekdays</th>
<th>Weekends and National Holidays</th>
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<tbody>
<tr>
<td>Banks</td>
<td>09:00 - 16:00</td>
<td>Closed</td>
</tr>
<tr>
<td>Government Offices and Organizations</td>
<td>09:00 - 18:00</td>
<td>Closed</td>
</tr>
<tr>
<td>Foreign Diplomatic Missions</td>
<td>Hours vary, please see the following link for more information (<a href="http://www.mofat.go.kr/ENG/main/index.jsp">http://www.mofat.go.kr/ENG/main/index.jsp</a>)</td>
<td></td>
</tr>
</tbody>
</table>
PASSPORT AND VISA

All foreign visitors wishing to enter the Republic of Korea must have a valid passport and obtain a Korean visa before coming. However, people from 51 selected countries who would like to visit Korea temporarily are permitted to enter without a visa according to visa-exemption agreements, and also in accord with principles of reciprocity or national interest.

TAX AND TIPPING

Value-added tax (VAT) is levied on most goods and services at a standard rate of 10% and is included in the retail price. In tourist hotels, this 10% tax applies to meals as well as other services and is added into the bill. Tipping is not a traditional Korean customs. A 10% service charge is added to your bill at all tourist hotels and 3-10% at some major restaurants.

ELECTRICITY AND VOLTAGE BRING

The standard voltage in Korea is 220 volts. The outlet has two round holes and is the same type used in France, Germany, Austria, Greece, Turkey, and many other countries. If you do not have a multi-voltage travel adapter, you can borrow one from your hotel front desk. If you want to buy one in Korea, you can do so at a duty-free shop, convenience shop at Incheon International Airport.

1330 KOREA TRAVEL PHONE

For English assistance or travel information, just dial 1330 and a bilingual operator will assist you with detailed information.
- Information provided 24 hours a day in Korean, English, Japanese, Chinese
- Korea Travel Phone : 1330
- Mobile Phone : area code + 1330
- From abroad : + 82 - area code 1330

EMERGENCY CALL

Dial 112 for the police, 119 for the fire department, or 1339 for medical emergencies (though most operators speak only Korean). A hotel staff or hotel manager can arrange for a doctor or an ambulance.
**Diplomatic Missions in Korea**

For more detailed information about diplomatic missions in Korea, please visit the homepage of the Ministry of Foreign Affairs and Trade.  
(http://www.mofat.go.kr/ENG/main/index.jsp)

**Useful Website**

- Korea Tourism Information :  
  www.visitkorea.or.kr  
- Korea Beyond Meetings :  
  www.koreaconvention.org

**Smoking Policy**

Since 1 January 2015, South Korea has completely banned smoking on all bars, restaurants and cafes regardless of size, including any smoking rooms. Any spotted smoker must pay fines of 100,000 won and up to 5 million won on shop owners not obeying the law. Anyone can report a smoker via calling or sending a text message to a government hotline (in the case of Seoul, the number is 120) with their location address and authorities will raid the reported place, of which a picture of the offending smoker will be taken and fined 100,000 won. Disguised authorities also secretly check random places at random times for offending smokers.

**Insurance**

The Conference Organisers cannot accept any responsibility for personal accidents and damage to the private property of Conference and Exhibition Delegates.

**Registration and Information Desk**

All attendees must be registered for the conference. Admission to the conference and social events is permitted only to those wearing the official conference badge. If a name badge is misplaced, please contact the registration desk.
◆ ACCOMMODATION : BEST WESTERN ARIRANG HILL DONGDAEMUN

◆ HOTEL INFORMATION

- A four star hotel, newly opened in Sept. 2015. Free high speed wireless and wireline internet is available throughout the hotel.
- 3.4 km (2.1 miles) from the conference venue (Korea Institute of Science and Technology). Shuttle service to the venue will be provided.
- 50 meters from a subway station (Sungshin women's univ.) can reach major tourist attractions of Seoul within 10 ~ 30 minutes via subway.
- A cafe and a buffet restaurant is in the hotel. Within 100 meters, there are many shops, eateries, hospitals, a shopping mall and a movie theater.
- Also the hotel has a business center, gym, coin laundry and meeting rooms. Rooms are equipped with temperature control, high quality beddings and toiletries with naturally derived ingredients.

<table>
<thead>
<tr>
<th>Key Words</th>
<th>Contents</th>
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<tbody>
<tr>
<td>Address</td>
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<tr>
<td>Arirang Hill</td>
<td>The original name is ‘Jeongneung hill’ Famous as the shooting location of the 1926 movie &quot;Arirang&quot;.</td>
</tr>
<tr>
<td>Arirang Cine Center</td>
<td>Founded to commemorate the Spirit of the movie “Arirang”</td>
</tr>
<tr>
<td>Nearby major universities</td>
<td>Seoul Univ Hospital, Kyunghee Univ, Korea Univ, Sungshin Univ, Catholic Univ, Hansung Univ etc</td>
</tr>
<tr>
<td>Rodeo Street</td>
<td>Sungshin Women Univ Entrance Station. The main commercial area.</td>
</tr>
<tr>
<td>Distance and duration</td>
<td>In-Cheon Airport 52.4km 70min</td>
</tr>
<tr>
<td></td>
<td>Kim-Po Airport 10.6km 56min</td>
</tr>
<tr>
<td></td>
<td>Hyehwa Station 2.08km 8min</td>
</tr>
<tr>
<td></td>
<td>Korea Univ 2.52km 10min</td>
</tr>
<tr>
<td></td>
<td>Dongdaemun Station 3.58km 10min</td>
</tr>
<tr>
<td></td>
<td>Gwanghwamun Station 4.3km 29min</td>
</tr>
<tr>
<td></td>
<td>Seoul Station 5.9km 23min</td>
</tr>
<tr>
<td></td>
<td>Myeongdong Station 6.28km 18min</td>
</tr>
<tr>
<td></td>
<td>Gangnam Station 10.6km 49min</td>
</tr>
</tbody>
</table>

◆ ADDITIONAL INFORMATION

- Opening date : 2015.09.01
- Reservation center - Tel: 82-2-925-7000 Email: rsvn@hotelahill.com
- Sales team - Tel : 82-10-7125-0474
- Email : sjkim@hotelahill.com
- Website :
  - http://www.hotelahill.com
  - https://www.facebook.com/hotelahill
SPECIAL EVENT

PERFORMANCE : KOREAN TRADITIONAL PERCUSSION QUARTET

- Tuesday, July 11th
- 17:30~18:30

About Korean Traditional Percussion Quartet

From Wikipedia,

Samul nori is a genre of percussion music originating in Korea.

The word samul means "four objects" and nori means "play"; Samul nori is performed with four traditional Korean musical instruments:

Samul nori has its roots in Pungmul nori (literally "Korean traditional percussion instruments playing"), a Korean folk genre comprising music, acrobatics, folk dance, and rituals, which was traditionally performed in rice farming villages in order to ensure and to celebrate good harvests. Since Korea's people until the modern times were 90% plus in farm related work this music defined Korean folk music or popular music and rhyme of Korea.

Samul nori has gained international popularity, with many Samul nori bands and camps worldwide. Since the 1980s in South Korea, there has been a marked increase in the amount of fusion music, combining Samul nori and Western instruments. Samul nori is also extensively used in the Korean musical Nanta.

The most famous Samul nori ensemble is the internationally famous South Korean ensemble called Samul Nori, which is credited for bringing the music from a rural folk genre to the contemporary stage.

The group was established in February 1978 by janggu player and former Namsadang star performer Kim Duk Soo. The group has collaborated and recorded with a number of non-Korean ensembles, most notably in 1987 with the Red Sun jazz band, with one SamulNori/Red Sun CD selling 70,000 copies. They have also performed (in August 2000 at the Earth Celebration International Arts Festival on Sado Island in Japan) with the Japanese taiko group Kodo.

About his choice to move from the more traditional outdoor performances to indoor venues, Kim Duk Soo states that at the time he established SamulNori, during the last years of the administration of former South Korean president Park Chung Hee, Korean traditional music was associated with the student movement, and anyone playing such instruments outdoors could be arrested. Thus, he developed the current version of the genre, which is generally presented indoors, on concert hall stages.

In 1993, SamulNori expanded to include twenty performers, and changed its name to SamulNori Hanullim, Inc. ("Hanullim" meaning "big bang").
**CITY TOUR (FOREIGNERS) : DMZ**

- Thursday, July 13th
- 14:00~18:00

**ABOUT DMZ**

- DMZ is a place where it connects historically the past, present and future of Korea.
- It is the tourist attraction because you can only see a divided nation in the world in Korea.
- Discover the 3rd Underground Tunnel near the DMZ that would have rewritten Korean history if it was not found.
- Thrilling walk in the most dangerous tunnel closest to South Korea, through which more than 500 soldiers and even tanks can go through.
- DMZ is the top tourist attraction for foreign visitors.

**DMZ TOUR POINT!**

- DMZ is an area extend over 2km out from the border of both Koreas, a large scale of 64 million Pyeong (and around 50,156 each). Along this DMZ bisecting the two Koreas stand almost 2 million armed armies from both sides. In the DMZ, you can see historical places breaking the heart of so many Koreans. It is a silent and calm place good preserving environment because no one has been allowed to get in for the past 4 decades. It’s also well-known for being home to precious wild nature and wildlife. Seen from the distance, DMZ looks alarming, but once you get to know it deeply, you actually notice it one of the safest security ecology tourist attractions.

- Do not miss an interesting trip to the world-unique demilitarized zone.
### SCIENTIFIC INFORMATION

The code attributed to Oral Presentation in the program corresponds to the code given in this proceeding book in the abstracts lists.

#### PLENARY ORAL PRESENTATIONS

<table>
<thead>
<tr>
<th>Tuesday, July 11th</th>
<th>Wednesday, July 12th</th>
<th>Thursday, July 13th</th>
<th>Friday, July 14th</th>
</tr>
</thead>
<tbody>
<tr>
<td>14:00 to 15:40 – PL-01~PL-03</td>
<td>09:00 to 10:40 – PL-06~PL-10</td>
<td>09:00 to 10:40 – PL-25~PL-29</td>
<td>09:00 to 10:40 – PL-34~PL-38</td>
</tr>
<tr>
<td>20min break</td>
<td>20min break</td>
<td>20min break</td>
<td>20min break</td>
</tr>
<tr>
<td>16:00 to 17:00 – PL-04~PL-05</td>
<td>11:00 to 12:20 – PL-11~PL-14</td>
<td>11:00 to 12:20 – PL-30~PL-33</td>
<td>11:00 to 12:20 – PL-39~PL-42</td>
</tr>
<tr>
<td>Lunch</td>
<td>Lunch</td>
<td>Lunch</td>
<td>Lunch</td>
</tr>
<tr>
<td>14:00 to 15:20 – PL-15~PL-18</td>
<td>14:00 to 16:00 – PL-43~PL-48</td>
<td>20min break</td>
<td>20min break</td>
</tr>
<tr>
<td>15:40 to 16:40 – PL-19~PL-21</td>
<td>20min break</td>
<td>17:00 to 18:00 – PL-22~PL-24</td>
<td></td>
</tr>
</tbody>
</table>

#### STUDENTS RAPID FIRE SESSION

- **Thursday, July 13th**
  - 14:00 to 15:00 *Students Rapid Fire Session (1)-SR-01–SR-10*
  - 20min break
  - 15:20 to 16:20 *Students Rapid Fire Session (2)-SR-11–SR-20*
  - Students must prepare 5ppt and submit it by July 3rd.
  - 5min will be given for each student.
  - In each Session, 5 students will be awarded 100,000KRW.

#### PRESENTATIONS UPLOAD

- The conference presentations will all take place at *International cooperation building (No.8) auditorium*.
- Personal computers or USB pen drive will be allowed for the presentation. In case of USB pen drive, files must be prepared in Power-Point 2007 or 2010.
- There will be a Speakers Preparation Desk in the information/registration desk where speakers must upload their presentation before the oral presentation.

#### POSTER UPLOAD

- Please find your poster code in the posters list. Place your poster on the placard identified with the poster code.
- In each Session, 5 posters will be awarded 100,000KRW.

#### POSTERS SETTING AND REMOVAL

- The poster area will take place at *International cooperation building (No.8) auditorium*.
- **Poster Session (1)-PO-01~PO45** must settle poster on Wednesday, July 12th from 08:00 to 18:00.
- **Poster Session (2)-PO-46~PO93** must settle poster on Thursday, July 13th to July 14th from 08:00 to 18:00.
- Make sure you remove your poster before 18:00. The organization will not be responsible for any poster that is left behind and will have to discard them.
## CONFERENCE PROGRAM

### FBPS’17-PROGRAM-ORAL PRESENTATION

#### Tuesday (July 11th)

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
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</thead>
<tbody>
<tr>
<td>08:30 –</td>
<td><strong>Poster Session[1]</strong></td>
</tr>
<tr>
<td>09:00 –</td>
<td>(Chairs: Chun Ho Kim; Heung Jae Chun)</td>
</tr>
<tr>
<td>09:20 –</td>
<td>PL6 Jun-ichiro Jo</td>
</tr>
<tr>
<td>09:20 –</td>
<td><strong>Poster Session[2]</strong></td>
</tr>
<tr>
<td>09:40 –</td>
<td>(Chairs: Chun Ho Kim; Heung Jae Chun)</td>
</tr>
<tr>
<td>10:20 –</td>
<td>(Chairs: Junhong Min; Ilkeun Kwon)</td>
</tr>
<tr>
<td>10:20 –</td>
<td>PL9 Deok-Ho Kim</td>
</tr>
<tr>
<td>10:40 –</td>
<td><strong>Break</strong></td>
</tr>
<tr>
<td>11:00 –</td>
<td>(Chairs: Moon Suk Kim; Oh Hyeong Kwon)</td>
</tr>
<tr>
<td>11:20 –</td>
<td>PL11 James Yoo</td>
</tr>
<tr>
<td>11:40 –</td>
<td>PL12 Yasuhiko Tabata</td>
</tr>
<tr>
<td>12:00 –</td>
<td><strong>Break</strong></td>
</tr>
<tr>
<td>12:00 –</td>
<td>(Chairs: Moon Suk Kim; Oh Hyeong Kwon)</td>
</tr>
<tr>
<td>12:20 –</td>
<td><strong>Lunch (Poster)</strong></td>
</tr>
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</table>

#### Wednesday (July 12th)

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
</tr>
</thead>
<tbody>
<tr>
<td>13:00 – 14:00</td>
<td><strong>Registration &amp; Opening Ceremony</strong></td>
</tr>
<tr>
<td>14:00 – 14:40</td>
<td>(Chairs: Young Ha Kim, Byoung Hyun Min)</td>
</tr>
<tr>
<td>PL1 Allan Hoffman</td>
<td></td>
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<tr>
<td>14:40 – 15:00</td>
<td><strong>Break</strong></td>
</tr>
<tr>
<td>PL2 Hai Bang Lee</td>
<td></td>
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<tr>
<td>15:10 – 15:40</td>
<td><strong>Break (Poster)</strong></td>
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</table>

#### Thursday (July 13th)

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
</tr>
</thead>
<tbody>
<tr>
<td>15:40 – 16:00</td>
<td>(Chairs: Soo Hyun Kim, Gilson Khang)</td>
</tr>
<tr>
<td>PL4 Claudio Migliari</td>
<td></td>
</tr>
<tr>
<td>16:30 – 17:00</td>
<td><strong>Break (Poster)</strong></td>
</tr>
<tr>
<td>PL5 Rui Reis</td>
<td></td>
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</tbody>
</table>

#### Friday (July 14th)

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
</tr>
</thead>
<tbody>
<tr>
<td>17:30 – 18:00</td>
<td><strong>Duk Soo Kim’s Samulnori</strong> (Korean traditional percussion quartet)</td>
</tr>
<tr>
<td>18:00 – 18:30</td>
<td><strong>Welcome Reception</strong></td>
</tr>
</tbody>
</table>

- **City Tour (Foreigners)**
- **Students Rapid Fire Session (1)**
- **Students Rapid Fire Session (2)**
- **Closing & Award**

**Posters**
- PL7 Daniel Cohn
- PL26 In-Woong Um
- PL35 Hong Kyun Kim
- PL10 Eben Alsberg
- PL29 Kyung-Sun Kang
- PL33 Yadong Wang
- PL42 Chan Hum Park

**Rapid Fire Sessions**
- Rapid Fire Session (1)
- Rapid Fire Session (2)
Prof. Gilson Khang  
Chonbuk National Univ., Korea

Prof. Allan Hoffman  
The Univ. of Washington, USA

Emeritus Prof. Hai Bang Kim  
GIST, Korea

Prof. Kazunori Kataoka  
The Univ. of Tokyo, Japan

Prof. Claudio Miglianesi  
The Univ. of Trento, Italy

Prof. Ha L. Reis  
The Univ. of Minho, Portugal

Prof. Jun-eho Jo  
Kyoto Univ., Japan

Prof. Daniel Cohn  
The Hebrew Univ. of Jerusalem, Israel

Prof. Hyunjoon Kong  
The Univ. of Illinois, USA

Prof. Deok-Ho Kim  
The Univ. of Washington, USA

Prof. Eben Alsberg  
Case Western Reserve Univ., USA

Prof. James Yoo  
Wake Forest School of Med., USA

Prof. Yasuhiko Tabata  
Kyoto Univ., Japan

Prof. Julio San Roman  
The Tech. Univ. of Middle East Tech., Turkey

Prof. Vasif Hasirci  
The Univ. of California, USA

Prof. Feng-Huei Lin  
National Taiwan University, Taiwan

Prof. John Fisher  
The Univ. of Maryland, USA

Prof. Jons Hilborn  
Upssala Univ., Sweden

Prof. Young Jik Kwon  
The Univ. of Hong Kong, Hong Kong

Prof. Heon Ju Lee  
Rokit, Korea

Prof. Miguel Oliveira  
The Univ. of Minho, Portugal

Prof. Lynn Huang  
National Cheng Kung Univ., Taiwan

Prof. Jong Young Kim  
Andong National Univ., Korea

Dr. Yoon Hoi Heo  
CGBio, Korea

Prof. Young Jik Kwon  
The Univ. of California, USA

Prof. Sei Kwang Hahn  
POSTECH, Korea

Prof. Nobuhiko Yai  
Tokyo Med. & Dent. Univ., Japan
| PL-01 | The Evolution of PEGylation of Drugs and Biomolecules  
Allan S. Hoffman  
*Professor Emeritus, Department of Bioengineering, University of Washington* |
| PL-02 | Cell Behavior on Polymer Surfaces and 3D-Printed Scaffolds for Tissue Engineering  
Hai Bang Lee  
*Department of Molecular Science and Technology, Ajou University* |
| PL-03 | Self-Assembled Supramolecular Nanosystems for Smart Diagnosis and Targeted Therapy of Intractable Diseases  
Kazunori Kataoka  
*Innovation Center of NanoMedicine, Kawasaki Institute of Industrial Promotion* |
| PL-04 | Cell Printing for Tissue Engineering and Biological Models  
Claudio Migliaresi, Antonella Motta, Volha Liaudanskaya, Nicola Cagol, Devid Maniglio  
*Department of Industrial Engineering Technology and BIOtech Research Center, University of Trento* |
| PL-05 | Unique TERM Strategies Based On The Use of Different Natural Origin Scaffolds, Hydrogels and Stem Cells  
Rui L. Reis  
*3B’s Research Group - Biomaterials, Biodegradables and Biomimetics, University of Minho* |
| PL-06 | Trial on Development of Imaging Technology for Regenerative Therapy with Polymer-Based Biomaterials  
Jun-ichiro Jo and Yasuhiko Tabata  
*Laboratory of Biomaterials, Department of Regeneration Science and Engineering, Institute for Frontier Life and Medical Sciences, Kyoto University* |
| PL-07 | "Smart" 3D Printed Biomedical Structures  
Daniel Cohn and Sujan Dutta  
*Casali Center of Applied Chemistry, Institute of Chemistry, Hebrew University of Jerusalem  
Edmond Safra Campus, Jerusalem 9190401, Israel* |
| PL-08 | Bioinspired Hydrogel Transformer for Minimally Invasive Revascularization Therapy  
Hyunjoon Kong  
*Departments of Chemical & Biomolecular Engineering, Bioengineering, & Pathobiology, University of Illinois at Urbana-Champaign* |
| PL-09 | Multi-Scale Biomimetic Human Cardiac Tissue Engineering for Disease Modeling and Drug Screening  
Deok-Ho Kim  
*Department of Bioengineering, Center for Cardiovascular Biology, Institute for Stem Cell and Regenerative Medicine, University of Washington* |
| PL-10 | Modular Inductive High-Density Cell Culture Systems for Engineering Complex Tissues  
Eben Alsberg  
*Departments of Biomedical Engineering and Orthopaedic Surgery, Case Western Reserve University* |
| PL-11 | In Situ Tissue Regeneration  
James Yoo  
*Wake Forest School of Med., USA* |
| PL-12 | Delivery Technology of Bio-Signals to Realize Tissue Regeneration  
Yasuhiko Tabata  
*Laboratory of Biomaterials, Institute for Frontier Life and Medical Sciences, Japan* |
| PL-13 | **Kyoto University**  
ICTP, CSIC |
| PL-14 | **Biomaterials and Surfaces in Engineering Tissues**  
Vasif Hasirci  
*Biomaterials and Tissue Engineering, Middle East Technical University (METU) Department of Biological Sciences* |
| PL-15 | **ESOMER® and RESOMER® Select Biodegradable Polymers**  
Bruce C. Johnson.  
*Innovation Management Biomaterials, Evonik Corporation* |
| PL-16 | **Hyaluronate-Based Thermo-Sensitive Hydrogel as Cell Carrier for Nucleus Pulposus Regeneration and Vitreous Body Substitute**  
Feng-Huei Lin  
*Institute of Biomed Eng & Nanomed* |
| PL-17 | **3D Printing for Engineering Complex Tissues**  
John P. Fisher  
*Center for Engineering Complex Tissues, Fischell Department of Bioengineering, University of Maryland* |
| PL-18 | **The Magic Bullet of Small Interfering RNA (siRNA) Is Easy to Manufacture, It Targets Sharply and Has High Kill Artes. But How To Pull The Trigger?**  
Jons Hilborn, Oommen Varghese and O.P. Oommen  
*Division of Polymer Chemistry, Department of Chemistry - Ansgtrom Laboratory* |
| PL-19 | **BGS-7(Novomax®) in Tissue Engineering**  
Yoen Hoi Heo  
*Department of Medical & Scientific Affairs, CGBio* |
| PL-20 | **Synergistic and Targeted Inhibition of CML Proliferation Using Viral/Nonviral Chimeric Nanoparticles**  
Margaret Lugin, Cheol Am Hong, Soo Kyung Cho, Julius Edson, Dominique Ingato, and Young Jik Kwon  
*Department of Chemical Engineering and Materials Science* |
| PL-21 | **Application Case Study All-In-One Bio 3D Printer, IN VIVO® from ROKIT Inc.**  
Heon Ju Lee, Jeonglan Park, Jin-il Huh, Bo Mi Nam, Min Chae Lee, Hunyeong Ban  
*ROKIT Inc.* |
| PL-22 | **Application of New Keratin-Chitosan Biomaterials for Peripheral Nerve Regeneration**  
Cristiana R. Carvalho, J. P. Gonçalves, Albino Martins, Nuno M. Neves, Kee Woei NG, Rui L. Reis, Joaquim M. Oliveira  
*3B’s Research Group - Biomaterials, Biodegradables and Biomimetics, University of Minho* |
| PL-23 | **Taiwan Lanyu Minipig Is A Better Animal Model for Biomedical Applications**  
Lynn L.H. Huang  
*Department of Biotechnology and Bioindustry Sciences, College of Bioscience and Biotechnology* |
| PL-24 | **Design and Fabrication of Bio-Scaffolds for Bone Tissue Engineering Using 3D Printing Technology**  
Min-Woo Sa, Jong Young Kim |
<table>
<thead>
<tr>
<th>Session</th>
<th>Title</th>
<th>Authors</th>
<th>Affiliations</th>
</tr>
</thead>
<tbody>
<tr>
<td>PL-25</td>
<td>Small Molecule Ligand-Driven Stem Cell Differentiation</td>
<td>Heemin Kang, Shyni Varghese, and Liming Bian</td>
<td>Department of Mechanical Engineering, Andong National University</td>
</tr>
<tr>
<td>PL-26</td>
<td>Demineralized Dentin Matrix as A Carrier of Recombinant Human Bone Morphogenetic Proteins</td>
<td>In-Woong Um, Sang-Ho Jun, Young-Kyun Kim and Yu-Mi Kim</td>
<td>Division of Biomedical Engineering, The Chinese University of Hong Kong</td>
</tr>
<tr>
<td>PL-27</td>
<td>Smart Multi-Functional Photomedicines Using Hybrid Nanomaterials</td>
<td>Sei Kwang Hahn, Dohee Keum and Seulgi Han</td>
<td>R&amp;D Institute, Korea Tooth Bank</td>
</tr>
<tr>
<td>PL-28</td>
<td>Emerging Polyrotaxane Frameworks for Modulating Cellular Functions</td>
<td>Nobuhiko Yui</td>
<td>Department of Organic Biomaterials, Institute of Biomaterials and Bioengineering, Tokyo Medical and Dental University</td>
</tr>
<tr>
<td>PL-29</td>
<td>Generation of Human Artificial Mini- Organs; Stem Cells and Organoids</td>
<td>Kyung-Sun Kang</td>
<td>Adult Stem Cell Research Center, College of Veterinary Medicine, Seoul National University</td>
</tr>
<tr>
<td>PL-30</td>
<td>A New Polymer Scaffold Suitable to Transplant and Repair Corneal Endothelium After Injury or Disease Causing Blindness</td>
<td>Karl David Brown, Berkay Ozcelik, Jean-Pierre Scheerlinck, Hong Zhang, Greg Dusting, Greg Qiao Mark Daniell</td>
<td>Ophthalmology, Dept of Surgery, University of Melbourne</td>
</tr>
<tr>
<td>PL-31</td>
<td>Functional Nanofibrous Scaffolds Combined with Stem Cells for Advanced Biomedical Devices and Therapies</td>
<td>Nuno M. Neves</td>
<td>Functional Nanofibrous Scaffolds Combined with Stem Cells for Advanced Biomedical Devices and Therapies</td>
</tr>
<tr>
<td>PL-32</td>
<td>Synthetic Hydrogels for Regenerative Medicine</td>
<td>André J. García</td>
<td>Georgia Institute of Technology</td>
</tr>
<tr>
<td>PL-33</td>
<td>Biomaterials for In Situ Tissue Regeneration</td>
<td>Yadong Wang, Kee-Won Lee, and William Chen</td>
<td>University of Pittsburgh</td>
</tr>
<tr>
<td>PL-34</td>
<td>H$_2$O$_2$-Activatable Engineered Nanoparticles for Ultrasound Imaging and Anti-Inflammatory Therapy for Oxidative Stress-Associated Diseases</td>
<td>Changsun Kang, Donghyuck Yoo, Eunkyung Jung, Joungyoun Noh, Dongwon Lee</td>
<td>Department of PolymerNano Science and Technology, Department of BIN Fusion Technology, Chonbuk National University</td>
</tr>
<tr>
<td>PL-35</td>
<td>Generation of Decellularized Cornea Lenticule Using Hypotonic Trypsin-EDTA for Corneal Tissue Engineering</td>
<td>Man-Il Huh, Kyung-Pil Lee, Hong Kyun Kim</td>
<td>Department of Ophthalmology, Kyungpook National University School of Medicine</td>
</tr>
<tr>
<td>PL-36</td>
<td>Preparation of Biomimetic Matrices for Controlling Stem Cell Functions</td>
<td>Guoping Chen, Rong Cai and Naoki Kawazoe</td>
<td>Research Center for Functional Materials, National Institute for Materials Science</td>
</tr>
</tbody>
</table>
| PL-37 | Biodegradable Polymers And Polymer-Based Composites for ACL Reconstruction Screws: Advantages, Limitations and Current Trends  
Antoniac Iulian  
*Faculty of Materials Science and Engineering, University Politehnica of Bucharest* |
| PL-38 | Phospholipid Polymer Soft-Biomaterials for Advanced Cell Engineering  
Kazuhiko Ishihara  
*Department of Materials Engineering, The University of Tokyo* |
| PL-39 | Tendon Tissue Engineering Approaches Using Magnetic Stimulus  
Manuela E. Gomes  
*3B’s Research Group - Biomaterials, Biodegradables and Biomimetics, University of Minho, Headquarters of the European Institute of Excellence on Tissue Engineering and Regenerative Medicine* |
| PL-40 | Polymers Designed by Nature: Rational, Strategies, Processing  
Antonella Motta  
*Department of Industrial Engineering and BIOTech Research Center, University of Trento* |
| PL-41 | Novel Approach for The Micrometastasis Cancer Detection Using A Nanoparticle Platform  
Ayesha B. Alvero, Gil Mor and Dongin Kim  
*Department of Pharmaceutical Sciences, Irma Lerma Rangel College of Pharmacy, Texas A&M University System* |
| PL-42 | Applications of Silk Biomaterials Using 3D Printing in Tissue Engineering  
Chan Hum Park  
*Nano-Bio Regenerative Medical Institute, Hallym University* |
| PL-43 | Micro and Nano Modifications of Surface and Bulk Properties of Polymeric Biomaterials  
Nesrin Hasirci  
*Biomaten – METU Center of Excellence in Biomaterials and Tissue Engineering, Middle East Technical University* |
| PL-44 | Acrylic Bone Cement  
Jen-Ming Yang  
*Department of Chemical and Materials Engineering, Chang Gung University* |
| PL-45 | Electroactive Spongy Like Hydrogels for Skeletal Muscle Tissue Engineering.  
Pathomthat Srisuk, Fernanda V. Berti, Rui L. Reis and Vitor M. Correlo  
*3B’s Research Group – Biomaterials, Biodegradables and Biomimetics, University of Minho* |
| PL-46 | Mussel and Insect-Inspired Adhesives: Polydopamine and It Derivative Materials for Self-Sealing and No-Bleeding Needles  
Haeshin Lee  
*Department of Chemistry, Center for Nature-inspired Technology (CNiT)* |
| PL-47 | The Use of Stem Cells Derived from Human Gingiva for The Enhancement of Bone Regeneration  
Jun-Beom Park  
*Department of Periodontics, College of Medicine, The Catholic University of Korea* |
| PL-48 | Coacervate-Mediated Dual Growth Factor Delivery for Skin Scar Reduction  
Kyobum Kim  
*Division of Bioengineering, College of Life Sciences and Bioengineering, Incheon National University* |
<table>
<thead>
<tr>
<th>Student Rapid Fire List</th>
</tr>
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</table>
| **SR-01** | Development of Antioxidant Biodegradable In Situ Forming Drug Delivery System for Glaucoma Therapy  
Li-Jyuan Luo and Jui-Yang Lai  
Department of Chemical and Materials Engineering, Chang Gung University |
| **SR-02** | Human Adipose Tissue-Derived Mesenchymal Stem Cells Alleviate Atopic Dermatitis via Regulation of B lymphocyte Maturation  
Byung-Chul Lee, Tae-Hoon Shin, Hyung-Sik Kim and Kyung-Sun Kang  
Adult Stem Cell Research Center, College of Veterinary Medicine, Seoul National University |
| **SR-03** | Tissue Adhesive, Injectable and Sprayable Hydrogel via Recombinant Tyrosinase Based Crosslinking  
Su-Hwan Kim, Sang-Hyuk Lee, Byung-Gee Kim and Nathaniel S. Hwang  
Interdisciplinary Program of Bioengineering, Seoul National University |
| **SR-04** | Patient Specific In Vitro Assessment Tool Using Dental Stem Cell with Bioink for 3D Printer  
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College of Nanoscience & Nanotechnology, Pusan National University |
| PO-68 | Microscopic Observational Assay for Antifungal Activity of Tetrodotoxin  
Huck Jun Hong, Suw Young Lee  
Biosensor Research Institute at Seoul National University of Science and Technology |
| PO-69 | Effect of Serum Types on Chondrogenic Differentiation of Adipose Derived Stem Cells  
Hyeran Cho, Aeri Lee and Kyobum Kim  
College of Life Sciences and Bioengineering, Incheon National University |
| PO-70 | Controlled Synthesis of Folate-Thioglycolate-Gold Nanoconjugates Using Citric Acid PEG Hyper Branched Polymer  

| PO-71 | Mani Gajendiran, Sungjun Kim and Kyobum Kim  
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| **PO-71** | **Functionalization of Porous Ceramic Scaffold by Generating Cell-Derived Extracellular Matrix**  
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| **PO-72** | **Evaluation of Release Properties and Biocompatibility of Gallium-Indium Eutectic Liquid Metal**  
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Chi Sung Jung, Junhee Lee, Byoung Hyun Min and Sang-Hyug Park  
*Departments of Molecular Science and Technology, Ajou University* |
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Yoon-Hee Jang, Jeong-Hoon Lee, Sung Yun Yang  
*Department of Organic Materials Engineering, Chungnam National University* |
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*Department of PolymerNano Science and Technology, Department of BIN Fusion Technology, Chonbuk National University* |
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*Department of PolymerNano Science and Technology, Department of BIN Fusion Technology, Chonbuk National University* |
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PLENARY LECTURE (1)

Tuesday, July 11th

- 14:00 to 15:40 – PL-01~PL-03
- 20min break
- 16:00 to 17:00 – PL-04~PL-05
Professor Allan S. Hoffman’s Biographical Summary

Professor Hoffman studied at M.I.T., where he received B.S., M.S., and ScD. degrees in Chemical Engineering [1953(B.S.), 1955(M.S.) and 1957(ScD.)]. He taught on the faculty of the M.I.T. Chemical Engineering Department for a total of ten years. Since 1970 he has been Professor of Bioengineering at the University of Washington (UW) in Seattle.

He is now Professor Emeritus at UW, and retired from active teaching, but he continues to actively teach in various short courses each year in the USA, Denmark, and South Korea. His major interests are in the areas of “smart” polymers and hydrogels, controlled drug delivery, affinity separations, and biomaterial surface modification.

Some of his professional activities, recognitions and awards have included:
- President, Society for Biomaterials (1983-1984)
- Biomaterials Science Prize, Japanese Biomaterials Society (1990)
- Founders’ Award of the Society for Biomaterials (2000)
- Chandra Sharma Award, Biomaterials Society of India (2003)
- Elected to the National Academy of Engineering (2005)
- International Recognition Award, Society for Polymer Science, Japan (2006)
- Founders’ Award of the Controlled Release Society (2007)
- International symposia have been organized in Maui, Hawaii in honor of his 60th birthday (1992) (Sung Wan Kim, Univ Utah, Chair), 70th birthday (2002) (Buddy Ratner, Univ of Washington, Chair), and 80th birthday (2012) (Buddy Ratner and Pat Stayton, Univ of Washington, Co-Chairs).
- “Hoffman Family” symposia (HFS) are scientific symposia organized in his honor by former Asian students and Asian colleagues. The first and second were held in Tsukuba, Japan in 2010 and 2014 (Mitsuhiro Ebara, Chair). A third HFS was held in Gwangju, Korea in 2015 (In-Kyu Park, Chair), and a fourth HFS was held in Taipei, Taiwan in 2016 (Wei Bor Tsai and Patrick Hsieh, Co-Chairs). A fifth HFS will be held in Shanghai, China in October, 2017 (Jie Chen, Chair).
The idea to conjugate poly(ethylene glycol) (PEG) to a protein, i.e., to “PEGylate” a protein, was first proposed in the early 1970s. The objective was to make the new recombinant protein drugs less immunogenic in our bodies, and thereby to enhance their circulation and activity lifetimes. In this talk I will cover the evolution of this immensely important concept from the first experiments on PEGylated proteins to the huge industry of PEGylated drugs that it stimulated. I will also briefly review the attachment of PEG to biomaterial surfaces, resulting in what are known as “non-fouling” biomaterial surfaces. I will then consider the recently encountered problems with PEGylated drug compositions, which include their enhanced clearance rate from circulation upon a second dose. Antibodies to PEG have been discovered and they may be responsible for the enhanced clearance rates.

I will finish with a discussion of the latest investigations into alternative “protective” molecules, including the interesting zwitterion compositions. These molecules might some day be an alternative choice to PEGylation as a way to extend drug circulation times while retaining drug activities, especially during chronic dosing regimes.
Professor Hai Bang Lee’s Biographical Summary

Hai Bang Lee is a Research Professor of Ajou University, Department of Molecular Science and Technology and an Emeritus Scientist and Consultant of Korea Research Institute of Chemical Technology. He received his PhD degree with Biomaterials Research in the Department of Materials Science and Engineering at the University of Utah in May 1974. He worked dental polymer as research associate at Dental Research Center, University of North Carolina at Chapel Hill from 1974 to 1976. He also worked in ophthalmic, orthopedic and medical disposable products development for U.S. Biomedical Industries, from 1976 to 1984 and joined Korea Research Institute of Chemical Technology for research in the area of biomaterials, drug delivery and tissue engineering as the Director and Distinguished Scientist of Biomedical Polymer Research Laboratory from 1984 to 2009. Dr. Lee is working on development of smart scaffold for tissue engineering at Ajou University as a research professor and principal investigator. He has more than 390 publications, filed 104 patents, and numerous conference presentations including plenary/keynote-invited lectures.

Dr. Lee devoted so much to the initial establishment stage of Tissue Engineering Society International (TESi) and Tissue Engineering and Regenerative Medicine International Society (TERMIS), as well as throughout the promotion of research in Asia-Pacific region. Hai Bang served as the first vice president of TESi for the AP region, 2003~2005, and the first TERMIS-AP Chapter Chair, 2005~2008. He also served as the first President of the Korean Tissue Engineering & Regenerative Medicine Society (KTERMS), 1999~2004.

He has received awards as the Presidential Award of Korea Science & Technology in 1994 (the highest ward in science & technology on Korea), National Order of Civil Merit in 1989, Korean Tissue Engineering Regenerative Medicine Award in 2015, Fellow of the American Institute for Medical and Biological Engineering, Fellow of the International Union of Societies for Biomaterials Science and Engineering, Fellow of Regenerative Medicine, and member of Korean Academy of Science & Technology.
Cell Behavior on Polymer Surfaces and 3D-Printed Scaffolds for Tissue Engineering

Hai Bang Lee

Department of Molecular Science and Technology, Ajou University,
Suwon 443-749, Korea
(*hblee@krict.re.kr)

The importance of biomaterials has been recognized in biomedical research for over four decades. Applications of biomaterials depend on the appropriate physical and biological responses collectively to biocompatibility. The response of biomaterials in a biological environment is characteristically associated with their surface properties. The modification of biomaterials by various surface treatments has recently become an active topic in surface engineering. A number of research groups have focused on the preparation of surfaces with a gradually varying chemical composition along the one dimension. Such a “gradient surface” is of particular interest for basic and applied studies of the interaction between biological species and surfaces as the dependence of a selected property, such as wettability, on composition, can be examined in a single experiment on one surface. The author will present the preparation and characterization of gradient polymer surfaces along with various cells. Three-dimensional biomaterial scaffolds are initially developed for the temporary substrate to grow cells in formed structure. It has been known that the three-dimensional organization of cell related with cellular adhesion affects the cellular development. Therefore, biocompatible polymers have used to fabricate three dimensional scaffolds for regenerative medicine. Scaffolds require a highly open porous structure with good interconnectivity and sufficient mechanical strength for cellular in growth. During last 5 years, we have developed 3D Printed scaffold for bone and nerve regeneration as well as biodegradable polymers, 3D printer and bioreactor. The author will inform the progress achieved from a project supported by the Ministry of Industry.

Professor Kazunori Kataoka’s Biographical Summary
(May 28th, 2017)

Dr. Kazunori Kataoka is Director General of Innovation Center of NanoMedicine (iCONM), Kawasaki Institute of Industry Promotion. He is also Professor at Policy Alternatives Research Institute, The University of Tokyo.

He received his B.Eng. (1974) in Organic Chemistry, M.Eng. (1976) and Ph.D. (1979) in Polymer Chemistry from The University of Tokyo. He started his academic career at Institute of Biomedical Engineering, Tokyo Women’s Medical College as Assistant Professor (1979) and was promoted to Associate Professor in 1988. He moved to Department of Materials Engineering, Tokyo University of Science in 1989 as Associate Professor and was promoted to full Professor in 1994. He joined Department of Materials Engineering, The University of Tokyo in 1998 as full Professor. He has been appointed joint-position of full Professor at Center for Disease Biology and Integrative Medicine, The University of Toyo Medical School since 2004. In 2016, he took mandatory retirement from Graduate School of Engineering/Graduate School of Medicine, The University of Tokyo, and moved to the current position. He has joint appointments at Eshelman School of Pharmacy, University of North Carolina Chapel Hill as Adjunct Professor (2015~), and at Biomedical Institute for Convergence at SKKU (BICS), Sungkyunkwan University, Republic of Korea as Director (2016~).

He has received several scientific awards, including the Clemson Award from the Society for Biomaterials, USA (2005), the Founder’s Award from the Controlled Release Society (2008), NIMS Award from National Institute of Materials Science, Japan (2009), The Prize for Science and Technology from the Minister of Education, Culture, Sports, Science, and Technology (MEXT), Japan (2010), Humboldt Research Award from Alexander von Humboldt Foundation (2012), Leo Esaki Prize (2012), SPSJ Award for Outstanding Achievements in Polymer Science and Technology from Society of Polymer Science, Japan (2014), Gutenberg Research Award from the University of Mainz, Germany (2015), and H. C. Brown Lectureship Award, Purdue University, USA (2017). He has been elected to a Member of the Science Council of Japan since 2006 and a Foreign Member of the United States National Academy of Engineering (NAE) since 2017.

He has more than 500 publications with h-index as high as 127, and is on the editorial board of 15 international journals. His current major research interests include supramolecular materials for nanobiotechnology, focusing on drug and gene delivery systems.
Self-Assembled Supramolecular Nanosystems for Smart Diagnosis and Targeted Therapy of Intractable Diseases

Kazunori Kataoka$^{1,2,3}$

$^1$Innovation Center of NanoMedicine, Kawasaki Institute of Industrial Promotion, Kawasaki 210-0821, Japan
$^2$Policy Alternatives Research Institute, The University of Tokyo, Tokyo 113-0033, Japan
$^3$Biomedical Institute for Convergence at SKKU (BICS), Sungkyunkwan University, Suwon, Giongi-do 440-746, Republic of Korea

(*kataoka@pari.u-tokyo.ac.jp)

Nanotechnology-based medicine (Nanomedicine) has received progressive interest for the treatment of intractable diseases, such as cancer, as well as for the non-invasive diagnosis through various imaging modalities. Engineered polymeric nanosystems with smart functions play a key role in nanomedicine as drug carriers, gene vectors, and imaging probes. This presentation focuses present status and future trends of self-assembled nanosystems from block copolymers for the therapy and the non-invasive diagnosis of intractable cancer.

Nanosystems with 10 to 100 nm in size can be prepared by programmed self-assembly of block copolymers in aqueous entity. Most typical example is polymeric micelles with distinctive core-shell architecture. Compared with conventional formulations, such as liposomes, polymeric micelles have several advantages, including controlled drug release, tissue penetrating ability and reduced toxicity$^{1,2}$. Notable anti-tumor efficacy against intractable and metastatic cancer, including pancreatic cancer$^3$, glioblastoma$^4,5$, and cancer stem cells$^6$, of antitumor drug-incorporated polymeric micelles with pH- and/or redox potential responding properties was demonstrated, emphasize their promising utility in cancer treatment. Versatility in drug incorporation is another feasibility of polymeric micelles. Loading of imaging reagents makes polymeric micelles with theranostic functions$^7$. These results demonstrate the promising features of polymeric micelles as platform nanosystems for molecular therapy of various intractable diseases.

References

Professor Claudio Migliaresi was born in 1947 Italy (69 years old), where he obtained his degrees in Chemical Engineering at the University of Naples. In 1980, after a 4 yrs. scholarship of the Italian Ministry of Education, he got the position of Research Assistant at the University of Naples. In 1987 he won a national competition becoming Associate Professor of Composite Materials Science and Technology and the same year he got an offer from the University of Trento where he decided to move to. In 1990 he got the Full Professorship at the same University, becoming Dean of the School of Engineering in 1991. Then Claudio Migliaresi has been Head of the Department of Materials Engineering, founder and Head of the Department of Industrial Engineering, Vice-Rector for Technology Transfer, Head of the Interuniversity Research Centre on Materials for Biomedical Technology, Head of the Research Centre on Biomechanics and Bioengineering and presently, since 2007, he leads the Research Centre on Biomedical Technologies, BIOtech.

Prof. Migliaresi research activity started in 1974 on polymeric hydrogels for biomedical applications, inspired by a publication of Prof. Allan Hoffman, and in parallel on polymer composites for industrial and also biomedical applications. In about 40 yrs. he worked on the mechanical and viscoelastic properties of polymer composites, on biodegradable polymers, composite biomedical prostheses, drug release, diffusion in polymers and more recently, since year 2000, on Tissue Engineering materials, scaffolds and methods.

Professor Migliaresi has been founder of the FBPS conference series in 1995, organizer of several International conferences and organizer for about 25 years of International schools of biomedical materials and TE.

He served in a few international societies and is frequently called to join the evaluation committee of international institutions for the advancement of career or for research projects.

Professor Migliaresi has been and is responsible of EU-Asia cooperation projects in the field of sustainable development and also Tissue Engineering.

Finally, his list of publications counts about 500 papers, proceedings included, the edition of seven books, many book chapters, about 15 patents, and more.
Cell Printing for Tissue Engineering and Biological Models

Claudio Migliaresi¹, Antonella Motta¹, Volha Liaudanskaya², Nicola Cago¹, Devid Maniglio¹

¹ Department of Industrial Engineering Technology and BIoTech Research Center, University of Trento, Trento, Italy
² Department of Biomedical Engineering, Tufts University, Medford, MA, USA
(*claudio.migliaresi@unitn.it)

Cell Printing technology could provide an enabling platform for the fabrication of hierarchically structured and functional cell assemblies mimicking composition, structure and physiological behavior of animal tissues and namely human tissues. These assemblies could be used as part of tissues for tissue engineered replacements that could be implanted in humans starting for the patient’s differentiated or stem cells. Moreover, they could constitute 3D model cell assemblies for the evaluation of drugs, contaminants, additives to food, pesticides, cosmetics etc., and also used as biological models to study the mechanism of in vitro induced diseases.

The platform should comprise: 1. the selection, design, control and optimization of cells encapsulation materials and methods; 2. the design and implementation of a computer controlled cell printing machine; 3. the identification of specific dynamic culture conditions in specific bioreactors to drive cell differentiation, ECM production, tissue assemblies.

The ideal path should proceed through the following steps: Encapsulation of cells under proper conditions and in proper gel materials; Deposition of the capsules of gel polymers containing different types of cells following specific 3D geometric patterns; Transfer of the printed assemblies to specifically designed dynamic bioreactors for culture under tailored dynamic conditions till the development of vascularized extracellular matrix.

The present talk will explore different cell printing technologies and will outline some of the results that we have achieved in the field by using a Electrodynamic Spraying method and sodium alginate as an encapsulating matrix material.

Considerations about the characteristics of the encapsulating materials and results about the effect of the method and of the materials on encapsulated cells viability and metabolic activity will be presented.
Professor Rui L. Reis’s Biographical Summary

Rui L. Reis is 48 years old and was born in Porto, Portugal (PT), where he still lives. Rui L. Reis PhD, DSc, Hon. Causa MD. is a Full Professor of Tissue Engineering, Regenerative Medicine and Stem Cells at the Department of Polymer Engineering, School of Engineering of University of Minho (UM). He is the Vice-Rector for Research of the University of Minho, Braga & Guimarães, Portugal. He is also the Director of the 3B’s Research Group – Biomaterials, Biodegradables and Biomimetics at the U. Minho in Portugal (www.3bs.uminho.pt), and the Director of the PT Government Associate Laboratory ICVS/3B´s. Both 3B’s and ICVS (Institute of Health and Life Sciences) are research units of Excellence, as evaluated by international panels of the Portuguese Foundation for Science and Technology (FCT). He is also, since 2000, the main responsible for LABMAT, the general materials characterization Lab. of U. Minho. Furthermore he is the President/Chairman and Chief Scientific Officer (CSO) of the company Stemmatters that he has founded as a spin-off of the 3B´s Research Group. As a result of that, he was awarded the 2007 START award (created by the bank BPI and by Microsoft), one of the major innovation awards in Portugal.

Rui L. Reis is the CEO of the European Institute of Excellence on Tissue Engineering and Regenerative Medicine (TERM) that has 22 partners from 13 different countries. He directs the correspondent European Economic Interest Group (EEIG), being the main office registered in Portugal. The headquarters of this Institute are located in AvePark, Taipas - Guimarães, Minho, Portugal, in a 3600 m2 state of the art unique facility fully designed for research in the TERM field. This building is also the home of the 3B´s Research Group since July 2008. The installation of the 3B´s and the headquarters of the Institute at AvePark were awarded the main innovation award for Northern Portugal (Prémio Novo Norte – Norte Inovador 2009) by the Northern Portugal regional coordination committee (CCDR-N) in May 2010. The same project was awarded the Grand Prize New North (Grande Prémio Novo Norte 2009) for best good practice in Northern Portugal for 2009 in all areas of activities. Rui Reis was also, from 2003-2009, Head of R&D for the Holding Corticeira Amorim SGPS, the world leading cork industrial company that is part of one of the major Portuguese controlled business groups with operations in around 100 countries world-wide.


Rui L. Reis has been involved in biomaterials research since 1990. He has worked several
periods abroad, in different Universities and companies. His main area of research is the
development of biomaterials from natural origin polymers (starch, chitin, chitosan, casein, soy, algae
based materials, silk fibroin, gellan gum, carragenan, hyaluronic acid, xanthan, marine collagen, etc.)
that in many cases his group originally proposed for a range of biomedical applications, including
bone replacement and fixation, drug delivery carriers, partially degradable bone cements and tissue
engineering scaffolding. Lately the research of his group has been increasingly focused on tissue
engineering, regenerative medicine, stem cells and drug delivery applications. His research group
works with bone marrow, adipose-derived, umbilical cord, amniotic origin and embryonic stem cells.

Furthermore, he has been responsible for several co-operation programs, with Universities
and Companies in UK, The Netherlands, Spain, France, Finland, Germany, Italy, Turkey, Ireland,
Singapore, USA, Canada, South Korea, Japan, China, Australia, New Zealand, etc.

He has been the co-coordinator of four major EU research project, funded under FP6 of the
European Commission. One of the main projects was the STREP “HIPPOCRATES” that had a 3 MEuros
budget. He also coordinated the only European Network of Excellence (NoE) on Tissue Engineering,
“EXPERTTISSUES”. This highly funded NoE (budget of around 7.3 MEuros) was composed by 22
partners, several being industrial, from 13 countries, and is continuing to lead the way in all Tissue
Engineering research in Europe. He has also coordinated the Marie Curie Early Stage Training Multi-
site project “ALEA JACT EST” (total budget of 2.6 MEuros), as well as the Marie Curie Series of
Conferences “InVENTS “, that had a budget of around 0.5 MEuros to prepare 6 cutting-edge research
conferences (all in Portugal) and 3 practical training courses at the highest level on the respective
research fields. He has also coordinated the large INTERREG Project PROTEUS, with a budget of 1.4
MEuros aimed to develop new materials for different applications based on marine resources from
Northern Portugal and Galicia. He is presently also involved in the large scale FP7 project
DISCREGENERATION, on FP7 projects BioHybrid and MultiScaleHuman (ITN) and coordinates five new
strategic international, including 3 FP7, funded projects. Those are: the project FIND & BIND and the
project SPECIAL, each one with a budget of around 3.6 MEuros, the project POLARIS (an FP7 REGPOT
with 3.1 MEuros of budget for U. Minho), as well as a 2 cross-broader large projects, IBEROMARE
with a budget of around 2 MEuros and NOVOMAR with a budget of 0.9 MEuros, and an Euro-Atlantic
project called MARMED, also with a budget of around 2 MEuros.

He is also the main responsible for several other projects funded by Portuguese, European
and American biomaterials and polymeric industries and for a range of bi-lateral concerted actions.
At only 46 years, he has been awarded and ERC AdG (European Research Council Advanced Grant),
the most prestigious grant available for European Researchers in all Europe (only around 1400 ERC
AdG grantees in all fields of research so far), of 2.35 MEuros for his project ComplexiTE.

Under HORIZON 2020 he is already the coordinator of the RISE Marie Sklodowska-Curie
UNICAT project, the scientific coordinator of a TEAMING proposal on Regenerative and Precision
Medicine (with UCL-London, FCT and the 6 major Portuguese Universities) and of the ERA Chairs
FoReCast grant (2.5 MEuros for 3B´s-UMinho).

At the present, he is the principal investigator (PI) of grants totalizing more than 35 MEuros
of which around 20 MEuros are U. Minho funding. As a result of these projects and other projects he
directed or is directing the work of more than 150 post-graduation researchers (at the present
moment around 35 Post-docs and 50 PhD students) from Portuguese, Spanish, Swedish, Dutch,
Slovak, Chinese, Bulgarian, Brazilian, German, Indian, Colombian, Venezuelan, Turkish, Italian, Cuban,
Polish, Hungarian, USA, Belgium, UK, Irish, Chinese, Lebanese, Thai, Russian, and South Korean origin.
He is involved on the Bioengineering Systems program of the Portugal – MIT (Massachusetts Institute
of Technology) initiative, being responsible for the biomaterials module.

As a result of his academic activities Rui L. Reis has been awarded several prizes. Some of
the most relevant ones were: (i) the ESAFORM 2001 Scientific Prize for his work on processing of
starch-based biomaterials, (ii) the Jean LeRay Award 2002 by the European Society for Biomaterials
for its outstanding contributions to the biomaterials field as a young scientist and (iii) the Stimulus to
Excellence Award 2004 by the Portuguese Minister for Science and Technology for being one of the
scientists with higher number of publications and citations in the Portuguese scientific arena (around
70 awardees - only 2 below 40 years old), (iv) the Pfizer Award for Clinical Research in 2007, (v) the
already referred to START Innovation award in 2007. (vi) the yearly award of scientific merit of the
University of Minho (awarded only for the second time this year) in 2010, (vii) an Honoris Causa
degree in Medicine (making him an h.c MD) awarded in 2010 by the historical and highly respected
University of Granada in Spain for his world-leading activities in the field of regenerative medicine,
(viii) the George Winter Award by the European Society for Biomaterials (the main career and senior
award in Biomaterials research in all Europe) that was presented in Dublin in September 2011, (ix)
The Gold Medal of Scientific Merit from the City of Guimarães, in June 2011, (x) International Fellow
of Biomaterials Science and Engineering (FBSE), Chengdu, China, June 2012, (xi) the Medal of Merit
of the Portuguese Health Minister, April, 2014; (xii) the Clemson Award for Contributions to the
Literature by the Society for Biomaterials (SFB, USA), Denver, Apr., 2014; (xii) the nomination as a
Commander (Comendador, a kind of knighthood) of the Military Order of Santiago de Espada by the
Portuguese President of the Republic, Guarda, Portugal, June, 2014; (xiv) the Gold Medal of the
City of Guimarães (birth place of Portugal), being nominated as one of the first two honorary citizens
of the city, Guimarães, Portugal, June, 2014.

In addition, he was or is a member of several editorial boards of journals (some examples
Materials Research Part B – Applied Biomaterials, Current Opinion on Solid State and Materials
Science, International Materials Reviews, Acta Biomaterialia, Nanomedicine), acts as referee of
numerous (more than 90) scientific journals and has been presenting author, member of the
scientific committees, organizing committees, referee, chairman, discussion leader in Gordon
Research Conferences, and invited lecturer in many conferences world-wide (Japan, USA, Canada,
Australia, South Korea, Israel, Turkey, Cuba, Colombia, Iran, Singapore, New Zealand, and a large
number of European Countries).

He was the founder and for 4 years (2006-2009) the President of the Portuguese Society
for Stem Cells and Cellular Therapies (SPCE-TC). He was elected again as President of SPCE-TC for
2011-2012. Rui L. Reis was in the Board of Directors of the European Tissue Engineering Society (ETES)
and is presently on the governing board of the Global (world) TERMIS – Tissue Engineering and
Regenerative Medicine International Society (the main International Society in his field of Research
Plenary Lecture 5 [PL-05]

with members from 83 different countries). He was, in early 2010, elected the TERMIS-EU chapter chair (for a 3 years term). Since 2013 he is the World President-Elect of TERMIS. He was also on the board of governors of the European Society for Artificial Organs (ESAO) and of the International Federation for Artificial Organs (IFAO) of which he organized the world meeting (IFAO-ESAO join meeting, October 2011, Porto, Portugal). He was Chair of Tissue Engineering Special Interest Group (SIG), Chair of the SIG on Orthopaedic Biomaterials, as well as a member of Membership Committee, of the Society for Biomaterials (SFB, USA). He is the Editor-in-Chief of the “Journal of Tissue Engineering and Regenerative Medicine” (IF = 4.4), John Wiley & Sons- Blackwell.

He was the Director and main responsible for organizing several main meetings and workshops. He has for instances organized, just with his team and no help from any professional organization, the large (730 people from 43 countries) TERMIS-EU 2008 meeting, in Porto. He is Editor of several international books and Guest Editor of several special issues of journals (J. Mater. Sci.: Mater in Medicine, Macromolecular Bioscience, Current Opinion on Solid State & Materials Science, Mater. Sci. & Eng.: Part C: Biomimetic and Supramolecular Systems, Journal of Supercritical Fluids). Presently, Rui L. Reis is the most productive (higher number of ISI Web of Knowledge listed publications) Portuguese scientist ever in all fields of research. He has produced so far 870 publications listed in ISI Web of Knowledge, including around 710 articles published in scientific journals with referee (the other are mainly abstract published in international journals or ISI listed proceedings) – being more than 50 of those review papers or editorials, 30 national and international awarded patents (several other applications ongoing – one of the awarded patents was selected as one of 15 finalists for the European Inventor Award of 2013), 5 books, 6 special issues in scientific journals, around 210 book chapters in books with international circulation and on international encyclopedias, and more than 1650 communications in conferences, almost all of them in international meetings (in Portugal, several other countries in Europe, USA, Canada, Australia, New Zealand, Japan, South Korea, Singapore, Taiwan, China, Israel, Chile, Colombia, Cuba, etc.), including around 200 plenary or invited talks. He presented around 150 invited lectures in other Universities or Research Institutes.

His work has been cited around 15450 times (around 19 citations per article, around 23000 citations in Google Scholar), and he has an ISI h-factor of 62 (72 according to Google Scholar). He is a member of 12 international research societies. His research work has been extensively covered by news and interviews in the most important PT and some international newspapers, radio stations and all the National TVs channels. He was selected as one of 100 most influential Portuguese citizens (in all areas of activity) by the respected EXPRESSO newspaper in 2013.

Researcher ID Reis, Rui L (A-8938-2008); Scopus Author ID 7103370557; ORCID 0000-0002-4295-6129;
Unique TERM Strategies Based on The Use of Different Natural Origin Scaffolds, Hydrogels and Stem Cells

Rui L. Reis

1- 3B’s Research Group - Biomaterials, Biodegradables and Biomimetics, University of Minho, Headquarters of the European Institute of Excellence on Tissue Engineering and Regenerative Medicine, AvePark, 4806-909 Taipas, Guimarães, Portugal
2- ICVS/3B’s - PT Government Associate Laboratory, Braga/Guimarães, Portugal

The selection of a proper material to be used as a scaffold or as a hydrogel to support, hold or encapsulate cells is both a critical and difficult choice that will determine the success or failure of any tissue engineering and regenerative medicine (TERM) strategy.

We believe that the use of natural origin polymers is the best option for many different approaches that allow for the regeneration of different tissues. In addition to the selection of appropriate material systems it is of outmost importance the development of processing methodologies that allow for the production of adequate scaffolds/matrices.

Furthermore an adequate cell source should be selected. In many cases efficient cell isolation, expansion and differentiation methodologies should be developed and optimized. We have been using different human cell sources namely: mesenchymal stem cells from bone marrow, mesenchymal stem cells from human adipose tissue, human cells from amniotic fluids and membranes and cells obtained from human umbilical cords.

The potential of each type of cells, to be used to develop novel useful regeneration therapies will be discussed. Their uses and their interactions with different natural origin degradable scaffolds and smart hydrogels will be described.

Several examples of TERM strategies to regenerate different types of tissues will be presented.
PLENARY LECTURE (2)

Wednesday, July 12th

- 09:00 to 10:40 – PL-06~PL-10
- 20min break
- 11:00 to 12:20 – PL11~PL-14
- Lunch
- 15:40 to 16:40 – PL-19~PL-21
- 20min break
- 17:00 to 18:00 – PL-22~PL-24
Professor Jun-ichiro Jo’s Biographical Summary

Nationality: Japan
Present Position: Assistant Professor of Laboratory of Biomaterials, Department of Regeneration Science and Engineering, Institute for Frontier Life and Medical Sciences, Kyoto University, Kyoto, Japan

Place of Birth: Hiroshima, Japan
Date of Birth: 30 Jul 1978

Education:
1998-2002 B.Eng. Undergraduate school of Industrial Chemistry, Faculty of Engineering, Kyoto University
2002-2004 M.Eng. Department of Polymer Chemistry, Graduate School of Engineering, Kyoto University
2004-2009 Ph.D. Department of Polymer Chemistry, Graduate School of Engineering, Kyoto University

Professional Positions:
2008-2010 Researcher, Department of Biomaterials, Field of Tissue Engineering, Institute for Frontier Medical Sciences, Kyoto University
2011-2013 Researcher, Diagnostic Imaging Program, Molecular Imaging Center, National Institute of Radiological Sciences
2013- Assistant Professor, Department of Biomaterials, Field of Tissue Engineering, Institute for Frontier Medical Sciences, Kyoto University (Laboratory of Biomaterials, Department of Regeneration Science and Engineering, Institute for Frontier Life and Medical Sciences, Kyoto University)
2014-2016 Associate Professor, Department of Mammalian Regulatory Network, Graduate School of Biostudies, Kyoto University
2013- Assistant Professor, Department of Polymer Chemistry, Graduate School of Engineering, Kyoto University

Research Interests: Biomaterials, Drug Delivery Systems, Molecular imaging, Tissue Engineering
Trial on Development of Imaging Technology for Regenerative Therapy with Polymer-Based Biomaterials

Jun-ichiro Jo and Yasuhiko Tabata

Laboratory of Biomaterials, Department of Regeneration Science and Engineering, Institute for Frontier Life and Medical Sciences, Kyoto University, 53 Kawara-cho Shogoin, Sakyo-ku, Kyoto 606-8507, Japan.
(* jo@infront.kyoto-u.ac.jp,)

Regenerative therapy is a new and promising therapy by making use of the natural healing potential of body itself for tissue regeneration and repairing. With the recent progress of tissue engineering and cell transplantation technologies, the effects of regenerative therapy of various tissues have been experimentally demonstrated in animal models. Based on that, some clinical trials have also been started. Under these circumstances, it is strongly required to develop a non-invasive visualization method (imaging) that can accurately evaluate the process of tissue regeneration and healing. Imaging of cells transplanted, tissue sites regenerated or the biological, histological, and anatomical conditions in defect area enables to repeatedly evaluate or predict the therapeutic efficacy of cell-based tissue regeneration. For the progress of imaging technology, it is indispensable to develop the modality, design imaging probes, and create the delivery system for probes. In this paper, several concrete examples of imaging technologies in the field of regenerative therapy are introduced to emphasize the importance of probe delivery system based on polymer-based biomaterials.

References
4. Tatsutomi M., Jo J., Tabata Y. Regenerative Therapy, 5, 64-71
**Professor Daniel Cohn’s Biographical Summary**

Prof. Cohn’s research activities focus on the synthesis, characterization and biological interactions of implantable polymeric biomaterials and medical devices, with special emphasis on the following areas: (1) *In situ* generated implants; (2) 3D printed biomedical systems; (3) Smart polymers; (4) Medical devices; (5) Biomedical polymers; (6) Biodegradable polymers.

He has served as the Director of the Casali Center of Applied Chemistry and as the Head of the School of Chemistry of The Hebrew University of Jerusalem. He has published numerous scientific papers, holds many patents (more than ten have been commercialized), edited several books and organized national as well as international scientific conferences.

Has been a key player in various start-up companies and has collaborative projects with leading Companies in the Medical Devices field, mainly in the US and Europe, based on technologies developed in his lab. Two products based on biodegradable polymers developed in his laboratory have been approved for clinical use by the FDA and other leading regulatory agencies. Recently, a third product based on a polymer developed in his laboratory has received the CE mark.
“Smart” 3D Printed Biomedical Structures

Daniel Cohn and Sujan Dutta

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The impressive progress made in the 3D printing field in recent years, has made possible the engineering of a myriad of new objects in a diversity of areas, including the medical devices arena. That said, only a new generation of 3D printed constructs, combining pioneering concepts and novel tailor-made materials, will permit further progress. As derived from this conceptual framework and contrary to the vast majority of the 3D structures printed to date, which are static in nature, our work aims at engineering 3D printed dynamic architectures that change “on command”. By engineering environmentally responsive 3D printed structures, stimuli such as temperature, pH, magnetic fields or biological cues, will cause them to change their shape and size, affecting also other of their properties.

This contribution focuses on the development of a series of environmentally responsive 3D printable polymers, and the generation of 3D printed hydrogel constructs responsive to temperature and pH, using a stereolithography Digital Light Processing 3D printer.

The basic building blocks of these printable polymers are polyethylene oxide-polypropylene oxide-polyethylene oxide dimethacrylates and acrylic acid, responsible for the temperature and pH responsiveness, respectively. The stimuli dependent response of a series of 3D printed constructs was investigated at 6 °C and 37 °C and at pH values below and above the pk_a value of acrylic acid. The cyclic behavior of the structures as they fluctuate between the two pH values was also studied. 3D printed structures comprising more than one temperature and pH responsive polymer were engineered and their behavior was investigated as a function of their respective composition.
Bioinspired Hydrogel Transformer for Minimally Invasive Revascularization Therapy

Hyunjoon Kong

Departments of Chemical & Biomolecular Engineering, Bioengineering, & Pathobiology, University of Illinois at Urbana-Champaign, Urbana, IL 61801 USA
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Hydrogels have been increasingly used to control the spatiotemporal distributions of various diagnostic and therapeutic bioactive molecules within tissues of interest through local and sustained molecular release. Success in this application greatly relies on the ability to deliver the gel implant in a minimally invasive manner, for instance, implantation through a catheter. To this end, this talk presents a hydrogel transformer that can undergo a shape change via subsequent folding and unfolding, a similar mechanism to the Venus flytrap. We could attain this shape transformation property by assembling a double-layered hydrogel patch of which each layer has significantly different expansion ratios, elastic moduli, and degradation rates. The transformation properties could be predicted by an equation used to estimate the curvature of a bimorph beam. This talk will further demonstrate that the shape change of the gel patch can regulate release rates of proangiogenic cargos and, in turn, stimulate neovascularization at an implantation site. This biomaterial design will greatly serve to expedite the use of biomaterials in various molecular therapies.

Acknowledgment: This work was supported by National Science Foundation (CBET-1403491 & STC-EBICS Grant CBET-0939511 to H.K.).
Plenary Lecture 9 [PL-09]

Professor Deok-Ho Kim’s Biographical Summary

Dr. Deok-Ho Kim is currently an Assistant Professor in the Department of Bioengineering and a Faculty Member of the Institute for Stem Cell and Regenerative Medicine at the University of Washington. He received his Ph.D. in Biomedical Engineering from the Johns Hopkins University (2010), his M.S. in Mechanical Engineering from Seoul National University (2000), and his B.S. in Mechanical Engineering from POSTECH (1998). In 1996, he studied at the University of Birmingham, UK, as a Hogil-Kim Memorial Fellow Exchange Student. From March 2000 to June 2005, he worked as a Research Scientist at the Korea Institute of Science and Technology (KIST), which included a 7 month academic visit to the Swiss Federal Institute of Technology at Zurich (ETH-Zurich). Prior to joining the University of Washington, he was an Assistant Research Professor in the Department of Biomedical Engineering at the Johns Hopkins University. He is also the founder and scientific advisor of NanoSurface Biomedical Inc.

His research interests center on the development of engineered microenvironments and functional tissue engineering models for elucidating regenerative biology, drug screening, disease modeling, and cell-based therapies. His current research aims to investigate how engineered microenvironments can direct cell function and tissue regeneration. He has authored and co-authored over 140 peer-reviewed journal articles and referenced conference proceedings, as well as 27 book chapters/editorials. In addition, he has edited two books and filed 21 patents (issued or pending; 2 licensed), and given more than 100 invited/keynote lectures. His papers have been cited over 5000 times in total (h-index: 37) and have been highlighted in Science Magazine, the JHU Gazette, UW Today, and many newspapers. Dr. Kim is an Associate Editor for Biomedical Microdevices, the Journal of Biomedical Nanotechnology, IEEE Transactions on NanoBioscience, the Journal of Micro-Bio Robotics, and the Journal of Tissue Engineering, and serves as a member of the editorial boards of numerous journals including Scientific Reports (Nature Publishing Group), Theranostics, International Journal of Nanomedicine, IET Nanobiotechnology, and SLAS Technology. Among the award he has received are the KIST Scientist of the Month Award (2005), the Surface Engineering Best Paper Award (2006), the American Heart Association Predoctoral Fellowship (2008), the Samsung Humanitech Thesis Award (2009), the Harold M. Weintraub Award in Biological Sciences (2010), the Perkins Coie Award for Discovery (2011), the American Heart Association National Scientist Development Award (2012), the KSEA Young Investigator Award (2013), the Springer Award for Most Downloaded and Most Cited Review Article from Annals of Biomedical Engineering (2013), the BMES-CMBE Rising Star Award (2013) and the BMES-CMBE Young Innovator Award (2015).
Multi-Scale Biomimetic Human Cardiac Tissue Engineering for Disease Modeling and Drug Screening

Deok-Ho Kim

Department of Bioengineering, Center for Cardiovascular Biology, Institute for Stem Cell and Regenerative Medicine, University of Washington, Seattle, WA 98195, USA
(* deokho@uw.edu)

My laboratory research spans the disciplinary boundaries between micro/nanotechnology, biomaterials, and mechanobiology with an emphasis on their applications to tissue engineering and regenerative medicine. Through the use of multi-scale fabrication and integration tools, my laboratory focuses on the development and application of bio-inspired materials/devices and tissue/organ-on-a-chip technologies for elucidating regenerative biology, drug screening, disease modeling, and cell-based therapies. In this talk, I will introduce scalable, nanotopographically-controlled cell and tissue culture models developed in our laboratory, including nanopatterned human 3D cardiac muscle patches, human iPSC-based cardiac microphysiological systems, and a high-throughput drug-induced cardiotoxicity screening assay. Using these biofabricated tools in combination with human pluripotent stem cell technologies, I will highlight how our biomimetic tissue models helps to gain a better understanding of the structure-function relationship in complex 3D tissues, and serve as emerging platforms for disease modeling, and drug screening.

References

7. Kim et al., ”Nanopatterned cardiac cell patches promote stem cell niche formation and myocardial regeneration,” Integrative Biology. 4:1019-1033 (2012).
Dr. Alsberg took a faculty position in 2005 at Case Western Reserve University, where he is currently Professor of Biomedical Engineering and Orthopaedic Surgery and serves as Director of the Stem Cell and Engineered Novel Therapeutics Laboratory. His lab focuses on the engineering of new technologies to regenerate tissues and treat diseases through the development of novel biomaterials and microenvironments. He’s co-authored over 100 peer reviewed papers and book chapters, and his work has been recognized with the 2008 Ellison Medical Foundation New Scholar in Aging Award, the Crain’s Cleveland Business 2009 Forty Under 40 Award, a Visiting Professorship at Kyung Hee University (Korea) and a Lady Davis Fellowship at the Technion (Israel). The NIH, DOD, NSF, the Ellison Medical Foundation, the Coulter Foundation, the Musculoskeletal Transplant Foundation, the State of Ohio and the AO Foundation have funded his lab’s research.
Modular Inductive High-Density Cell Culture Systems for Engineering Complex Tissues

Eben Alsberg

Departments of Biomedical Engineering and Orthopaedic Surgery,
Case Western Reserve University, Cleveland, OH, 44106, USA
(*eben.alsberg@case.edu)

High-density cultures of cells can mimic immature condensates present during many developmental processes. Presenting specific soluble signals, such as growth factors, exogenously in tissue culture media can regulate cell behavior in these cultures and promote new tissue formation. However, shortcomings of this approach include transport issues, limited spatial control over signal presentation, and required repeated dosing in the media. We have engineered technology that overcomes these challenges by incorporating polymer microspheres containing bioactive signals within the high-density cell cultures, which permits localized spatial and temporal control over the presentation of these regulatory signals to the cells. In this talk, I will present our research using this strategy to engineer a variety of tissues, including bone, cartilage and trachea. The capacity to deliver diverse signals, including growth factors and plasmid DNA, for driving new tissue formation will be demonstrated. In addition, the value of this technology for engineering a wide range of tissue shapes, including spheres, sheets, rings and tubes will be shown. Finally, the utility of providing cell-instructive bioactive factors from biomaterials in a controlled manner for the assembly of modular tissue units to engineer complex constructs comprised of multiple tissue types will be explored.

Acknowledgements: This work was supported by the National Institutes of Health (R01AR063194), the Department of Defense Congressionally Directed Medical Research Programs (OR110196), the AO Foundation, and a New Scholar in Aging grant from the Ellison Medical Foundation.
Plenary Lecture 11 [PL-11]

Professor James J. Yoo’s Biographical Summary

Wake Forest Institute for Regenerative Medicine (WFIRM)
Wake Forest School of Medicine
Winston-Salem, North Carolina, U.S.A.

Dr. Yoo is a surgeon and researcher. He is currently a Professor, Associate Director and Chief Scientific Officer at the Wake Forest Institute for Regenerative Medicine (WFIRM), and is cross-appointed to the Departments of Urology, Physiology and Pharmacology and Biomedical Engineering. Dr. Yoo’s research efforts have been directed toward the clinical translation of tissue engineering technologies and cell-based therapies. Dr. Yoo’s background in cell biology and medicine has facilitated the transfer of several cell-based technologies from the bench-top to the bedside. A few notable examples of successful clinical translation include the bladder, urethra, vagina, and muscle cell therapy for incontinence. Dr. Yoo has been a lead scientist in the bioprinting program at WFIRM, and has been instrumental in developing skin bioprinting and integrated tissue and organ printing systems for preclinical and clinical applications.
In Situ Tissue Regeneration

James Yoo

Cell-based approaches using tissue engineering and regenerative medicine techniques have offered new opportunities for repairing various tissue pathologies. The concept of using cells and scaffolds to develop functional tissues has remained as a valid strategy to bring new therapies to the clinic. However, this approach often requires a donor tissue biopsy and ex vivo cell manipulation prior to application in vivo. Simplifying these processes would provide a more efficient means of developing biological substitutes for functional tissue restoration. It has been demonstrated that almost every tissue in the body contains some type of stem or progenitor cells. These cells are believed to be part of underlying regenerative machinery that is responsible for daily maintenance and repair of injured tissue. The presence of an underlying regenerative mechanism in the form of tissue-specific stem and progenitor cells suggests that there may be a potential opportunity to bias the host response towards repair and replacement of tissue defects. This may be achieved by maneuvering host stem and progenitor cells using target specific scaffolds. The concept of in situ tissue regeneration using the body’s own biological resources and potential tissue applications will be discussed.
Dr. Yasuhiko Tabata is the Professor and Chairman of the Laboratory of Biomaterials at the Institute for Frontier Life and Medical Sciences, Kyoto University and a Professor of the Graduate School of Medicine, Osaka University, and guest professors at the Graduate School of Medicine, Dentistry, Pharmaceutical Sciences, and Engineering of 17 different universities. He received his BD in Polymer Chemistry (1981), Ph.D. (1988) in Technology, D.Med.Sc. (2002), and D.Pharm. (2003) all at Kyoto University. He was a Visiting Scientist at the MIT (Professor Robert Langer) (1991-92). He has published 1,280 scientific papers including 120 book chapters and review articles, and has 140 patents. He received the Young Investigator Award (1990), the Scientific Award from the Japanese Society for Biomaterials (2002), the Scientific Award from the Japan Society of Drug Delivery System (2011), Chandra P. Sharma Award of the International Society of Biomaterials & Artificial Organs (2011), the Scientific Award from the Japanese Society for Regenerative Medicine (2014), Merit Award Winners for Industry-Academia-Government Collaboration, President of Science Council of Japan Award (2016), and several awards.

Dr. Tabata is the board member of the Japanese Society of Regenerative Medicine (JSRM), the Japanese Society for Biomaterials (JSB), the Japan Society of Drug Delivery System (JSDDS), and the Japanese Society of Inflammation and Regeneration (JSIR) or the councilor of the Japanese Society of Wound Healing, the Japanese Artificial Organ Society. He is an associate member of the Science Council of Japan, Cabinet Office, a fellow of the New York Academy of Science and American Institute for Medical and Biological Engineering (AIMBE), and the Founding Fellow for Tissue Engineering and Regenerative Medicine (FTERM).

Dr. Tabata is the one of founder members of Asian Biomaterial Federation (ABF). He is a board member of Tissue Engineering Society International for 2001-2003 and 2012-present. He organized the 13th Annual Congress of JSRM (2014) and the 37th Annual Congress of JSB (2015), the 37th Annual Congress of JSIR (2016), and the 33th Annual Congress of JSDD (2017). He is a board member of TERMIS-AP for 2013-present and the chair of TERMIS-AP for 2016-2020, and will organize the 5th TERMIS World Congress 2018, Kyoto, Japan.

His research is very interdisciplinary in nature and brings together the fields of polymer chemistry, pharmaceutical science, biology, and basic and clinical medicines. His research focuses on the design and preparation of biodegradable or non-biodegradable biomaterials for their biological, medical, and pharmaceutical applications, while the keywords are biomaterials, drug delivery system (DDS), tissue engineering, regenerative medicine, stem cell technology, and medical diagnostics.
Delivery Technology of Bio-Signals to Realize Tissue Regeneration

Yasuhiko Tabata

Laboratory of Biomaterials, Institute for Frontier Life and Medical Sciences,
Kyoto University, 53 Kawara-cho Shogoin, Sakyo-ku, Kyoto 6068507 JAPAN
(*yasuhiko@frontier.kyoto-u.ac.jp)

Tissue regeneration therapy of a new therapeutic trial based on the natural self-healing potential of body itself to induce tissues regeneration and repairing has been increasingly noted. The healing potential is physiologically based on the ability of cells for proliferation and differentiation. To realize this tissue regeneration therapy, there are two practical approaches; cell therapy and tissue engineering. The cells with a high ability are transplanted into the tissue site to be regenerated, and tissue regeneration by cells transplanted is expected to achieve the site. The basic idea of tissue engineering is to artificially create a local environment for enhancement of cells proliferation and differentiation abilities, resulting in cell-induced tissue regeneration, by making use of biomaterials technology. The tissue engineering is one of the biomaterial technologies newly emerging. For examples, biomaterials are being utilized as the cell scaffold and delivery carrier of bio-signals (growth factor, chemokine, and gene). If a key bio-signal is supplied to the right place at the right time period and concentration, it is no doubt that the body system will initiate to physiologically function, resulting in the natural induction of tissue regeneration. One practically possible way to enhance the in vivo therapeutic efficacy of bio-signals with in vivo short half-life period is to make use of biomaterial delivery technology.

We have explored biodegradable hydrogels for the controlled release of various growth factors and succeeded in the growth factor-induced regeneration and repairing of different tissues. Some clinical trials of tissue regeneration by making use of the growth factor delivery have demonstrated the good therapeutic efficacy. The delivery system can be combined with cells or/and the cell scaffold to promote the therapeutic efficacy of tissue regeneration. Combination with the delivery technology also enhances the therapeutic efficacy of cell transplantation. On the other hand, the delivery technology is also applicable for the dual release of chemokine and growth factor in different time profiles. For example, a chemokine is released to enhance the in vivo recruitment of stem cells to a target site to be regenerated, followed by the release of growth factor to activate the cells recruited thereat, resulting in an enhanced cell-based tissue regeneration.

This paper introduces several examples of tissue regeneration with the delivery technology of bio-signals with or without the cell scaffold and cell transplantation combination to emphasize scientific and clinical significance of bio-signals delivery technology in regenerative medicine.

Professor Julio San Roman’s Biographical Summary

Julio San Román is full research professor of the National Research Council of Spain CSIC, and active member of the CIBER-BBN, specialised in the design, preparation and application of biofunctionalised polymers for biomedical applications, including polymeric systems for drug delivery, tissue engineering and regenerative medicine. (http://www.ictp.csic.es/npb/biomat/). He is associated professor of the University of the vasque country, invited profesor of the University of Havana (cuba) and member of the catedra UNESCO of Biomaterials at the University of Havana.

His scientific activity is centered on the design, preparation and application of polymeric systems from natural origin or synthetic one, for the development of advanced components for Tissue Engineering, Polymer Drugs, and biodegradable systems for controlled drug delivery. He has published more than 430 articles in journals SCI, 35 chapters of specialised books, and coeditor of 3 books on biodegradable polymers for biomedical applications, Smart polymeric systems and biomaterials. He has participate as plenary speaker in more than 250 international congress in the fields of advanced polymers, controlled release systems and biomaterials. He has 25 patents on polymers and biomateriels, three of them are on exploitation by pharmaceutical and medical devices companies, and has supervised 33 doctoral thesis.

He is president of the group of polymers of the Spanish Royal Society of Chemistry and Physics, and fellow of the international societies of biomaterials, and has been president of the European Polymer Federation in the period 2010-2011, and member of the European Society of Biomaterials since 1987, being in the council of the society during the period 2010 – 2014.

Julio San Román, Blanca Vazquez, Marcela Martin-del-Campo, Raul Rosales-Ibañez, Keila Alvarado, Jose G. Sampedro, Christian A. Garcia-Sepulveda, Sanjukta Deb, Itzia Rodríguez-Méndez, Mar Fernández-Gutiérrez, Amairany Rodríguez-Navarrete and Luis Rojo.

Sr(II) has demonstrated an interesting role in bone regeneration and remodeling, with clear contributions to the activation of osteoblasts and modulate action of the control of osteoclast. In this sense there is an increasing interest in the application of derivatives of strontium salts in bone tissue regeneration processes. One point of interest is the application of these compounds in 3D scaffolds to activate the repair of bone defects, considering formulations and methodologies for the local delivery of the corresponding bioactive compounds. The presentation will be centered in the application of Sr fluoride SRF in 3D scaffolds biohybrid composites based on scaffolds of poly(caprolactone) and chitosan crosslinked ionically with tripolyphosphate. The incompatibility of PCL (highly hydrophobic) with chitosan (highly hydrophilic) gives rise to the formation of biohybrid and biodegradable composites that present nanoparticles of PCL distributed homogeneously in a continuous matrix of crosslinked chitosan. Membranes of these formulations were applied in an animal model for the regeneration of the calvaria defect of rats, and results of the remodeling process will be shown (1). Other interesting system studied previously is the design and application of Strontium Folate SrFo in bone regenerative process. Biohybrid systems prepared by lyophilisation of semi-interpenetrating networks of chitosan polyethylene glycol dimethacrylate and beta tri-calcium phosphate (βTCP) fabricated using free radical polymerization and loaded SrFo were applied in regenerative process. The scaffolds were seeded with pluripotent stem cells obtained from human dental pulp and their potential to regenerate bone tissues were assessed using a critical sized defect model of calvaria in rats and compared with those obtained without SrFO. The results obtained both in vitro and in vivo demonstrated excellent cytocompatibility with resorption of scaffolds in 4–6 weeks and a total regeneration of the defect, with a more rapid and dense bone formation in the group with SrFO. Thus, the use of stem cells sourced from human dental pulp in combination with SrFO are very promising systems for their application in compromised osseous tissue regeneration.

2 – Marcela Martín del campo et al. Biomaterials Science (2016), 4, 1596-1604

Acknowledges: Financial support from project MAT2014-51918 and CIBER-BBN is acknowledged.
Professor Vasif Hasirci’s Biographical Summary

Dr. Vasif Hasirci is a chemist and is an expert in biomedical, biotechnological and nanotechnological applications of natural and synthetic polymers. He is the Director of the Center of Excellence in Biomaterials and Tissue Engineering at the Middle East Technical University (METU) and the President of the Biomaterials and Tissue Engineering Society (Turkey). He serves on the Editorial Boards of the journals Biomaterials; Nanomedicine; and J. Biomaterials Science: Polymer Edition among others. He has published more than 200 SCI journal papers, has 3700 citations and a h-index of 38. He received 5 patents and/or patent applications, supervised 45 M.Sc. and 19 Ph.D. students. Dr. Hasirci is among the founders of the Departments of Micro and Nanotechnology, Biotechnology, and Biomedical Engineering at METU. He is a Fellow of the Science Academy (Turkey), the International College of Fellows of Biomaterials Science and Engineering (FBSE), and the Royal Society of Chemistry (FRSC) (UK); and a member of European Society for Biomaterials (ESB), and American Chemical Society, Turkish Chemistry Society.
Implants need to offer appropriate surfaces to stem or differentiated cells when tissue engineering is targeted. The cells need not just to adhere, but spread, proliferate, differentiate. The substrates they are seeded on are not stable surfaces as the tissue engineering cell carriers are needed to degrade in time to be replaced by the healing tissue. The native tissues offer chemical-biological and mechanical cues to guide the tissue formation and the synthetic substrates that the scientists offer are generally devoid of them. Just to show how the surface properties affect cell behavior the example below is satisfactory. In this case there are dental pulp stem cells seeded on chemically modified and unmodified (hydrophobic) surfaces decorated with micro sized physical cues or just plain smooth surfaces. The smooth-untreated surfaces present the unmodified normal behavior of cells whereas the other extreme modified and with physical cues present the excessively deformed form of the same cells. These physical appearance changes are definitely reflected on the biochemical and physiological properties of the cells and eventually of the potential of the cells to provide appropriate healing. The collective efforts of MEMS technology and cell biology, polymer chemistry are the main tools to lead us to the ideal tissue engineering scaffolds.

Figure: DBMS cells on chemically and physically modified polymeric surfaces. O. Hasturk, M.Sc. Thesis, 2016
Dr. Bruce C. Johnson was born in 1958 in Wilmington, DE, USA. He grew up in the Shenandoah Valley of Virginia. He attended college at Virginia Polytechnic Institute and State University (Va Tech) and earned a B.A. degree in Chemistry (1980) and a Ph.D. in Materials Engineering Science (1984), Dissertation: “High Performance Polyimide Copolymers: Synthesis and Characteristics.” In his doctoral work, Bruce worked closely with NASA on high performance polyimide-polysiloxane copolymer films. These polymers were of high interest as NASA needed materials that would have longevity in low Earth orbit environments where atomic oxygen is abundant. The copolymers were part of experiments conducted on Space Shuttle missions in the early 1980’s.

Bruce began his industrial career at General Electric, in upstate New York, as a Product Development Specialist where he developed materials, processes and established property profiles for a variety of products. Key developments included reactive extrusion compounding of polyphenylene oxide blends for automotive applications and core-shell emulsion/suspension acrylonitrile-styrene-butylacrylate polymerizations and blends for weatherable applications.

Bruce made a career move after 5 years at GE and accepted a position with Johnson and Johnson in New Jersey. He spent 21 years with J&J moving from a Principal Scientist up to a corporate recognized Research Fellow. During this time his teams developed materials and processes that were commercialized for the medical industry. Key achievements include development and commercialization of materials for IUDs and HDPE sutures, breathable (high MVTR) viral barrier operating room gown films, breathable wound care films (Bioclusive MVP®), acetal forming sleeves for hydroentangled nonwoven fabric production, feminine hygiene barriers and covers, and diaper transfer layers.

From J&J, Bruce transitioned to Site Director of Materials Formulations for Alcon’s contact lens manufacturing operation in north Georgia. The resin formulations, saline solutions, and pigment additives his department produced were used to manufacture over one billion lenses per year.

Currently, Bruce is the Director, Innovation Management Biomaterials for Evonik Corporation and is located in Birmingham, AL. He has been with Evonik for two years and has responsibility for RESOMER® and RESOMER® Select technologies. He began his career with Evonik as the MedTech Lab and Technology Manager for Project House Medical Device (PHMD). PHMD was formed to develop and advance RESOMER® Select materials for medical device applications and is located at the Birmingham, AL facility.
ESOMER® and RESOMER® Select Biodegradable Polymers

Bruce C. Johnson.

Innovation Management Biomaterials, Evonik Corporation, 756 Tom Martin Drive Birmingham, AL 35211 USA (*bruce.johnson@evonik.com)

Evonik is one of the world’s leading specialty chemical companies with more than 35,000 employees. The RESOMER® brand of products is part of Evonik’s Nutrition and Care segment that produces specialty chemicals for use in consumer goods, animal nutrition, and healthcare products. Evonik manufactures a medical grade line of biodegradable products under the trade names RESOMER® and RESOMER® Select. These products are the premier brand in Controlled Release (CR) applications and in Medical Devices (MD). In CR applications, RESOMER® brand products are excipients that perform as the Active Pharmaceutical Ingredient (API) carrier. The form of delivery includes both injectable and implantable products. In MD applications, RESOMER® branded materials can perform as engineering thermoplastics that can be converted into biodegradable devices via common processes including, extrusion, injection molding and 3D printing. In fact, Evonik manufactures a number of medical grade polymers including Vestakeep® polymer (PEEK, Vestamid® polymer (PEBA), and Decacryl® polymer (PMMA). Additionally, Evonik produces an alpha-ketoglutaric acid under the trade name cQrex® that is specifically designed to increase the efficiency of cell culture applications.

This presentation will focus on the RESOMER® and RESOMER® Select brand of biodegradable polymers. The breadth of products available and the ability to custom design polymers will be discussed. Control of factors such as monomer composition and selection, microstructure, molecular weight, and polymer architecture will be covered.
Hyaluronate-Based Thermo-Sensitive Hydrogel as Cell Carrier for Nucleus Pulposus Regeneration and Vitreous Body Substitute

Feng-Huei Lin (double)

Institute of Biomed Eng & Nanomed, NHRI, Zhu Nan, Taiwan
Institute of Biomedical Engineering, National Taiwan University, Taipei, Taiwan

Intervertebral disc degeneration usually starts at the nucleus pulposus. In the past decades, several techniques and prosthetics (artificial disc) have been developed to regenerate or replace the nucleus pulposus. However, these kind of pre-formed devices have to remove the nucleus pulposus and then replace an artificial one to relieve the symptom of intervertebral disc degeneration. Recently, cell-based tissue engineering provides a rational approach to regenerate active nucleus pulposus cells (NP cells) to restore intervertebral disc architecture and function. However, the source of autologous nucleus pulposus cells are limited and their functional state does not favor regeneration. Besides, nucleus pulposus cells grown in monolayer may result in fibroblast-like transformation. Thus, the 3D hydrogel co-culture system maybe an alternative method to provide an adequate environment for nucleus pulposus cells proliferation, extracellular matrix production, cytokines secretion.

Human vitreous is a gelatinous substance that is predominantly composed of collagen fibril, hyaluronic acid (HA) and water (97–99%). Vitreous substitutes are needed to tamponade the detached retina after vitrectomy when treating retinal detachments. However, several drawbacks associated with current vitreous substitutes have been reported. In the present study, we developed a colorless, transparent and injectable hydrogel as a vitreous substitute that was formed by oxidated HA (oxi-HA) and adipic acid dihydrazide (ADH). The results of biodegradation demonstrated that the hydrogel could maintain its gel matrix over at least 35 days depending on the ADH concentration. In addition, the biocompatibility was evaluated on a retina pigmented epithelium (RPE) cell culture following ISO 10993-5 (tests for in vitro cytotoxicity), and the hydrogel was found to be nontoxic. This study suggested that the injectable oxi-HA/ADH hydrogel could fulfill many critical elements that are desirable in vitreous substitutes.
Professor John P. Fisher’s Biographical Summary

Dr. John P. Fisher is the Fischell Family Distinguished Professor and Department Chair in the Fischell Department of Bioengineering at the University of Maryland. Dr. Fisher is also the Director of the newly established NIH Center for Engineering Complex Tissue (CECT) that aims to create a broad community focusing on 3D printing and bioprinting for regenerative medicine applications. Dr. Fisher leads the Tissue Engineering and Biomaterials Laboratory and investigates biomaterials, 3D printing, stem cells, and bioreactors for the regeneration of lost tissues, particularly bone, cartilage, vasculature, and skeletal muscle. The lab examines questions related to how biomaterials affect endogenous signaling among embedded cells as well as the interactions between stem cells and host vascularization. Key recent developments include the creation of a modular and scalable bioreactor for cell and tissue culture as well as the fabrication of 3D printed substrates for tissue regeneration. The lab is supported by research grants from NIH, FDA, NSF, NIST, DoD, and other institutions, and has authored over 115 publications, 260 scientific presentations, and 13 patents / patent applications. Dr. Fisher has advised 6 postdoctoral fellows, 18 Ph.D. students, 6 M.S. students, and over 60 undergraduate researchers. Dr. Fisher is a Fellow of the American Institute for Medical and Biological Engineering (2012) and the Biomedical Engineering Society (2016). In 2015 Dr. Fisher visited the National University of Ireland, Galway as a Fulbright Fellow. Dr. Fisher is currently the Editor-in-Chief of the journal Tissue Engineering, Part B: Reviews, and Continental Chair Elect of the Tissue Engineering and Regenerative Medicine Society International – Americas Chapter.
3D Printing for Engineering Complex Tissues

John P. Fisher

Center for Engineering Complex Tissues, Fischell Department of Bioengineering, University of Maryland, College Park, MD, USA
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The generation of complex tissues has been an increasing focus in tissue engineering and regenerative medicine. With recent advances in bioprinting technology, our laboratory has focused on the development of platforms for the treatment and understanding of clinically relevant problems ranging from congenital heart disease to preeclampsia. We utilize stereolithography-based and extrusion-based additive manufacturing to generate patient-specific vascular grafts, prevascular networks for bone tissue engineering, dermal dressings, cell-laden models of preeclampsia, and bioreactors for expansion of stem cells. Furthermore, we have developed a range of UV crosslinkable materials to provide clinically relevant 3D printed biomaterials with tunable mechanical properties. Such developments demonstrate the ability to generate biocompatible materials and fabricated diverse structures from natural and synthetic biomaterials. In addition, one of the key challenges associated with the development of large tissues is providing adequate nutrient and waste exchange. By combining printing and dynamic culture strategies, we have developed new methods for generating macrovasculature that will provide adequate nutrient exchange in large engineered tissues. Finally, the use of stem cells in regenerative medicine is limited by the challenge in obtaining sufficient cell numbers while maintaining self-renewal capacity. Our efforts in developing 3D-printed bioreactors that mimic the bone marrow niche microenvironment have enabled successful expansion of mesenchymal stem cells by recapitulating the physiological surface shear stresses experienced by the cells. This presentation will cover the diverse range of materials and processes developed in our laboratory and their application to relevant, emerging problems in tissue engineering.
Professor Jons Hilborn’s Biographical Summary
(May 9, 2017)

Jöns Hilborn is since 2001 the head of the Polymer Chemistry program at the Department of Materials Chemistry, Uppsala University in Sweden. He received his PhD from the Royal Institute of Technology in Stockholm, which was followed by seven years in industry before he joined the Swiss Federal Institute of Technology in Switzerland for eight years. He has extensive management experience from life science industry and co-ordination of national and international research projects. His research interests are in the design, synthesis and preparation of polymers and specifically materials for tissue scaffolds and as delivery vehicles. Current focus is on injectable in-vivo gel forming matrices that acts on endogenous cells to regenerate and the development of RNAi to allow translation to therapies. Chemistry, biology, engineering is combined with medicine to bring basic research findings from the lab bench to the clinic and commercial applications. He served as president of “Tissue Engineering and Regenerative Medicine International Society” (TERMIS), which he was a part of creating. He currently serves as ERC panel chair, board member of the UK medical research council in regenerative medicine, associate editor, international advisor and the editorial board for a number of journals. He is a frequently invited speaker at international events and has published 200 scientific papers (h=47), 26 patent applications and has started 7 companies.
The Magic Bullet of Small Interfering RNA (siRNA) Is Easy to Manufacture, It Targets Sharply and Has High Kill Rates. But How to Pull the Trigger?

Joens Hilborn, Oommen Varghese and O.P. Oommen

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Development of new therapeutics is a constant search for successful and safe molecules that maintain high clinical efficacy. Small-molecule drugs were traditionally the only solution for diseases treatment until the development of monoclonal antibody therapy. Such therapy has been successful for many diseases, but has shortcomings of tissue penetration, manufacturing, and purification. RNA interference (RNAi) therapeutics (Nobel prize 2006) provides alternative treatment options when current drug technology fails. Small interfering RNAs (siRNAs) and microRNAs (miRNA) target the mRNA, the molecular machinery that synthesize defective proteins, and silence its function. Although there were initial difficulties in achieving efficacious in vivo results with RNAi without toxic side effects, advances in delivery and improved chemistry made a resurgence possible. Today more than 20 RNAi-based therapeutics are currently in clinical trials, with several in Phase III.

Despite recent advancements, developing RNAi-based drug molecules that are specific to target cells (tissue) and abolish non-specific effects (off-target effects) is still the Holy Grail that is sought-after. We aim to overcome these hurdles and have made a significant discovery: endosomolytic cell penetrating RNA or cpRNA. The unique design of cpRNA has already been demonstrated to improve RNAi activity, and favour cellular delivery as shown in Figure 1. This initial breakthrough is however limited to in vitro applications only. Currently we are developing this technology to make it applicable for human therapies. This is therefore a stepping-stone that could change the current landscape not only of RNAi-based drugs but to make disruptive changes to drug discovery in general.
Dr. YoenHoi Heo’s Biographical Summary
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EDUCATION
Master’s Degree in Pharmacy, Ewha Womans Graduates, Seoul (2002)
Bachelor’s Degree in Pharmacy, Ewha Womans University, Seoul (2000)

CURRENT ROLE
● CGBio Inc., Department of Medical & Scientific Affairs
● Team Manager of Medical & Scientific Affairs

PROFESSIONAL EXPERIENCE
● Team Manager of Medical & Scientific Affairs
● Global Wound Senior Product Manager
● Wound Care Team Leader in charge of Health Care Professional training
● Commercial Excellence Trainer
● Organization Development Specialist

License
Pharmacist license 2000.
BGS-7 (Novomax®) in Tissue Engineering

Yoen Hoi Heo

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Since a bioactive glass, 45S5, was discovered by Larry L. Hench, it has changed paradigm of previous human tissue replacement using bio-inert materials. Bioactive glasses form a bond with living tissues and cannot be easily removed from its implant sites and do not induce foreign body reaction. Thus it has been considered in implants or prostheses and in repair or replacement of bones, joints and teeth. Nonetheless it has a disadvantage, short period of existence within tissues.

In 2000, CGBio Inc. initiated the development of a new bioactive glass which has advantages of a bioactive glass and improves its strength within tissues. In 2004, CGBio Inc. succeeded in development of final composition of a new bioactive glass, BGS-7 (CaO-SiO2-P2O3-B2O3, Novomax®) with high strength. Clinical Trials for KFDA approval was terminated in 2013 and KFDA approval was completed in March, 2014. Now it has been tried in clinical indications such as PLIF and ACDF and its results are expected to be reported soon.

In this presentation, I will introduce the development history and the technical and clinical properties of a new bioactive glass, BGS-7 (CaO-SiO2-P2O3-B2O3, Novomax®). Along with these properties, I will introduce 3D printing application using BGS-7 (CaO-SiO2-P2O3-B2O3, Novomax®).
Professor Young Jik Kwon’s Biographical Summary
(May 2017)

Dr. Young Jik Kwon is a professor at UC Irvine in the
Pharmaceutical Sciences, Chemical Engineering and Materials Science,
Biomedical Engineering, and Molecular Biology and Biochemistry
departments. Following his undergraduate education in Biological
Engineering at Inha University, Dr. Kwon received his Ph.D in Chemical
Engineering from the University of Southern California with a focus on
retroviral gene delivery in 2013 and did post-doctoral training in
department of chemistry at UC Berkeley on polymeric vaccine carriers
under the supervision of Prof. Jean Fréchet. He started his academic
career in Biomedical Engineering at Case Western Reserve University in
2005 and moved to UC Irvine in 2007.

He currently oversees research at the BioTherapeutics
Engineering Laboratory (BioTEL) at UC Irvine and his current projects mainly focus on gene/drug
delivery, cancer-targeted therapeutics, and combined molecular imaging and therapy. Dr. Kwon is a
member of the NCI-designated Chao Family Comprehensive Cancer Center, the Institute for Cancer
Research, and the Center for Virus Research at UC Irvine. Dr. Kwon’s work was awarded the Medical
Research Award from Gabrielle’s Angel Foundation for Cancer Research in 2011, the Faculty Early
Career Development Award (CAREER) from the National Science Foundation in 2010, and the Faculty
Career Development Award from UC Irvine in 2008. He has also received the best reviewer in the
subject area of Pharmaceutical Sciences, Elsevier (2011), FEBS Journal Top-Cited Paper Award, Wiley
(2013), and Top downloaded article award in 2014, Journal of Materials Chemistry, Royal Society of
Chemistry Publishing (2014). He has also been a special visiting professor to the Pharmacy School of
Federal University of Minas Gerais (UFMG) in Belo Horizonte, Brazil since 2015.
Synergistic and Targeted Inhibition of CML Proliferation Using Viral/Nonviral Chimeric Nanoparticles

Margaret Lugin¹, Cheol Am Hong², Soo Kyung Cho, Julius Edson³, Dominique Ingato¹, and Young Jik Kwon¹,²,³,₄, *

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²Department of Pharmaceutical Sciences,  
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Viruses are nature-designed nanomaterials that form a highly organized structure in a very sophisticated manner and have ideally uniform materials properties. Despite their tremendous potentials in basic science and clinical translation, the use of viral particles has been greatly hampered by the limited tool kits in molecularly tuning their physical, chemical, and biological properties. Simultaneously tackling multiple molecular pathways that contribute to the development and progression of cancer is indispensable for efficient and safe therapy. For example, BCR-ABL+ leukemia proliferates via reducing pro-apoptotic protein BIM and up-regulating survival gene MCL-1. Tyrosine kinase inhibitors (TKIs) interfering with BCR-ABL fusion protein have revolutionized the treatment of BCR-ABL-driven leukemias; however, they are inefficient in eradicating leukemia cells due to up-regulated MCL-1, must be taken continuously even by pediatric patients, and generate acquired resistance attributed to mutations in BCR-ABL. We have developed novel AAV/polymer chimeric nanoparticles (ChNPs) that simultaneously express BIM and silence MCL-1 for significantly enhanced activity selectively against BCR-ABL+ leukemia cells in vitro and in vivo, with avoided immunogenicity and toxicity. The insightful and intriguing findings in this study offers the high possibility for clinical translation, not only for CML therapy but also therapies for other cancers.

Acknowledgment: This work was supported by Medical Research Award by Gabrielle’s Angel Foundation for Cancer Research (Award #56).
Application Case Study All-In-One Bio 3D Printer, IN VIVO® from ROKIT Inc.

Heon Ju Lee, Jeonglan Park, Jin-il Huh, Bo Mi Nam, Min Chae Lee, Hunyeong Ban

ROKIT Inc., B-1106, Gapeul Grerat Valley, Digital 9-ro 32, Geuncheon-Gu, Seoul, 08512 Korea(South)
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From June 2016 to May 2017, approximately 60 customers purchased our all-in-one 3D printers for mostly their research purposes. For the last a year, we can feel sudden increasing movement of tissue engineering and biofabrication research using bio 3D printers and we are introducing its applications case studies through the consulting with our customers.

First, cell bio printings with bio-inks is a one big category. Vascularized kidney, cardiac myocyte regeneration, Neuron regeneration for dementia patients, liver function regeneration, Oncology using target therapy, and pancreatic cell regeneration are proposed for tissue engineering researches using our product of 3D bio printers. All the cases include live cell as a printing biomaterials and consist with scaffold design.

Second application category is human skin equivalent (HSE). Skin is relatively easier than other organs for fabrication sue to is structure. Dermis and epi-dermis are not containing large vascular, so many researchers are working on this topic, HSE. One third of our customers were also purchased our 3D bio printers for human skin equivalent. The final applications for HSE are cosmetics test for substitution of animal tests and artificial skin for wound healing for burnt patients.

Third application cases are bone and teeth, hard tissue application. Not just simple or uniform shape of bone-replace scaffold, non-uniform, which is gradually increasing pore size toward outside. This structure may prevent clogging or fouling on the surface and cannot fill the designed structures. In fact, more than half of the studies related to bio-implant is recently focused on scaffolds’ internal structure design.

The world is changing so fast. Artificial intelligence, big data, internet of things are conversing with biofabrication. There are hundreds of potential applications for regeneration medicine. Therefore, we are planning to develop biofabrication platform for accumulate the knowledge for bio-printed organ growth protocols, customized medicine information, and history tracking system for collect useful big data. We are expecting the fourth medical revolution will be a regeneration medicine and it is already started.
Plenary Lecture 22 [PL-22]

**Professor Miguel Oliveira’s Biographical Summary**

Miguel Oliveira, BSc, PhD is an Assistant Researcher at the PT Government Associate Laboratory ICVS/3B’s (http://www.3bs.uminho.pt/users/migueloliveira), University of Minho (UM), Portugal (PT). He is hired by the Portuguese Foundation for Science and Technology (FCT), under the most prestigious program available “Investigador FCT 2012” (IF/00423/2012, Starting grant-STG), which supports the top young scientists (PhD<5 years). He has funded his independent group at ICVS/3B’s in Jan. 2013 under the IF2012 (StG) establishing a strategic research line on 3D in vitro models (www.3bs.uminho.pt). Miguel Oliveira is Director of Pre-Clinical Research and Basic Science at both the FIFA MEDICAL CENTER, Estádio do Dragão, Porto, PT since Feb. 2013 and the recently established D. Henrique Research Centre (Porto - PT). Currently, Miguel Oliveira is also a Lecturer in Doctoral Program in Tissue Engineering, Regenerative Medicine and Stem Cells (TERM&SC; http://termsc.3bs.uminho.pt/content/about) at UM, PT (since Dec. 2013). He is also Invited Lecturer in three different PT Universities in the topic of: (i) Orthotraumatology, Faculty of Medicine, University of Porto, PT (since Sep. 2013); Tissue Engineering and Regenerative Medicine, University of Algarve, PT (since Mar. 2010); and Biomaterials at Dep. of Polymer Engineering, University of Minho, PT (since 2009). In the last 15 years, he has focused his work on the field of biomaterials for tissue engineering, nanomedicine, stem cells and cell/drug delivery. He has been involved in the development of biomaterials from natural origin polymers (chitin, chitosan, carboxymethylchitosan, algae-based materials such as ulvan, silk-fibroin, and gellan gum and its derivatives) and ceramics (tricalcium phosphate, hydroxyapatite) for bone, cartilage, osteochondral tissue, peripheral nerve, spinal cord injury, meniscus and intervertebral disc (IVD) regeneration. His research activities have been increasingly focused on tissue engineering, nanomedicine, stem cells and drug delivery applications. He made great contributions in the osteochondral TE field, namely by proposing bilayered scaffolds, which has been highly cited by its peers. He has also a unique type of research in the areas of isolation, selection of sub-populations and differentiation of distinct sources of stem cells, and combining them with new biomaterials, leading to innovative regenerative approaches. In particular, his extensive and innovative work with biomaterials allowed the development of an exciting class of enzymatically cross-linked (e.g. enzymatically cross-linked silk fibroin hydrogels) and photo-crosslinked (e.g. methacrylated gellan gum) biomaterials with tunable properties including its processability, biodegradability and biological performance as compared to the existing materials. He has been the responsible for developing and licensing a patent on gellan gum-based polysaccharides. As result of his proficiency (as of 15th Nov. 2015), Miguel Oliveira produced 119 publications listed in ISI Web of Knowledge (ResearcherID: H-8636-2012), 123 publications listed in ORCID (0000-0001-7052-8837) and 80 original articles (listed in Scopus) published in scientific journals with referee, some of which in high impact Journals (e.g. Biomaterials, Adv. Materials, Adv. Funct. Materials, Small, Progress in Polymer Science, Trends in Biotechnol., Biotechnol. Adv., ACS Biomater. Sci. Eng.) – being 9 of those review papers (3 under invitation). The PI has an h-index of 23, i10 of 42 and received ~2110 citations (Google Scholar) or an
h-index of 18, ~1516 total citations or 1334 citations (excluding self-citations) by 1251 documents (Scopus). He has an RG37.24 (ResearchGate index).

He is a member of 6 Editorial Advisory Boards of journals and also scientific adviser of several journals (n=35) and Science Funding Agencies. He was Member of several Master/PhD Assessment Committees. Miguel Oliveira is a very committed member of several Societies, editor and referee of several Journals in the regenerative medicine field. At the present, he is the PI or scientific responsible of grants totalizing ~3.2 M€, but he has been involved in the preparation of other PT and EC funded projects at UMINHO (e.g. Infrastructure, Equipment’s, Promotion of Series of Events in TERM field and Human resources) totalizing ~27 M€. He currently supervises/co-supervises 8 PhD students and 6 Post-docs, being 8 currently funded by FCT and 6 under EC funded projects (PhD and Post-doctoral grants). Miguel Oliveira was granted 9 patents. In addition, he has published 2 books (1 in preparation, Springer), 1 special issue in scientific journals, 33 book chapters in books with international circulation and encyclopaedias, and 4 book chapters (science dissemination). He has participated in more than 150 communications in national/international conferences, almost all of them in international meetings (Portugal but mostly in other countries in Europe, USA, Japan, South Korea, Singapore, China). In addition, he participated as invited/keynote speaker in more than 40 plenary sessions. As a result of his academic activities, Miguel Oliveira has been awarded 20 prizes/honours, being the most prestigious one, The Jean Leray Award 2015 (Young Scientists and Group Leaders under 40 years old) attributed by the European Society for Biomaterials for its Outstanding Contributions within the field of Biomaterials.

One of the technologies developed by Miguel Oliveira “the meniscus implants” is in the permanent collection of the National Museum of Sports, Palácio Foz, Lisbon - Portugal. For his scientific achievements the Municipality of Guimarães (PT), in the person of the City Mayor Dr. Domingos Bragança, attributed a Vote of Honor (ref. 92-SEG-JX dated from Mar. 19th, 2015).
Application of New Keratin-Chitosan Biomaterials for Peripheral Nerve Regeneration

Cristiana R. Carvalho\textsuperscript{1,2}, J. P. Gonçalves\textsuperscript{1,2}, Albino Martins\textsuperscript{1,2}, Nuno M. Neves\textsuperscript{1,2} Kee Woei NG\textsuperscript{3}, Rui L. Reis\textsuperscript{1,2}, Joaquim M. Oliveira\textsuperscript{1,2}

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Peripheral nerve injuries (PNI) are a large-scale problem that affects over one million people around the world. For PNI that require surgical intervention and in the case of long gap injuries, autologous nerve grafts (ANG) have been considered the gold standard for decades. However, the random efficiency of ANG is associated to several drawbacks, for instance, donor site morbidity, limited availability and nerve mismatches, leading to merely 50% rates of success. Keratin is a highly available fibrous protein found in hair, wool and feathers and it has been used in tissue engineering procedures since it possess cell binding motifs. In this study, an innovative combination of chitosan and keratin (human air) is obtained in order to create novel materials aimed at finding applications in the treatment of PNI. Two types of biomaterials were produced: Chitosan/keratin membranes by solvent casting and nanofibers by electrospinning technique. Scaffolds were physicochemical and biologically characterized. Keratin/chitosan membranes and nanofibers topography showed a rough surface, with ridges and pores. FTIR revealed characteristic peaks of keratin and chitosan in both membranes and electrospun nanofibers, suggesting the presence of both biomaterials in the blend solution. Regarding mechanical properties, both membranes and nanofibers showed mainly elastic behavior and a low ability to dissipate energy, but the latest showed higher stiffness. In vitro studies using L929 cells seeded onto materials revealed that cell viability increased with culturing time in both chitosan/keratin membranes and electrospun nanofibers. When human Schwann cells, human brain microvascular endothelial cells and human dermal fibroblasts were cultured onto the materials, it was observed a significantly higher cell adhesion and metabolic activity after 14 days in chitosan membranes containing 1% keratin as compared to chitosan membranes. This study showed that materials have appropriate physicochemical and mechanical properties, indicating the suitability of keratin containing materials for Peripheral Nerve Regeneration.

Keywords: Peripheral Nerve Regeneration, Nerve conduits, Bio-materials

Acknowledgments: EU-FP7-Health-2011-collaborative project 278612, Biohybrid - Templates for peripheral nerve regeneration and PhD Scholarship (Norte-08-5369-FSE-000037). J. M. Oliveira also thanks the FCT for the funds provided under the program Investigador FCT 2012 and 2015 (IF/00423/2012 and IF/01285/2015)
Taiwan Lanyu Minipig is A Better Animal Model for Biomedical Applications

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Developing therapeutic approaches to treat wounds requires the selection of a suitable animal model that resembles human skin conditions. This study aimed to compare the skin wound healing features of Taiwanese Lanyu mini-pigs (TLY) with those of the domestic pig (Landrace, which is a well-known skin wound animal model) for evaluating whether TLY can be used to develop a wound healing animal model. Physiological parameters were measured, and skin growth rate was determined by measuring the changes in the size of tattoos drawn on the dorsal skin of pigs as a percentage of skin expansion of the original tattooed area. Contraction and re-epithelialization of full-thickness wounds were monitored histologically as well as by measuring the margin area and open wound area during healing.

In summary, compared to domestic Landrace pigs, the TLY mature earlier, have a smaller body size and bodyweight, and show stable increases in physiological growth parameters, including body weight, body length, and abdominal circumference. Thus, TLY are favored for laboratory experiments. We highlight the main physiological properties of Taiwanese Lanyu mini-pig skin compared with those of domestic pig skin. The morphological features, skin growth profile, stable wound healing profile during wound contraction, re-epithelialization potential, and histological findings for the TLY obtained in this study might serve as the basis for future researches on using this breed as excision wound healing models. Taken together, our findings suggest that Taiwanese Lanyu mini-pigs can be used for developing skin wound healing animal models.

Acknowledgment: MOST 105-2119-M-006-017; 106-2622-8-006 -003 -TB1
Professor Jong Kim’s Biographical Summary
(June 16st, 2017)


He had received Ph.D. degree at the Department of Mechanical Engineering, POSTECH in Republic of Korea from 2005 to 2009. His thesis is about the development of multi-head deposition system for three-dimensional scaffold fabrication and its application to bone tissue regeneration.

Since 2010, Prof. Kim is now working in Andong National University, Republic of Korea. He is a member of Korean Tissue Engineering and Regenerative Medicine Society (TERMIS), Society for Korean Society of Mechanical Engineers and Korean Society of Precision Engineering and so on.

He has published about 40 original international papers, and presented over 100 times in international conference. His major scientific interests are about manufacturing and fabrication technology, 3D printing, 3D scaffolding methods, tissue engineering, and ultra-precision mechanical system.
Design and Fabrication of Bio-Scaffolds for Bone Tissue Engineering Using 3D Printing Technology

Min-Woo Sa, Jong Young Kim*

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3D bio-scaffolds with optimal interconnected pore shapes have attracted intensive interests to guide bone tissue regeneration. Generally, 3D bio-scaffolds such as polymer and ceramic are being widely fabricated in recent years. Porous scaffolds can be fabricated using traditional fabrication methods, including synthetic techniques and natural structures. However, it has complexity and lack of control over the structure of controllable porous scaffolds. On the contrary, 3D printing technology has strong potential for the fabrication of customized tissue engineering scaffold. In our laboratory, we have developed a couple of fabrication methods by various bio-polymers and ceramic scaffolds using 3D printing technology, which can be rapidly applied in the medical field. In this study, direct and indirect methods for a suitable engineering process in the scaffold fabrication will be introduced. Therefore, it would be promising to fabricate bio-scaffolds via 3D printing technology, and the 3D printed scaffolds might be one of excellent candidates in tentative bone tissue repair. In this session, several our research works and literature investigations will be provided.

Acknowledgment: This research was supported by Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Education (NRF. 2016R1D1A3B03933081).
PLENARY LECTURE (3)

- Thursday, July 13th

- 9:00 to 10:40 – PL-25~PL-29
- 20min break
- 11:00 to 12:20 – PL-30~PL-33
Dr. Heemin Kang’s Biographical Summary
(Jun 18th, 2017)

Dr. Heemin Kang is currently a University’s Postdoctoral Fellow in the group of Prof. Liming Bian at the Chinese University of Hong Kong, focusing on the development of nanomaterials for dynamic engineering and imaging of stem cells and immune cells, both in vitro and in vivo. He received his Ph.D. degree in Materials Science and Engineering at the University of California, San Diego in 2016, in the group of Prof. Shyni Varghese. During his Ph.D. study, he had created biomimetic materials and discovered the small molecule for elucidating their role in directing stem cell differentiation and functional skeletal tissue regeneration. He received his M.S. degree in 2008 and B.S. degree in 2005, in Materials Science and Engineering, from Stanford University and Korea University, respectively. At Stanford University and Applied Materials, Inc., he developed polymeric and inorganic material-based devices. He has received the University’s Postdoctoral Fellowship at the Chinese University of Hong Kong in 2016-2017 and was nominated as the finalist for the 2016 Chancellor’s Dissertation Medal at University of California, San Diego. He received the 2015 Acta Student Award, selected by the editor-in-chief in the Acta Biomaterialia.
Small Molecule Ligand-Driven Stem Cell Differentiation

Heemin Kang1,2*, Shyni Varghese2, and Liming Bian1

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Cellular behaviors, such as stem cell differentiation, are regulated by complex interactions between cell surface receptors and small molecule ligands. In this presentation, I will focus on the application of small molecule ligand to induce osteogenic differentiation of stem cells. I will present the use of adenosine, a small molecule ligand, to directly convert stem cells into functional osteoblasts, through its ligation to adenosine A2b receptor. The stem cells treated with adenosine not only expressed the molecular signatures of osteoblasts, but also participated in the repair of critical-sized bone defects through the formation of integrated neo-bone tissue. I will also demonstrate the strategies for ligand activation or oscillation to regulate stem cell differentiation. Taken together, such versatile use of small molecule ligand holds great promise in the application of stem cells for regenerative medicine.
Dr. In-Woong Um was born in 1959 in South Korea (58 years old), where he obtained his degrees at the Seoul National Univ (B.S., M.S. and Ph.D.).

After graduation and training in Oral and Maxillofacial Surgery (OMS) in Dental School, Seoul National University (Seoul, Korea), he has been working as professor in the Dept. of OMS at Chungnam National University (Daejeon, Korea) from 1990~1991, as assistant professor in Dept. of Oral Biology at the Medical College of Georgia (Atlanta, GA, USA) from 1993~1994, and Dept. of OMS at Wonkwang University (Iksan, Korea) (1991~1995).

Dr. Um is Science Director at Board of Bone Bank of The Korean Association of Oral and Maxillofacial Surgeons (1994~1996) and Board Member of Bone Bank of The Korean Association of Oral and Maxillofacial Surgeons (2002~2004). Dr. Um positioned as Board Member of The Tooth/Bone/Stem Cell Bank Committees at The Korean Association of Oral and Maxillofacial Surgeons since 2008. and one of Board Members in The Korean Academy of Dental Science and Specialized Assessment Committees by Area in New Health Technology Assessment (nHTA), Ministry of Health & Welfare. Recently, he is appointed chairman of Implant Clinical Research Committee, The Korean Association of Oral and Maxillofacial Surgeons and Director of The Korean Academy of Implant Dentistry.

From 2014, he has been reviewer for many scientific journals such as Journal of Periodontology, Journal of Oral Implantology and The Journal of Oral and Maxillofacial Surgery.

Dr. Um is Director of Research and Development Institute, Korea Tooth Bank that he founded. He received award from Ministry of Health & Welfare (Health Industry Technology) and several academic awards mainly in the contribution of developing Demineralized Dentin Matrix (DDM) that is certified as a “New Health Technology” by the Ministry of Health & Welfare, Republic of Korea. Recently, Korea Tooth Bank developed and launched two more new biomaterials (DDM).

He has published about 100 research papers and clinical papers including SCI(E) journals, mainly related to new biomaterial (DDM). He recently published book entitled “Demineralized Dentin Matrix by KTB” in addition to the other 4 edited books including “Advances in Oral Tissue Engineering”.
Deminerlized Dentin Matrix as A carrier of Recombinant Human Bone Morphogenetic Proteins

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This study aimed to evaluate the efficacy of rabbit deminerlized dentin matrix (DDM) as a recombinant human bone morphogenetic protein (rhBMP-2) carrier using the subcutaneous tissues of nude mice and rabbit calvarium critical-sized defects. DDM of rabbit, combined with rhBMP-2 (DDM/rhBMP-2) was transplanted into the subcutaneous tissues of nude mice and rabbit calvarium critical-sized defects. DDM (0.03 g, control) was transplanted into the left subcutaneous tissues of nude mice (n=6), and DDM/rhBMP-2 (0.03 g of DDM, 0.2mg/ml, 5.0 μg of rhBMP-2) into the right side (symmetrically) (n=6). For rabbits, round critical-sized defects (8 mm diameter) were formed with burs on both sides of the exposed skull. DDM (0.03 g) was transplanted into the two defects on the left sides (n=12) and DDM/rhBMP-2 (0.03 g of DDM, 0.2mg/ml, 5.0 μg of rhBMP-2) into the right sides (n=12). Animals were sacrificed at the first, second, and fourth experimental week (two each per time point for histomorphometric analysis). Inflammatory cells and osteogenic cells in the tissues of the nude mice were counted. Tissues from rabbits were imaged via micro-computed tomography (μCT). DDM/rhBMP-2 in nude mice induced new bone formation at 2 weeks and maturation with bone marrow at 4 weeks. DDM/rhBMP-2 in rabbit calvarium induced new bone formation remarkably at 4 weeks [21.77–47.99% (histomorphometry)] compared to the DDM control.

In this observation, the authors suggest that DDM of allogenic origin could be considered a potential carrier of rhBMP-2.

Acknowledgment: This study was supported by the Korea Health Industry Department Institute (KHIDI) grant that is funded by the Ministry of Health & Welfare, Republic of Korea under Grant HI15C3136.
Professor Sei Kwang Hahn’s Biographical Summary
(May 1st, 2017)

Dr. Sei Kwang Hahn obtained his B.S., M.S., and Ph.D. in the Department of Chemical and Biomolecular Engineering at Korea Advanced Institute of Science and Technology (KAIST). As the youngest Ph.D. at LG Chemical Group in 1996, he started his research on biodegradable polymer and then sustained release formulation of hGH, which was successfully commercialized in Korea under the trade name of Declage® in 2007. From 2001, he did his post-doctoral research with Prof. Allan Hoffman in the Department of Bioengineering at the University of Washington. After that, he worked for long acting formulation of various biopharmaceuticals at the Roche Group, Chugai Pharmaceutical Co. in Japan for more than three years.

Since 2005, he has worked as a professor in the Department of Materials Science and Engineering at POSTECH and an adjunct professor in the School of Interdisciplinary Bioscience and Bioengineering at POSTECH. He worked as a consultant for Johnson & Johnson in New Jersey and made a collaboration project contract with Hoffman-La Roche. In 2012, he joined in the Wellman Center for Photomedicine, Harvard Medical School and Massachusetts General Hospital for his sabbatical research supported by LG Yeonam Fellowship. He received the Korean President Award in 2015 and Korean Minister of Education Award in 2013. He published more than 110 SCI journal papers including Nature Photonics, Nature Communications, Progress in Polymer Science, Advanced Materials, and ACS Nano, and filed more than 120 Korean and international patents. He founded a bio-venture company of “PHI BioMed” in 2014. He is an editorial board member of ACS Biomaterials Science and Engineering, Biomacromolecules, and Biomaterials Research. He is one of the Samsung Future Technology Committee Members and the National Science and Technology Councils.
Smart Multi-Functional Photomedicines Using Hybrid Nanomaterials

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Advances in photonics have stimulated significant progress in medicine with many techniques now in routine clinical use. However, the finite depth of light penetration in tissue is a serious constraint to clinical applications. Here, we developed implantable light-delivery devices using biodegradable polymers. With this light delivery system, we demonstrated photochemical tissue bonding (PTB) for wound healing with a Rose Bengal (RB) dye, achieving a full thickness (410 mm) wound closure of porcine skin. In addition, we successfully demonstrated the facilitated PTB using hyaluronic acid (HA) – RB conjugate and upconversion nanoparticle (UCNP). The UCNP emitting red and green light in the skin tissue by skin-penetrating near infrared (NIR) laser illumination could activate the RB dye and crosslink the collagen, inducing skin repair and deep tissue wound healing. Furthermore, we developed cell-integrated poly(ethylene glycol) hydrogels for in vivo optogenetic sensing and therapy. Real-time optical readout of encapsulated heat-shock-protein-coupled fluorescent reporter cells made it possible to measure the nanotoxicity of cadmium-based quantum dots in vivo. Using optogenetic cells producing glucagon-like peptide-1, we performed light-controlled therapy and obtained improved glucose homeostasis in diabetic model mice. Finally, we developed a smart contact lens composed of biosensors, drug delivery systems, and power sources for the treatment of diabetic retinopathy as a model disease. This presentation will provide the current state-of-the-art smart photomedicines for further clinical applications.

Acknowledgment: I greatly appreciate Prof. Allan Hoffman for his kind advice for my academic and industrial research at the University of Washington, Roche Group, Chugai Pharmaceutical Co., and POSTECH.
Professor Nobuhiko Yui’s Biographical Summary
(Feb 1st, 2017)

Nobuhiko Yui is Professor and Chair of the Department of Organic Biomaterials in the Institute of Biomaterials and Bioengineering at Tokyo Medical and Dental University (TMDU). He started his academic career at Tokyo Women’s Medical University as an Assistant Research Professor in the Institute of Biomedical Engineering (IBM) (the Director was Professor Yasuhisa Sakurai) after his Ph.D. completion at Sophia University in 1985 (the Supervisor of the Ph.D. thesis was Professor Naoya Ogata). IBM has been active as an institute for biomaterials researches since the late 1970’s, and many well-known exponents of biomaterials such as Prof. T. Akaike, Prof. T. Okano, Prof. K. Kataoka, Dr. M. Maeda, and Prof. K. Ishihara appeared from IBM during the 1980’s. From 1988 to 1989, he spent at the University of Twente, the Netherlands, as a Postdoctoral Research Fellow at the laboratory of Professor Jan Feijen. He then joined Japan Advanced Institute of Science and Technology (JAIST) as an Associate Professor in 1993 to establish his laboratory, and was promoted to Professor in 1998. Since 2011 he has been his present position to strengthen collaborative biomaterials researches with the School of Medical and Dental Science of TMDU. His chairing Department has the longest history of more than 60 years in Japan to lead organic biomaterials researches, and he is recognized as one of the core and representative researchers of organic biomaterials in Japan as well as a worldwide leading scientist of designing supramolecular biomaterials.

His research interests include supramolecular biomaterials and their practical applications. His notable and outstanding contribution to the field of biomaterials science has been to emerge that supramolecular frameworks of polyrotaxanes can bring a variety of biomedical functions. For instance, molecularly movable surfaces using polyrotaxane structures for modulating intracellular functions, and lysosomally degradable polyrotaxanes as therapeutics for ameliorating metabolic disorders have been representatives of his research themes to explore new paradigm of biomaterials science since 1993. He has published 311 scientific papers and 48 books.

Emerging Polyrotaxane Frameworks for Modulating Cellular Functions

Nobuhiko Yui1*

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We have proposed an idea of using supramolecular-framed polyrotaxanes (PRXs) as advanced biomaterials over the last two decades, since one of the dominant parameters to design biomedical functions would be the mobility of molecules constructing materials [1]. In PRXs, many cyclodextrin (CD) molecules are threaded onto a linear polymeric chain capped both terminals with bulky end-groups, and it will be easily imagined that CD molecules can slide and rotate along the linear polymeric chain to affect interaction with cells. Moreover, all the threaded CD molecules will be released to act as nanomedicines if one of the terminals in the PRXs is to be cleaved in a certain intracellular site after their endocytosis. In our systematic studies the most striking feature toward directing cellular functions on PRX surfaces has been clarified to regulate small GTPase proteins in relation to the surface molecular mobility at hydrated states. Cell adhesion is generally mediated via specific interaction between transmembrane integrin and proteins in extracellular matrix, and RhoA and Rac1 are representatives in Rho family of the small GTPase proteins to dominate cytoskeletal signaling pathways in the down streaming process of integrin-mediated cell adhesion. We have found that down-regulated RhoA-ROCK and up-regulated Rac1/cdc42 are observed for stem cells on the PRX surfaces with increasing the molecular mobility. Eventually, osteogenic and adipogenic differentiation from mesenchymal stem cells [2] and cardiomyocyte differentiation and beating colony formation from iPS cells [3] have been already demonstrated on the PRX surfaces with a variety of molecular mobility. Unique property of pH-degradable PRXs is to perform lysosomal β-CD release for ameliorating cholesterol accumulation at lysosomes seen in metabolic disorders such as Niemann Pick type C disease [4]. We have also clarified that such specific characteristics can be effective as novel therapeutics for improving autophagic disorders [5]. Finally, it is concluded that supramolecular biomaterials with molecularly mobile PRX frameworks can perform far-reaching consequences in modulating a variety of cellular functions.

Acknowledgments: Dr. Tetsuji Yamaoka, Dr. Sachiro Kakinoki, National Cerebral and Cardiovascular Center Research Institute, Dr. Ji-Hun Seo, Dr. Atsushi Tamura, and Dr. Yoshinori Arisaka, Tokyo Medical and Dental University, are acknowledged.

Professor Kyung-Sun Kang’s Biographical Summary

Dr. Kyung-Sun Kang was born in 1963 in South Korea (55 years old), where he obtained his degrees at the Seoul National University (B.S., M.S., PhD) in 1993. He was studying for a Ph.D. degree at the College of Veterinary Medicine, Seoul National University from 1991~1993, he worked on the development of drug toxicity animal model systems and anticancer studies. Dr. Kang started research on the adult stem cell biology in Michigan State University in April 1994 as a post-doc and research assistant professor and worked in MSU for 4 years. During staying in USA, he firstly isolated and established human adult stem cells from mammoplasties human breast. This work was first report for human adult stem cells in 1996.

Dr. Kang is a full member of Korean Academy of Science and Technology from 2011. Prof. Kang is currently General Secretary of Korean Society of Stem Cell Research. He is also currently served Editorial board members such as Scientific reports (NPG) etc. He has published 250 original research SCI-indexed papers. His papers were cited >4,400 times. (h-index >44) His major scientific contribution has been to appreciate and develop mass producible druggable stem cell treatments targeting immune diseases. He also research and develop high value-added regenerative therapies such as induced adult stem cells and the generation of artificial human organs from patient somatic cells.
Generation of Human Artificial Mini-Organs; Stem Cells and Organoids

Kyung-Sun Kang

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Organoid system leverages the self-organizing properties of stem cells to create diverse multicellular tissue. Most organoids showed one single tissue or partial component of tissues. Organoids have been generated from both pluripotent stem cells (PSCs) and adult stem cells (ASC) by mimicking biochemical and physical cues of tissue development and understanding human diseases and biology. Recently, we have reported induced Adult stem cells (iASC) technology using human somatic cells. And we are able to show that these iASCs cell can generate tissue specific human organoids mimicking real functional human organs and disease modeling. These 3D organoids can be applying for in vivo modeling such as organogenesis, pathogenesis, drug discovery, toxicity assessment, patient-customized treatment as well as transplantation such as organ surrogates, built-in response, therapeutic transplants and repaired autologous organs in near future.
Professor Greg Dusting’s Biographical Summary
(1 June, 2017)

Prof Greg Dusting (Honorary Professorial Fellow, University of Melbourne) is a distinguished pharmacologist who was appointed inaugural Executive Director Research to the Centre for Eye Research Australia (CERA) in 2012. This followed 5 years as Professor and Director of Tissue Engineering at the O’Brien Institute (OBI) nearby. He was a NHMRC Principal Research Fellow of many years standing, and is internationally renowned for his work on the vascular endothelium, tissue engineering and drug mechanisms in cardiovascular and retinal disease. With his team he continues collaborative work at OBI to build cardiac tissue from stem cells, and has been tackling the causes of aberrant corneal and retinal vascularisation in major retinal diseases, and recently also drug-targetable mechanisms of Age-Related Macular Degeneration. He has attracted new recruits to CERA in stem cell biology and cytoprotective strategies in basic pharmacology, who underpin and interact with the world class clinical and genetics researchers in the major retinal diseases at the core of this program. In 2017 CERA was re-affirmed as ranking number 4 of all Eye Research Institutes in the world, based on research output metrics.

Prof Dusting was elected as Fellow of the British Pharmacological Society in 2005, and in the last 5 years was awarded both the Rand Medal for Pharmacology by ASCEPT (the most prestigious prize established by this Pharmacological Society), and the Heart Foundation Research Medal, for distinguished lifetime contributions to cardiovascular research. His additional appointments include Professorial Fellow of University of Melbourne, adjunct Professor of Australian Catholic University, visiting Professor for cardiac regenerative medicine and tissue engineering in the NHC, SingHealth; ChonBuk National University (2009-2011 BIN Fusion Program), JeonJu, Korea; and the Key Centre for Vascular Re-modelling in Qilu Hospital, Shandong University, China. He has been a key instigator of commercial developments from his research, some with established or new biotech companies, and was the major inventor to invention of two cardiovascular drugs now on the market or in clinical trial. The first (treprostinil) now has a worldwide market exceeding $1 billion pa. The second new lead compound to treat heart attack he invented with his team at the Florey Institute. This NCE is in clinical development, and with major Pharma investment is set to conclude in 2017 a Phase 2 clinical trial for Armaron Bio P/L, the company which he and colleagues founded with venture capital. He is or has been a member of the Editorial Board of 8 scientific journals including Pharmacology and Therapeutics (IF =11) and Tissue Engineering and Regenerative Medicine (IF =1.0). He has trained or mentored 8 full professors of Pharmacology or Medicine, now leading distinguished academies in Australia, USA and China.

He has published more than 300 original research papers, cited >7,000 times (h-index 47). His major scientific contributions have been discovery of roles of the vascular endothelium in vascular and retinal disease, and invention of new therapeutic approaches based on these mechanisms. He is now helping develop a regenerative approach to repair of damaged cornea and cardiac tissue, and new drugs and delivery materials for retinopathies.
A New Polymer Scaffold Suitable to Transplant and Repair Corneal Endothelium After Injury or Disease Causing Blindness

Karl David Brown¹, Berkay Ozcelik² Jean-Pierre Scheerlinck³, Hong Zhang⁴, Greg Dusting¹, Greg Qiao² Mark Daniell¹

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Our research theme is ocular tissue engineering and cell therapy in which chemical engineers, cell biologists, and ophthalmologists collaborate in an integrated manner to cure blinding eye disease. Here we focus on the development of a tissue-engineered corneal endothelium (TCE) to replace donor tissue used for corneal endothelial keratoplasties. Most Asian countries suffer from the lack of availability of corneas from donors.

A TCE consisting of a polyethylene glycol-based hydrogel film (PHF) and confluent cultured corneal endothelial cells (CEC) was developed. The PHF was selected by the following criteria: the ability to be drawn through a Busin’s glide (a funnel used in this surgery), transparency, and optimal CEC proliferation on the surface. The tensile properties of the selected candidates were tested using an Instron Microtester 5848 with a 50N load cell. Films of 1cm² area were subjected to tensile forces until film breakage. Ultimate stresses and strains were 5.2 +/- 0.2 MPa and 61 +/- 3 % respectively; comparable to donor tissue lenticules widely used in such implantation procedures. Thickness was determined by scanning electron microscopy and spectral reflectance showed approximately 50µm, compatible with existing surgical techniques.

Sheep CEC cultured on PHF were positive for the crucial Na⁺K⁺ATPase membrane pump. Cultured CEC density on PHF was 3150 +/- 459 cells/mm²(n=4). Normal CEC density in vivo in sheep was 3150 +/-88 cells/mm² (n=3). In adult ewes (female sheep) endothelial dystrophy was created by surgically removing CEC from a 7mm diameter area of the central cornea to assess the TCE for toxicity, immunogenicity and the ability to clear the cornea of oedema. Controls included PHF without CEC and TCE not placed over the endothelial wound. Sheep were observed for at least 21 days post-surgery and scored for oedema on a validated scale of 0-4, with 0 being completely thin and 4 being maximally thick. Allogeneic TCE was non-toxic and non-immunogenic for >20 days (n=13). When placed over the endothelial wound the implant did indeed abate oedema (final score 0 or 1, 70% n=10). Histology revealed complete degradation of the PHF in TCE-transplanted sheep.
Conclusion- A tissue-engineered corneal endothelium (TCE) consisting of cultured corneal endothelial cells (CEC) on a hydrogel film might well be suitable to replace donor tissue after corneal injuries or disease causing loss of vision.
Plenary Lecture 31 [PL-31]

**Professor Nuno M. Neves’s Biographical Summary**

(March 18th, 2016)

Nuno M. Neves is an Assistant Professor at the Dept. of Polymer Eng. of Univ. Minho in Portugal, where he is Vice-Director of the 3B’s Research Group – Biomaterials, Biodegradables and Biomimetics. This is a research unit of Excellence, directly funded by the Portuguese Foundation for Science and Technology (FCT). The 3B’s Research Group also integrates the PT Associate Laboratory ICVS/3B’s, as homologated by the Portuguese Ministry for Science and High Education, being Nuno M. Neves one of the members of the Board of Directors.

His background education includes: (i) BSc in Polymer Engineering, Univ. Minho, (ii) a Master degree by research on Polymer Engineering and (iii) a PhD on Polymer Science and Engineering, Univ. Minho, Portugal, degree that was prepared in co-operation with the University of Twente, Netherlands. Nuno M. Neves has been involved in biomaterials research since 2002. He has worked several periods abroad at the University of Twente and recently in a sabbatical leave at the University of Tokyo, Japan (at Prof. Kazunori Kataoka's lab). His main area of research is focused on tissue engineering and regenerative medicine strategies using stem cells and advanced drug delivery scaffolds and medical devices.

He is supervising or co-supervising the work of more than 10 post-graduation researchers (including Post-docs and PhD students). The researchers have a multidisciplinary background including, Mat. Sci. Eng., Polymer Eng., Chem. Eng., Chemistry, Biological Eng., Biochemistry, Biology and Applied Biology, Medicine and Dentistry. He is also involved on the Bioengineering program of the Portugal – MIT (Massachusetts Institute of Technology) initiative, lecturing for the biomaterials module and supervising PhD students.

As of March 2016, he is the author of 146 publications listed in the Web of Science (100+ peer reviewed international papers), with h-factor of 29 and a total number of citations of over 2660 (2950 in Scopus). He was invited and currently serves as Academic Editor of PLoS ONE and the peer-reviewed Elsevier Journal on Regenerative Therapy started in January 2015. Nuno M. Neves acts as referee of more than 70 major scientific journals and major international scientific meetings. Furthermore he is routinely invited to review grants and research proposals for the European Commission and for various funding agencies namely in Portugal, Argentina, Austria, Czech, France, Georgia, Germany, Netherlands, New Zealand, Singapore, Slovakia and Slovenia and USA and advisory panels of research labs in France and Croatia.

He recently finished a term as member elected of the Board of the European Chapter of the Tissue Engineering and Regenerative Medicine International Society, having served as member of the Nominating Committee of the European Chapter. He is member of the European Society for Artificial Organs and is currently the responsible for the Tissue Engineering Working Group of the ESAO. He has been serving as officer of the Orthopaedic Biomaterials Special Interest Group (SIG) of the Society for Biomaterials (SFB, USA). He was since its foundation until 2013 a member of the Board of the Portuguese Society for Stem Cells and Cellular Therapies (SPCE-TC).
Selected recent publications (IF>6)
Faia-Torres A.B., …, Neves, N.M. Regulation of human mesenchymal stem cell osteogenesis by specific surface density of fibronectin: A gradient study, ACS Applied Materials and Interfaces, 7 (2015) 2367-2375 (IF:6.7)
Monteiro N., …, Neves, N.M., Instructive nanofibrous scaffold comprising runt-related transcription factor 2 gene delivery for bone tissue engineering, ACS Nano, 8 (2014) 8082-8094 (IF:12.8)
Martins, A., …, Neves, N.M., Osteogenic induction of hBMSCs by electrospun scaffolds with dexamethasone release functionality, Biomaterials, 31 (2010) 5875-5885 (IF:8.5)
Functional Nanofibrous Scaffolds Combined with Stem Cells for Advanced Biomedical Devices and Therapies

Nuno M. Neves\textsuperscript{1,2}

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\textsuperscript{2}ICVS/3B’s, PT Government Associate Laboratory, Braga/Guimarães, Portugal (*nuno@dep.uminho.pt)

Among the various possible embodiments of Advanced Therapies and in particular of Tissue Engineering the use of temporary scaffolds to regenerate tissue defects is one of the key issues. The scaffolds should be specifically designed to create environments that promote tissue development and not merely to support the maintenance of communities of cells. To achieve that goal, highly functional scaffolds may combine specific morphologies and surface chemistry with the local release of bioactive agents.

Many biomaterials have been proposed to produce scaffolds aiming the regeneration of a wealth of human tissues. We have a particular interest in developing systems based in biodegradable polymers. Those demanding applications require a combination of mechanical properties, processability, cell-friendly surfaces and tunable biodegradability that need to be tailored for the specific application envisioned. Those biomaterials are usually processed by different routes into devices with wide range of morphologies such as biodegradable fibers and meshes, films or particles and adaptable to different biomedical applications.

In our approach, we combine the temporary scaffolds populated with therapeutically relevant communities of cells to generate a hybrid implant. For that we have explored different sources of adult and also embryonic stem cells. We are exploring the use of adult MSCs, namely obtained from the bone marrow for the development autologous-based therapies. We also develop strategies based in extra-embryonic tissues, such as the perivascular region of the umbilical cord (Wharton’s Jelly).

This talk will review our latest developments of natural-based biomaterials and scaffolds in combination with stem cells for advanced biomedical devices and therapies.
Professor Andrés J. García’s Biographical Summary

Andrés J. García is the Rae S. and Frank H. Neely Endowed Chair and Regents’ Professor in the Woodruff School of Mechanical Engineering and the Petit Institute for Bioengineering and Bioscience at the Georgia Institute of Technology. He earned a B.S. in Mechanical Engineering with Honors from Cornell University in 1991, and M.S.E. (1992) and Ph.D. (1996) degrees in Bioengineering from the University of Pennsylvania. He completed a post-doctoral fellowship in cell and molecular biology at the School of Medicine of the University of Pennsylvania and then joined the faculty at Georgia Tech in 1998.

Dr. García’s research program integrates innovative engineering, materials science, and cell biology concepts and technologies to create cell-instructive biomaterials for regenerative medicine and generate new knowledge in mechanobiology. This cross-disciplinary effort has resulted in new biomaterial platforms that elicit targeted cellular responses and tissue repair in various biomedical applications, innovative technologies to study and exploit cell adhesive interactions, and new mechanistic insights into the interplay of mechanics and cell biology.

Dr. García is recognized as an international leader in bioengineering as demonstrated by his prestigious scholarly publications, invited presentations at conferences and research programs world-wide, research funding from NIH, NSF and private foundations, and membership on the editorial boards of leading biomaterial and regenerative medicine journals. In addition, his research has generated intellectual property and licensing agreements with start-up and multi-national companies, demonstrating the translational potential and impact of this work. He has received several distinctions, including the NSF CAREER Award, Arthritis Investigator Award, Young Investigator Award from the Society for Biomaterials, Georgia Tech’s Outstanding Interdisciplinary Activities Award, and the Clemson Award for Basic Science from the Society for Biomaterials. He has been recognized as a top Latino educator by the Society of Hispanic Professional Engineers. He is an elected Fellow of Biomaterials Science and Engineering (by the International Union of Societies of Biomaterials Science and Engineering), Fellow of the American Association for the Advancement of Science, Fellow of the American Society of Mechanical Engineers, and Fellow of the American Institute for Medical and Biological Engineering.
Synthetic Hydrogels for Regenerative Medicine

Andrés J. García

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Hydrogels, highly hydrated cross-linked polymer networks, have emerged as powerful synthetic analogs of extracellular matrices for basic cell studies as well as promising biomaterials for regenerative medicine applications. A critical advantage of these synthetic matrices over natural networks is that bioactive functionalities, such as cell adhesive sequences and growth factors, can be incorporated in precise densities while the substrate mechanical properties are independently controlled. We have engineered poly(ethylene glycol) [PEG]-maleimide hydrogels to support the development of stem cell-derived organoids. In another application, we have developed synthetic hydrogels that support improved pancreatic islet engraftment, vascularization and function in diabetic models. These studies establish these biofunctional hydrogels as promising platforms for basic science studies and biomaterial carriers for cell delivery, engraftment and enhanced tissue repair.
Yadong Wang is the William Kepler Whiteford Professor of Bioengineering with adjunct positions in Chemical Engineering and Surgery at the University of Pittsburgh. He obtained his Ph.D. degree in Chemistry at Stanford University in 1999, and performed his postdoctoral studies in biomaterials at MIT. He joined the Bioengineering Department at University of Pittsburgh in 2008 after serving as an assistant professor at the Georgia Institute of Technology for 5 years. His research focuses on creating biomaterials that present controlled chemical, physical, and mechanical signals to cells, tissues and organs. The ultimate goal is to control how the human body interacts with these materials. He is especially interested in applications of biomaterials in the cardiovascular, nervous and musculoskeletal systems. His team enjoys collaborating with other scientists and clinicians who share the same passion in translational research. Current projects include vascular grafts, controlled release of proteins and microfabrication of biomaterials.
My lab works on in situ tissue engineering. We design new polymers for protein delivery and as grafting materials for cardiovascular, ophthalmological and musculoskeletal systems. We use a heparin-based injectable coacervate for the former and a biocompatible elastomer for the latter. For the first topic, the delivery vehicle mimics how growth factors are stored in the extracellular matrix. The coacervate delivery system is effective in multiple growth factors and cytokines in several animal models. I will discuss their applications in angiogenesis and cardiac repair post-infarction. For the second topic—grafting materials, I designed porous grafts made of poly(glycerol sebacate). This material transmits mechanical forces to the cells residing within the grafts and degrades fast to allow infiltration of host cells and deposition of native extracellular matrix. We use these scaffolds for in situ regeneration of blood vessels, cartilage, and bone. The arterial grafts were used to replace a segment of artery in rats. The grafts degrade completely and transform neo-arteries that mimicked native artery mechanically, biochemically, and structurally. We recently embarked on a new aspect of biomaterials—regenerative extracellular matrix. I will report our work on the amazing capability of matrix from zebrafish at regenerating cardiac tissues after infarction in a rodent model.
PLENARY LECTURE (4)

◆ Friday, July 14th

- 9:00 to 10:40 – PL-34~PL-38
- 20min break
- 11:00 to 12:20 – PL-39~PL-42
- Lunch
- 14:00 to 16:00 – PL-43~PL-48
Professor Dongwon Lee’s Biographical Summary

Dr. Dongwon Lee is an Associate Professor in the Department of BIN Fusion Technology and Department of Polymer-Nano Science and Technology, Chonbuk National University, Jeonju. He earned his Ph.D. degree at the Department of Materials Science and Engineering, The University of Florida (US) in 2004. During his studies for Ph.D, he worked as Research Assistant in Particle Engineering Research Center (PERC) to develop engineered nanoparticulates for drug detoxification.

After his Ph.D studies, he became a Postdoctoral fellow in the Department of Internal Medicine at the University of South Florida College of Medicine and James A Haley Veteran’s Hospital. He developed engineered chitosan nanoparticles that can effectively deliver drugs and genes to lung and cancer cells. During his postdoctoral research, he obtained general understanding of biological and animal studies using polymeric nanoparticles. After 2 year’s of postdoctoral studies, he moved to Atlanta to become a Research Associate in the Department of Biomedical Engineering at Georgia Institute of Technology/Emory University, in August, 2006. His research areas were extended to include synthetic polymers and bioimaging. He developed novel chemiluminescent polymer nanoparticles that can image hydrogen peroxide in vitro as well as in vivo. His chemiluminescent polyoxalate nanoparticles was the first imaging agent that could detect hydrogen peroxide in vivo, which was published in Nature Materials (Oct. 2008). The novel nanoparticles has attracted enormous attentions in the field of polymer science and biomedical engineering and bioimaging and initiated extensive research on reactive oxygen species worldwide.

In Sep. 2008, Dr. Lee came back to Korea to be an Assistant Professor in Department of Polymer-Nano Science and Technology, Chonbuk National University, Jeonju. His main research interests include stimulus-responsive polymers for drug delivery system, biodegradable scaffold-based tissue engineering, bioimaging, theragnostics and polymeric prodrugs. His research achievements include more than 50 papers published in peer-reviewed journals including Nature Materials, Nature communications, Advanced Functional Materials, Biomaterials, Journal of Controlled Release.
H$_2$O$_2$-Activatable Engineered Nanoparticles for Ultrasound Imaging and Anti-Inflammatory Therapy for Oxidative Stress-Associated Diseases

Changsun Kang, Donghyuck Yoo, Eunkyung Jung, Joungyoun Noh, Dongwon Lee

Department of PolymerNano Science and Technology, Department of BIN Fusion Technology, Chonbuk National University, 567 Baekje-daero, Jeonju, Chonbu, 54896 Korea (South)
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Ultrasonography has been extensively used for detection of muscle and tendon injuries, but it is challenging to find right diagnosis of minor musculoskeletal injuries by conventional ultrasonographic imaging. Overproduction of hydrogen peroxide (H2O2) is commonly implicated in tissue damages such as mechanical injury and therefore H2O2 exhibits tremendous potential as a diagnostic and therapeutic biomarker for musculoskeletal injuries. We previously developed poly(vanillyl alcohol-co-oxalate) (PVAX), which rapidly scavenges H2O2 and exerts antioxidant and anti-inflammatory activity in H2O2-associated diseases. On the basis of the hypothesis that H2O2-mediated hydrolysis of PVAX nanoparticles generates CO2 bubbles which could enhance ultrasound contrast significantly, we studied the translational potential of PVAX nanoparticles as a H2O2-activatable ultrasound contrast agent and therapeutic agent for musculoskeletal injuries. Contusion injury in skeletal muscles and Achilles tendons displayed a significantly elevated level of H2O2. Upon intramuscular injection, PVAX nanoparticles significantly enhanced the ultrasound contrast and inhibited contusion-mediated inflammation and apoptosis in the musculoskeletal system. We anticipate that PVAX nanoparticles hold great potential as theranostic agents for musculoskeletal injuries.
Professor Hong Kyun Kim’s Biographical Summary

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Dept. of Ophthalmology,
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Education
1989-1995   Bachelor, Kyungpook National University School of medicine
2006-2008   PhD, Kyungpook National University School of medicine

Residency
1996-2000 Resident training for Ophthalmology, Kyungpook National University Hospital,
Daegu, Korea

License and academic membership
1995   Medical Doctor License
2000   Korean Board of ophthalmology

- Vice president, Biomedical research institute, Kyungpook National University Hospital (2015 ~)
- Executive director, Korean External Eye Disease Society (2010 - 2011)
- Executive director, Korean Society of Cataract and Refractive Surgery (2005 - )
- CTO, Keyem’s Lab. LLC.

Academic Appointments/Positions
2003. 5 - 2005. 7 : Assistant Professor in the Dongguk University School of medicine
2005. 7 - 2009. 5 : Clinical Assistant Prof. in Kyungpook National University hospital
2009. 5 - 2011. 8 : Assistant Prof. in the Kyungpook National University School of medicine
2011. 8 - 2013. 7 : Visiting Scholar in Wake-Forest University Institute for Regenerative Medicine
(Winston-Salme, NC. US)
2013.10 - Associate Professor in Kyungpook National University School of Medicine

Award Lists
1. Slit illumination in anterior segment surgery. Video presentation Winner, 95th Korean
Ophthalmologic Society Congress
2. Various illumination methods in anterior segment surgery. Video presentation. Winner, 100th
Korean Ophthalmologic Society Congress
3. Capsular bag distension due to inflammatory reaction after cataract surgery. Posters of interest.
2006 ASCRS.
4. Intracameral Bevacizumab in eyes with iris neovascularization. Honorable mention, 2007 ASCRS
Plenary Lecture 35 [PL-35]

congress poster presentation.
5. Fibrin Glue in ocular surface surgery. 1st Prize, 2007 ESCRS film competition.
7. Digital Axis marking technique. 1st Prize 2009 ESCRS film competition.
Generation of Decellularized Corneal Lenticule Using Hypotonic Trypsin-EDTA for Corneal Tissue Engineering

Man-Il Huh, Kyung-Pil Lee, Hong Kyun Kim*

Department of Ophthalmology, Kyungpook National University School of Medicine, Daegu, Korea(South)
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For bioengineering corneal substitutes, the scaffold should be transparent, biocompatible and mechanically stable. The dCL has the same structure and composition as the natural and would be suitable for the ideal scaffold. To select the optimized condition for the decellularization of corneal tissue, we compared the decellularization efficacy of the several reagents with different tonicities. The decellularization with Trypsin-EDTA in hypotonic Tris buffer (10 mM, pH 7.6) showed the best condition for the complete removal of cellular contents, which was confirmed by 4', 6-diamidino-2-phenylindole (DAPI) and vimentin staining. Hypotonic Trypsin-EDTA decellularization protocol showed highly effective, biocompatible with the minimal DNA contents. Collectively, we could generate the ideal acellular corneal lenticule using the novel method. Furthermore, it is possible to be a scaffold making bioengineered corneal substitute.

Acknowledgement: This research was supported by Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Science, ICT & Future Planning (NRF-2012R1A1A1010163 and NRF-2013R1A6A3A01063261).
Professor Guoping Chen’s Biographical Summary
(Jun 6th, 2017)

Prof. Guoping Chen received his Ph.D. from Kyoto University in 1997 majoring in Biomaterials and did postdoctoral research until 2000. He became a researcher in 2000 and a senior researcher in 2003 at Tissue Engineering Research Center, National Institute for Advanced Industrial Science and Technology, Japan. He moved to Biomaterials Center, National Institute for Materials Science as a senior researcher in 2004 and was promoted to group leader in January, 2007. He was Principal Investigator and Unit Director of Tissue Regeneration Materials Unit from April, 2011 to March, 2017. He is also a Professor of Joint Doctoral Program in Materials Science and Engineering, Graduate School of Pure and Applied Science, University of Tsukuba. His research interests include tissue engineering, polymeric porous scaffolds, nonbiomaterials, biomimetic biomaterials, nano/micro-patternning and surface modification. He has authored more than 260 publications and holds 18 issued patents. He has given more than 140 invited lectures at conferences. He is an Associate Editor of Journal of Materials Chemistry B; an Editor of Science China Chemistry and Editorial Boards of Journal of Bioactive and Compatible Polymers, Tissue Engineering (Parts A, B and C) and Journal of Tissue Engineering and Regenerative Medicine. He also currently serves as Member-at-Large of Tissue Engineering and Regenerative Medicine International Society’s Asian-Pacific Chapter and Director of Japanese Society for Biomaterials. He has been selected Fellow of the Royal Society of Chemistry in 2015 and Fellow of the American Institute for Medical and Biological Engineering (AIMBE) in 2017.
Preparation of Biomimetic Matrices for Controlling Stem Cell Functions

Guoping Chen¹ *, Rong Cai² and Naoki Kawazoe³

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Extracellular matrices (ECM) play an important role in controlling cell functions. ECM are tissue-specific and dynamically remodelled during the development of each tissue and organ. We have established a method to prepare development-mimicking ECM by stepwise differentiation of human bone marrow-derived mesenchymal stem cells (MSCs). In this study, ECM mimicking the osteogenesis-co-adipogenesis of MSCs were prepared.

MSCs were cultured in mixture media composed of osteogenic medium (OM) and adipogenic medium (AM) at different ratios of 95/5, 85/15, 70/30 and 50/50. The cells were cultured in the mixture media for 7, 14 and 21 days. The progress of simultaneous osteogenic and adipogenic differentiation of MSCs was confirmed by histological staining and related gene expression. MSCs cultured in O85A15 for 1 week showed early osteogenesis and early adipogenesis (EOEA). MSCs cultured in O50A50 for 2 weeks showed early osteogenesis and late adipogenesis (EOLA). MSCs cultured in O95A5 for 3 weeks were at a stage of late osteogenesis and early adipogenesis (LOEA). MSCs cultured in O70A30 for 3 weeks were at a stage of late osteogenesis and late adipogenesis (LOLA). MSCs cultured in basal medium for 1 week were defined as cells at the undifferentiated stem cell stage (SC). The cells were decellularized to prepare their respective matrices. OEAE, OLAE, OELA, OLAL and SC matrices were prepared after decellularization. The matrices were used for culture of MSCs to investigate their effect on adhesion, proliferation, osteogenic and adipogenic differentiation of MSCs. The stepwise osteogenesis-co-adipogenesis-mimicking matrices had different compositions depending on the stage of osteogenesis-co-adipogenesis. They supported adhesion and proliferation of MSCs. They had different effect on differentiation of MSCs. LOEA and LOLA matrices promoted osteogenic differentiation but not adipogenic differentiation of MSCs. EOE matrices promoted adipogenic differentiation but not osteogenic differentiation of MSCs. EOLA did not promote either osteogenic or adipogenic differentiation of MSCs. The stepwise osteogenesis-co-adipogenesis-mimicking matrices should be useful for controlling stem cell differentiation.

Acknowledgment: This study was supported by KAKENHI Grant Number 15H03027 from the Ministry of Education, Culture, Sports, Science and Technology, Japan.
Professor Iulian Antoniac’s Biographical Summary
(Feb 1st, 2017)

Dr. Iulian Antoniac was born in 1972 in Romania (45 years old), where he obtained his degrees at the University Politehnica of Bucharest (M.E., Ph.D. and PostDoc in Materials Science). Since 2002, he has been associated with the Medical Engineering program in the Faculty Materials Science and Engineering, University Politehnica of Bucharest, which is focused on biomaterials obtaining and characterization, medical image processing and the development of new implants for medical applications. Dr. Iulian Antoniac is the leader of the Biomaterials Group, head of the Biomaterials & Interface Phenomenon Laboratory, full professor at Faculty Materials Science and Engineering. He was appointed ViceDean of Faculty Materials Science and Engineering and member of the Senate of University Politehnica of Bucharest in 2016. Dr. Antoniac’s research interests include: metallic and polymeric biomaterials for orthopedic and dental applications, bioceramics, biocomposites, retrieval analysis of explants, microscopy techniques for materials characterization, bone regeneration, physical and chemical characterization of nano- and micro- particles for biomedical application.

Dr. Antoniac is currently Vice President and Council Member of the Romanian Society for Biomaterials (SRB), Former President and permanent Member of Executive Committee of the International Society for Ceramics in Medicine (ISCM).

From 2016, he is the Editor-in-Chief of the Material Science Forum. Also, he serves as member of the Editorial Board for many scientific journals.

He has published widely, with over 200 papers published in peer-reviewed journals and conference proceedings, 7 patents, several editorials and books (like Handbook of Bioceramics and Biocomposites) and many invited lectures at conferences focused on biomaterials, bioceramics, polymers, materials science and tissue engineering. His major scientific contribution has been to appreciate and analyse the importance of bioceramics, biocomposites, biodegradable metallic and polymeric biomaterials, surface modification, interaction tissue-biomaterials, biointerfaces, bone regeneration, retrieval and failure analysis of orthopedic and dental implants.
Biodegradable Polymers and Polymer-Based Composites for ACL Reconstruction Screws: Advantages, Limitations and Current Trends

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Various biodegradable and biocompatible polymers, of both synthetic and natural origin, have been developed for orthopedic applications. To overcome the limitations of metallic implant, biocompatible and biodegradable polylactic acid polymer implants were developed for orthopedic surgical interventions like anterior cruciate ligament (ACL) reconstruction. Polylactic acid polymer interference screws are commonly used in ACL reconstructions, especially in proximal tibia fixation. However, several concerns have been raised, including the acid products during its degradation in vivo.

The analysis of retrieved ACL reconstruction screw appears to be a useful tool to evaluate the performance of these implants in human body environment. Until now, the main option to improve the mechanical properties and biodegradation of polymeric ACL screw was to develop new composite materials by reinforcing the polymeric matrix with biodegradable ceramics like β-tricalcium phosphate (βTP) or hydroxyapatite (HA). The addition of βTP or HA, can accelerate the incorporation of tendon grafts into bone tunnels and provide better mechanical properties. Use of composite interference screws may lead to earlier and stronger graft incorporation, replacement of the screws with cancellous bone, and easier revision surgery. But the degradation kinetics differ substantially among different bioabsorbable polymers and numerous factors affect degradation rates, including molecular weight, sterilization, implant size, self-reinforcement, copolymer or stereocopolymer ratios, and processing techniques.

The presentation summarizes the recent progress in PLA-based biomaterials for bone, ligament, cartilage, and meniscus regeneration.
Plenary Lecture 38 [PL-38]

Professor Kazuhiko Ishihara’s Biographical Summary
(Feb 1st, 2017)

Prof. Kazuhiko Ishihara graduated Waseda University, Tokyo, Japan (Applied Chemistry) in 1984 and had PhD degree of engineering. After that, he has been in Sagami Chemical Research Center (1984-1986), Tokyo Medical and Dental University as an assistant professor (1987-1990) and as an associate professor (1991-1998). He moved to The University Tokyo in 1998 and has been a full professorship since 2000. He has been an organizer and a principal researcher of research group, which has been conducted by a Grant-in-Aid for Scientific Research on Innovative Areas “Nanomedicine Molecular Science” from Ministry of Education, Culture, Sports, Science, and Technology of Japan since 2011.

He has research interests include polymer biomaterials, cell and material interactions, blood/bio compatibility of materials, artificial cell membrane, photoreaction on the polymer surfaces, nano/micro diagnostic system, and biointerfaces.

He published more than 570 research articles, 230 reviews and book chapters in his research career. Most importantly, he has developed essential synthetic process of 2-methacryloyloxyethyl phosphorylcholine (MPC) and its polymers as biomaterials. The MPC and MPC polymers are now commercially available and applied for medical devices in various fields worldwide.

He is active member of Society of Polymer Science Japan, Japanese Society of Biomaterials, Japanese Society of Materials Science, American Chemical Society, and Society for Biomaterials. He is a former President of the Japanese Society for Biomaterials. He belongs in two significant College of Fellows in American Institute of Medical and Biological Engineering (AIBME) and International Union of Societies Biomaterial Science and Engineering (IUSBSE).

Phospholipid Polymer Soft-Biomaterials for Advanced Cell Engineering

Kazuhiko Ishihara

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Temporal and spatial encapsulation of the cells by polymer hydrogels is getting an attention as a novel way to handle cells in the 3-D conditions. We have provided spontaneously forming and reversibly dissociating polymer hydrogel matrix composed of two kinds of cytocompatible pre-polymers [1]. These pre-polymers were poly(2-methacryloyloxyethyl phosphorylcholine (MPC)-co-n-butyl methacrylate (BMA)-co-p-vinylphenylboronic acid (VPBA)) (PMBV) and poly(vinyl alcohol) (PVA). Through its gelation process, cells could be encapsulated in the hydrogel under mild cell culturing conditions. This PMBV/PVA hydrogel could be dissociated by addition of natural sugar compounds. The storage modulus of the PMBV/PVA hydrogel matrix was controlled between 0.3 kPa and 2.5 kPa, that corresponded to very soft natural tissue [2]. The proliferation rates of murine pluripotent stem cell, C3H10T1/2 were influenced by the storage modulus of the PMBV/PVA hydrogel matrix [3,4]. When the storage modulus of The PMBV/PVA hydrogel was above 1.0 kPa, the proliferation rate of cells was suppressed and provided uniformed cells in G1-phase as up to 95%. As the storage modulus was lowered to 0.7 kPa by swelling with cell culture medium, the cells restarted their proliferation process. At this time, differentiation signal molecules (BMP) reacted with encapsulated C3H10T1/2 cells effectively (4-5 times higher compared with that of normal cell culture condition on tissue culture plate), and the cells transformed to osteoblast cells. This is a novel way to control large amount of cell proliferation.

Acknowledgment:
The research was supported by a Grant-in-Aid for Scientific Research (B) (26282135). The author makes special thank to Dr. Haruka Oda and Dr. Tomohiro Konno, The University of Tokyo.

Professor Manuela E. Gomes’s Biographical Summary
(May 2017)

Manuela E. Gomes graduated in Metallurgical and Materials Engineering, University of Porto, Portugal in 1997, obtained the MSc in Polymer Engineering, Univ. of Minho in 2001 and the PhD in Materials Science and Engineering – Tissue Engineering/Hybrid Materials in collaboration with the Rice University (USA) in 2005. In 2005 she was awarded with a Post-doc fellowship of the FCT (Portuguese Science Foundation) and from January to June of 2007 she continued developing her work at the 3B’s Group as an Assistant Researcher, under the scope of the NoE EXPERTTISSUES. From July 2007 to August 2013 she was Invited Assistant Professor (100%) of the MIT-Portugal Program. In 2013 she was awarded with a Career Development Grant from the Portuguese Science Foundation (FCT) that supported her position as Principal Investigator. In 2016 she was awarded with a Consolidator Grant from FCT which supported her position as Coordinator Investigator until she was recently nominated Associate Professor of the 3B’s Research Group of the University of Minho. She was a founder researcher of the 3B’s Research Group and from 2011 she is one of the Vice-Directors Group.

Manuela E. Gomes is editor of 2 books and author of 34 book chapters, 145 full papers published in international refereed journals, and more than 215 communications (h factor = 34). She has been invited to give 31 seminars in internationally conferences and advanced schools. In 2013 he received TERMIS-EU Young Investigator Award, in Istanbul, Turkey, in recognition of outstanding achievements in the field of tissue engineering and regenerative medicine research during the early stages of the career.

Manuela E. Gomes is an active member of several International Scientific Organizations namely, particularly of the Tissue Engineering and Regenerative Medicine International Society (TERMIS), being currently Council member of the TERMIS-EU (2nd term), Chair of the TERMIS Editorial Committee (EU, AM and AP chapters) and chair of the TERMIS-EU Communication and Outreach Committee.

Her research interests focus on bone, cartilage and more recently, tendon and ligament tissue engineering strategies, particularly in the design of specific scaffold designs to direct the differentiation of stem cells from different sources using synergies between (nano) structural, biochemical and mechanical/magnetic stimulus. More recently, her research has been also focusing on magnetic TE approaches, stimulating stem cells previously bonded to magnetic nanoparticles or onto magnetic scaffolds/hydrogels and using the application of external magnetic fields to control/modulate the in vivo response.
Tendon Tissue Engineering Approaches Using Magnetic Stimulus

Manuela E. Gomes\textsuperscript{1,2}

\textsuperscript{1} 3B’s Research Group – Biomaterials, Biodegradables and Biomimetics, University of Minho, Headquarters of the European Institute of Excellence on Tissue Engineering and Regenerative Medicine, AvePark – Parque de Ciência e Tecnologia, Zona Industrial da Gandra, 4805-017, Barco GMR, Portugal

\textsuperscript{2} ICVS/3B’s – PT Government Associate Laboratory, Braga/Guimarães, Portugal

The development of tissue engineering (TE) approaches for tendon regeneration requires biomechanically-stimulating culture environments as tendon tissue functionality is known to be highly dependent on mechanical loading. That can be achieved modulating the scaffold architecture, properties and composition. The incorporation of magnetic nanoparticles (MNPs) within 3D constructs constitutes a novel and attractive strategy towards the development of magnetically-responsive system that may eventually combine therapeutic and diagnostic functionalities. An additional advantage is that cells naturally respond to magnetic forces, and consequently, the application of a magnetic field may enhance stem cells biological performance, and ultimately stimulate cell proliferation and/or differentiation. This work reports on recent studies concerning the development of specific scaffolds architectures based on various polymers, doped with MNPs and fabricated using different technologies enabling responsive systems for culturing stem cells, stimulating their tenogenic differentiation. Moreover, we hypothesized that ex-vivo application of pulsed electromagnetic field therapy (PEMF) applied in combination with magnetic responsive materials, may also enable to modulate the inflammatory response and consequently promote a better tissue regeneration.

Acknowledgment

FCT (Fundação para a Ciência e Tecnologia), for the Career Consolidation Grant IF/00593/2015 (MEG). Project “Accelerating tissue engineering and personalized medicine discoveries by the integration of key enabling nanotechnologies, marine-derived biomaterials and stem cells”, supported by Norte Portugal Regional Operational Programme (NORTE 2020), under the PORTUGAL 2020 Partnership Agreement, through the European Regional Development Fund (ERDF).
Professor Antonella Motta’s Biographical Summary  
(May 7th, 2017)

After ten years research activity at the Experimental Silk Center in Milan (Italy), Antonella Motta got an appointment as Assistant Professor at the Department of Materials Engineering and Industrial Technologies of the University of Trento, Italy, and then as Associate professor at Department of Industrial Engineering.

The research topics include polymer-based materials for regenerative medicine applications, chemical-physical and biological characterization of materials for biomedical use, interactions between implants materials, proteins and cells, protein based materials, immobilization and adhesion mechanisms of proteins and cells, blood-contacting materials, nanostructured materials for biomedical applications; in particular, a 20 years experience on silk-based matrices design for application in tissue engineering such as bone, cartilage, brain, myocardium regeneration.

Editor-in-Chief of Journal of Biomaterials, Polymer Edition; Associate Editor of Journal of Bioactive and Compatible Polymers; Member of the Scientific Editorial Board of International Journals, and referee for international Journals in the Biomaterials and Biomedical Technologies field.

Visiting professor in several Universities, i.e. Tufts University (Boston, MA, USA), Chulalongkorn University (Bangkok, Thailand), University of Texas at Arlington (Arlington, TX, USA), University of Colorado at Boulder (Boulder, CO, USA).

Member of TERMIS-EU Council since 2015 and chair of TERMIS Endorsement Committee starting from 2018 .

Polymers Designed by Nature: Rational, Strategies, Processing

Antonella Motta

Department of Industrial Engineering and BIOtech Research Center, University of Trento, Via Sommarive 9, 38123 Trento, Italy
European Institute of Excellence in Tissue Engineering and Regenerative Medicine, Trento Unit, Italy
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Natural materials have been designed by Nature with properties apt to respond in a proper way to complex requirements, multifunctional, dynamic, environment or stimuli responsive, and have been produced by Nature assembling a limited number of “cheap basic building blocks”. This is the case of proteins, where a few amino acidic sequences make up the estimated 50,000 proteins of the human body. In addition, many natural materials possess unique properties in terms of ability to interact with the biological environment in particular controlling its response and in the case of biomedical applications the biocompatibility pathway and for TE the regeneration process. Using “green” procedures, starting from raw biopolymers isolated from different organisms, multifunctional systems can be produced with composition and structure required by cells to promote and realize the tissue repair or regeneration.

This concept has been extensively studied and applied in the last years to the design and fabrication of scaffolds for tissue engineering strategies.

The lecture regards the fabrication of nature-derived materials, biopolymers’ structure and function, and the use of natural-based polymers for the fabrication of bioactive scaffolds for tissue engineering applications. Specific examples will be presented.
Dr. Dongin (Donoven), Kim’s primary research goal, is to marry therapeutic and diagnostic tools to enable theranostic research that can be applied in clinical applications for diagnosing, monitoring, and treating a variety of diseases, including cancer and heart disease. He has experience in the development of novel ‘theranostic’ (therapeutic + diagnostic) nanoparticle based drug delivery and diagnostic system over 15 years ranging from chemical synthesis and formulations to biological (in vitro, and in vivo) validation.

Dr. Kim completed his B.S. in Applied Chemistry at Ajou University (Korea). After that, he committed to research and received his MS in Materials Science and Engineering in 2002 from University of Florida. His research was focused on the interaction between nanoparticle with blood components during the systemic injection of the nanoparticle. Then, he continued to his research and received Ph.D. in Pharmaceutics and Pharmaceutical Chemistry in 2009 from University of Utah. He investigated the pH-sensitive micelle for overcoming multidrug resistant tumor. After completing his doctoral studies, he trained as a Post-Doc in the Biomedical engineering department at Georgia Institute of Technology. In 2011, Dr. Kim began T-32 Post-doc at the Yale University in the Department of Biomedical Engineering and Internal Medicine and his researches aimed to develop the synergistic nanoparticle for anticancer immunotherapy and the nanoparticle-based new CT contrast imaging agent. Then, he became an Associate Research Scientist at Yale University in Department of Biomedical Engineering from 2014 to 2015.

Currently, Dr. Kim is an Assistant Professor at Texas A&M Health Science Center, Irma Lerma Rangel College of Pharmacy, and Department of Pharmaceutical Sciences.

He has authored and co-authored 34 research articles including Nature Materials, Nature Nanotechnology, Nature Medicine, Small, and Angewandte Chemie International Edition as well as three patents and his works have been cited more than ~2100 times with h-index 17.

Dr. Kim is eager to apply his interdisciplinary background to an efficient and translation-focused research dedicated to the development of novel therapies and diagnostics for the treatment of diseases for the translational research and to train future scientists.
Novel Approach for The Micrometastasis Cancer Detection Using A Nanoparticle Platform

Ayesha B. Alvero\(^{2}\), Gil Mor\(^{2}\) and Dongin Kim\(^{1,\ast}\)

\(^{1}\)Department of Pharmaceutical Sciences, Irma Lerma Rangel College of Pharmacy, Texas A&M University System, Health Science Center, Reynolds Medical Building, Suite 159, Mail Stop 1114, College Station, TX 77843-1114 USA

\(^{2}\)Division of Reproductive Sciences, Department of Obstetrics, Gynecology and Reproductive Sciences, Yale University School of Medicine, New Haven, CT

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Patients with epithelial ovarian cancer have the best overall survival when maximal surgical effort is accomplished. However, despite numerous technological advances, surgery still relies primarily on white-light reflectance and the surgeon’s vision. As such, micrometastases are usually missed and most patients clinically classified as a complete responder eventually recur and succumb to the disease. Our objective is to develop optical enhancers which can aid in the visualization of ovarian cancer micrometastasis. To this end we developed a nanoparticle (NP) platform, which is specifically targeted to the tumor microenvironment. Targeting is achieved by coating FDA-approved PLGA-PEG NP with the peptide sequence RGD, which binds with high affinity to αVβ3 integrins present in both the tumor-associated neovasculature and on the surface of ovarian cancer cells. Administration of the NP platform carrying fluorescent dyes to mice bearing intraperitoneal ovarian cancer allowed visualization of tumor-associated vasculature and its contrast against normal blood vessels. More importantly, we demonstrate the visualization of intraperitoneal ovarian cancer micrometastasis as small as 100\(\mu\)m with optimal resolution. Finally, we demonstrate that the fluorescent dye cargo was able to penetrate intra-tumorally. Such modality could be used to allow microscopic surgical debulking to assure maximal surgical effort.
Dr. Chan Hum Park was born in 1969 in Korea(South), I graduated the Hallym University Medical School(M.D.) in 1996. I obtained Ph.D. degree from KangWon National University, Korea. I have been working in chief(associate professor) of the department of Otorhinolaryngology Head & Neck Surgery in Chunchon Sacred Heart Hospital of Hallym Medical Center from 2004. My major study’s field of medical part is the facial surgery and reconstruction such as rhinoplasty, facial trauma, skin cancer etc. I studied the biomaterials for facial reconstruction such as Gore-Tex, Silicone, metal plate, absorbable fixation plate etc. And I was developing biomaterials using silk fibroin from 2008. I had been awarded the research grants(Rural development administration : fifty million USD for 4 years). For this study, I founded the Nano Bio Regenerative Medical Institute and was working as the chief. Through the various methods such as freezing, electrospinning and electrospray, I developed the artificial dermis, tympanic membrane, absorbable fixation plate, artificial bone, tendon and wound dressing materials. And I developed the world’s first artificial tympanic membrane from silk fibroin and achieved the KFDA’s approval. Tympanic membrane using silk fibroin was commercialized in 2012.

Nowadays, our lab focus on stem cell and iPs for regenerative medicine(cardiac cell sheet, cornea regenerative medicine).

My another study’s field is the developing of medical electronic devices. Previously, I was developed the medical imaging system based on wireless camera, LED based medical light sources, and medical head light system, medical data base software (Image chart: Eastsoft) in 2003. I worked the computer and electronic department of the Illinois University as the visiting professor in 2009-2010. Recently, I am developing the wound healing system using microplasma jet in regenerative medicine. And as the artificial tympanic membrane, I achieved KFDA approval and commercialization of biomaterial using the silk fibroin.

I am a member of Tissue Engineering and Regenerative Medicine International Society, Society for Biomaterials, World rhinologic society. I have co-authored or edited 7 books. I have published over 120 original research papers.

I have great experiences and technology not only a medical doctor but the technical knowledge of biomaterial and electrical engineering.
Applications of Silk Biomaterials Using 3D Printing in Tissue Engineering

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Silk fibroin (SF) of silkworms has been used as cloths and simply suture materials in medical filed before very long time ago. But recently, SF has been widely studied as biomaterials and engineering fields. In the biomedical field, SF is being developed such as dermal substitute, tympanic membrane, bone and drug delivery. As new direction or way for SF applications it is being developed electronics, photonics, MEMS and microfluidics in engineering field. Recently, three-dimensional printing is a fast-growing trend in tissue engineering due to its ability to fabricate patient-specific scaffolds with well-controlled porous architecture and the capability of printing cells in 3D configurations. Nowadays, 3D printing is popularly used for tissue engineering and regenerative medicine. Because it is easy to make detail and customized structures. This presentation will focus on fabrication, characterization, and outcomes of SF biomaterials using 3D printer.
Professor Nesrin Hasirci’s Biographical Summary

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Member: METU-BIOMATEN, Biomaterials and Tissue Engineering Center of Excellence
Member of METU Graduate Departments: Biotechnology, Biomedical Engineering, Micro and Nanotechnology, Polymer Science and Technology

Dr. Nesrin Hasirci has received her master and Ph.D. degrees from METU (Middle East Technical University) at Ankara, Turkey. She is working on Biomaterials and Tissue Engineering applications of polymers and composites. Her works cover the synthesis and modification of biomaterials, controlled and targeted micro and nano drug delivery systems, bone cements, enzyme immobilization, scaffolds prepared by 3D printing technology and investigation of surface-cell interactions. She had been at Drexel University (Pennsylvania, USA) for Post-Doc studies the years of 1982-1984; and at MIT (Cambridge, USA) as Visiting Professor granted by Fulbright Commission during the years 1994-1995.

Prof. Hasirci has more than 200 papers published in refereed scientific journals, 17 chapters in scientific books, 1 edited book, 5 patents approved or filed. She has attended more than 450 congress, conferences and symposia where more than 100 of them were invited. Dr. Nesrin Hasirci supervised or been as co-supervisor of 50 master and 21 Ph.D. theses. She organized or been in the organization committees of more than 50 conferences, symposia and workshops.

Dr. Nesrin Hasirci is a member of numerous scientific Societies, such as European Society of Biomaterials, Tissue Engineering and Regenerative Medicine Society, Controlled Release Society, Turkish Fulbright Alumni Association, Turkish Biomaterials and Tissue Engineering Society, Turkish Polymer Science and Technology Society, Turkish Chemical Society, and also she is a member of the Stirring Committee of Medical Industry Group of OSTIM.

She is one of the founder and the first Head of the Graduate Department of Biomedical Engineering established at METU. She also administered as Head of the Graduate Department of Biotechnology twice at different periods.

Dr. Nesrin Hasirci received the University Awards (given in every year to the successful scientists of the previous year) since 2001 in every year. She also received ‘Science Award’ given by Parlar Foundation, and ‘Technology Award’ given by Elginkan Foundation in Turkey. Prof. Nesrin Hasirci is an elected member of ‘Science Academy’ in Turkey.
Micro and Nano Modifications of Surface and Bulk Properties of Polymeric Biomaterials

Nesrin Hasirci

BIOMATEN – METU Center of Excellence in Biomaterials and Tissue Engineering, Middle East Technical University, Department of Chemistry, Graduate Departments of Biomedical Engineering; Biotechnology; Micro and Nanotechnology; Polymer Science and Technology, Ankara, Turkey
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Materials used in medicine to treat, support or augment the damaged tissues of the biological system are either obtained from natural sources or produced in the labs. For medical applications, although polymers are preferable due to their versatility, easy production and being economical, still they may not have the required bioactivity and need to be modified either by blending with other natural or synthetic polymers, by combining inorganic particles and fibers, by adding micro and nano drug carriers, or by grafting and immobilizing molecules on their surfaces. Some polymers are stable and stay at the implantation area for the life time of the patient while some are preferred to be degradable after the healing of the tissue. This depends the application area, and in each case it is essential that the material should be biocompatible, and if possible, bioactive. In the recent decades, multifunctional biomaterials having tunable properties, such as those with antibacterial, antithrombogenic, angiogenetic properties and enhance cell adhesion and proliferation, and therefore, lead to fast and proper healing of the host tissue, have gained increasing importance in tissue engineering applications.

In this presentation, multifunctional macro, micro and nano systems, 3D bioprinted scaffolds prepared from polymers and used in tissue engineering applications will be discussed. The techniques applied in the modifications and the results obtained after in vitro and in vivo applications will be summarized.

Acknowledgments: We gratefully acknowledge the Turkish Ministry of Development for the grant (DPT2012K120870) for the establishment of METU BIOMATEN, METU for the grant BAP-01-08-2013-003. Author also would like to thank TUBITAK and METU-BAP Grants for supporting the students.
Professor Jen-Ming Yang’s Biographical Summary

Jen Ming Yang is currently a Professor in department of Chemical and Materials Engineering at Chang Gung University, Research Fellow (joint appointment) of Chang Gung Memorial Hospital, Linkou, President of Taiwan Society of Blood Biomaterials, and Council of Tissue Engineering and Regenerative Medicine International Society -Asia-Pacific Chapter (TERMIS-AP). He is one of the editors of two international journals, MOJ Polymer Science and Material Science & Engineering International Journal. Prof. Yang received his Bachelor’s Degree in Chemistry at National Taiwan University in 1980. Two years later, he obtained a Master Degree in Polymer Science at National Tsing Hua University, and in 1990 he received his PhD in the same field. From 1990 to 1991 he continued his studies at the University of California at Berkeley, and achieved his Postdoctorate degree in Polymer Science. From Aug, 2002 to Jul. 2003 he had been a visiting scholar of Prof. Langer’s group at Massachusetts Institute of Technology. Prof. Langer is one of the prestigious and outstanding pioneers in the fields of Tissue Engineering, Biomaterials and Drug Controlled Release. Currently, Prof. Yang’s field of research encompasses Polymer Science, Membrane, and Biomaterials. He has been board member of some societies and conferences. He has also presented keynote and invited speeches at many conferences and hosted international conferences. His research interests include Hydrogels, Polyelectrolytes, Polymeric Nanomaterials and Nanostructured Polymers, Polymers at Surfaces and Interfaces, Biomedical Applications of Polymer, and Polymers for Energy Applications.
Acrylic Bone Cement

Jen-Ming Yang

Department of Chemical and Materials Engineering, Chang Gung University, Tao-Yuan, Taiwan
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Poly(methyl methacrylate) (PMMA), a strong, tough, and lightweight material also known as acrylic, is a transparent thermoplastic. As PMMA has good compatibility with human tissue, it is widely used in medical technologies and implants. PMMA is used as bone cement in orthopedic surgery to affix implants and to remodel lost bone. Basically, the chemical composition of PMMA bone cement consists of a solid powder and a liquid component. When PMMA bone cement is used for surgery, some major problems are found. (1) Due to unreacted monomer release, MMA is considered to be an irritant and a possible carcinogen and resulting in chemical necrosis. (2) Bone cement does not bond to either the bone or the implant, so poor cement distribution around the implant is found. (3) It heats up to 82.5 °C while setting that may cause thermal necrosis of neighboring tissue. (4) The effect of stress shielding occurs when PMMA cement is used. Since PMMA has a Young's modulus between 1.8 and 3.1 GPa, which is lower than that of natural bone (around 14 GPa for human cortical bone). (5) Shrinkage of cement during polymerization.

Many researchers have attempted to solve these problems by incorporating additional agents into conventional ingredient of the bone cement, such as composite resin materials, calcium phosphate, or calcium sulfate cements. In addition, new formulations of bone are now developed for clinical use. We have evaluated the thermal necrosis and chemical necrosis based on the principle of free radical polymerization. Because composite materials are usually subjected to dynamic loading conditions in vivo, dynamic mechanical analysis of composite materials has become increasingly relevant and are adapted to evaluate the property of bone cement. New bone cements are also developed in our laboratory.

Acknowledgment: The author thanks the financial support by Ministry of Science and Technology of the Republic of China with grant MOST-104-2211-E-182-054-MY3 and partial financial support of Chang Gung Memorial Hospital with grant CMRPD2D0061, CMRPD2D0062, CMRPD2D0063, CMRPD2F0011 and CMRPD2F0012.
Dr. Vitor M. Correlo’s Biographical Summary

(Feb 1st, 2017)

Dr. Vitor M. Correlo has a PhD in Materials Science and Technology from the University of Minho, Portugal. Part of his PhD work was developed at the University of Minnesota, USA. On August 2013 he got a position as Assistant Researcher and, since January 2015, he has an “Investigador FCT” grant. His actual main research topics include: i) application of micro and nano fabrication methods to generate high-precision scaffolds for engineering multi-component structures; ii) cell printing, iii) tailoring hydrogel properties by incorporating bioactive agents and/or electroactive materials aiming to tailor the cellular fate; iv) electrical stimulation of stem cells, v) implantable biosensors and vi) 3D cancer models. As result of his research efforts within the field of Tissue Engineering and Regenerative Medicine, presently he is author or co-author of more than 68 ISI listed publications, 45 full papers in scientific journals, 5 international book chapters and more than 70 communications (as oral/poster presenter) in international meetings. He is also co-author of 3 patent. His work has been cited around 1000 times and he has an h-factor of 17. Dr. Vitor M. Correlo is also the main responsible for the Department “3B’s Services and Consulting” and is member of the Quality and Management System (QMS).
Electroactive Spongy Like Hydrogels for Skeletal Muscle Tissue Engineering.

Pathomthat Srisuk, Fernanda V. Berti, Rui L. Reis and Vitor M. Correlo.

Despite, topography, material stiffness and mechanical force, electrical stimulation is an emergent factor affecting cellular behaviours and activity. Thus, electroactive hydrogels have a great potential as bioactive materials for tissue engineering applications. Recently we combined gellan gum (GG) with PPy or PANi to create a new class of electroactive spongy-like hydrogels (SLH) with increased properties. The physicochemical characterization, surface morphology, electro-conductivity and mechanical performance were assessed by FTIR, SEM, four-probe technique and compression testing, respectively. Additionally, C2C12 myoblast cell morphology, viability and proliferation were studied by phalloidin staining, MTS assay and DNA quantification, respectively. Host tissue response and the integration of samples were mainly investigated by intramuscular implantation at 1, 2 and 6 weeks.

The results revealed that it was possible to obtain electrically conductive GG based spongy-like hydrogels by *in situ* oxidative polymerization with improved electro-conductivity and mechanical properties, when compared with GG spongy-like hydrogels. Furthermore, it was also concluded that electroactive GG based spongy-like hydrogels could provide supporting for cell attachment and growth. Histological results exhibited that PANi and PPy-GG induced moderate inflammatory reaction compared to GG spongy-like hydrogels. The inflammatory cytokine expression, TNF-α and IFN-γ, were overexpressed when PANi-GG spongy-like hydrogels were implanted and anti-inflammatory cytokine; IL-10 and IL-12a were expressed by the muscle tissue when PPy-GG and GG spongy-like hydrogels were implanted. These results highlight that electroactive GG spongy like hydrogels are attractive candidates to be used on skeleton muscle tissue engineering.
**Professor Haeshin Lee’s Biographical Summary**  
*(June 1st, 2017)*

Professor Haeshin Lee studied at KAIST where he received his B.S. degree in Biological Sciences between in 1996. He received his Ph.D. degree at Biomedical Engineering Department, Northwestern University in 2007. He started his professional carrier from 2009 at Department of Chemistry, KAIST.

Haeshin Lee invented the first material-independent surface chemistry named ‘polydopamine coating’ in 2007, and this study has been cited more than 3,400 times. Also, his total citations (~ 14,000 times) of his bioadhesive studies show that his research is widely recognized. He is the inaugural member of Korea Academy of Science Young Scholars (only 75 people in all areas of science and engineering nationwide). He is a currently director of Center for Nature-inspired Technology (CNiT) at KAIST.


**Representative Publications (total 160 papers)**
Mussel and Insect-Inspired Adhesives: Polydopamine and Its Derivative Materials for Self-Sealing and No-Bleeding Needles

Haeshin Lee

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Catecholamines are found ubiquitously in nature. Wetting-resistant, adhesive foot-pads in mussels, neurotransmitters in the brain, melanin biopigments in the skin and eyes, squid beaks, and insect cuticles are the examples. In materials science, catecholamines have recently attracted significant attentions due to the unprecedented material-independent surface functionalization properties. The most well-known material is poly(dopamine) and other derivatives such as poly(norepinephrine), chitosan-catechol and others will be introduced.

The first of my talk will introduce polydopamine surface modification methods and its various derivative compounds for interface property controls. Low energy surfaces typically exhibit non-adhesive for cell adhesion, but polydopamine coating conveniently converts showing cell adhesive properties. iPS and pluripotent stem cells can also be cultured onto polydopamine coated surfaces. My second talk will introduce a self-sealing concept utilizing catecholamine polymers. The unique properties of self-sealing materials are that they require only gaseous oxygen for spontaneous sealing without any external stimuli such as light, temperature, pressure, pH, and humidity. Finally, utilizing the self-sealing concept, we recently developed a needle that exhibit immediate sealing for no-bleeding needles.
Professor Jun-Beom Park's Biographical Summary
(June 21st, 2017)

Dr. Jun-Beom Park was born in 1973 in South Korea (43 years old), where he obtained his degrees at Seoul National University (B.S., M.S. and Ph.D.). In 2008, he joined the Dr. Victor C. Yang's Lab at University of Michigan (Ann Arbor, MI, USA). He continued his postdoctoral fellowship at the Dr. Youngro Byun's Lab at Seoul National University (Seoul, Korea). He continued his career at The Catholic University of Korea and he is working as an Associate Professor at Department of Periodontics, Seoul St Mary's Hospital, College of Medicine, The Catholic University of Korea. His main interests are the stem cell research, tissue engineering, dental implants and periodontitis.

Dr. Park is the member of the Korean Academy of Periodontology and the international member of American Academy of Periodontology. He served as an Associate Director of General Affairs at the Korean Academy of Periodontology and he is currently working as an Editorial Board Member for Scientific Reports.

He has authored nine book chapters and he has published more than 50 original research papers. His papers were cited > 950 times. His major scientific contribution has been to enhance the bone regeneration using stem cells and growth factors, as well as to optimize the treatment of peri-implantitis.
Human mesenchymal stem cells have previously been isolated and characterized from the gingiva, and gingiva-derived stem cells have been applied for tissue engineering purposes. Three-dimensional culture systems have demonstrated the importance of intercellular interactions in regulating stem cell self-renewal and differentiation.

Gingival tissues were collected from healthy patients undergoing clinical crown-lengthening procedures. Spheroids were formed in the concave microwells. The viability of stem cell spheroids was determined by the fluorometric method using calcein and ethidium homodimer-1 using LIVE/DEAD® viability/cytotoxicity kit. Quantitative analysis was performed with Cell Counting Kit-8, which is based on the ability of mitochondrial dehydrogenases to oxidize WST-8 into a formazan product. The osteogenic potential of cell spheroids was evaluated. Additionally, the effects of co-culture with other cells including osteoblast-like cells were tested. The size-controllable stem cell spheroids were obtained with microwells and the shape and the viability were clearly maintained during the experimental periods.

Multi-cell spheroids were fabricated using stem cells and endothelial cells with different ratios of 0:6 (Group 1), 2:4 (Group 2), 3:3 (Group 3), and 4:2 (Group 4). Stem cells and/or endothelial cells formed spheroids in concave microwells. There was a decreasing trend in the diameter of spheroids with increasing amounts of endothelial cells, but there were no statistically significant differences between the groups. The secretion of vascular endothelial growth factor from the spheroids was noted. The results of the alkaline phosphatase activity assays showed significantly higher values for groups 2, 3, and 4 when compared with the value of group 1.

Stem cell spheroids had osteogenic potential and co-culture with osteoblast-like cells enhanced functionality regarding regulating stem cell viability and differentiation. Conclusively, multi-cell spheroid-based cell delivery could be a simple and effective strategy for improving stem cell therapy.
Coacervate-Mediated Dual Growth Factor Delivery for Skin Scar Reduction

Kyobum Kim1,*

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In order to improve neovascularization in skin flaps, we developed an exogenous growth factor (GF) delivery platform comprised of coacervate-coated poly(lactic-co-glycolic acid) (PLGA) nanofibers. We used a coacervate that is a self-assembled complex of poly(ethylene arginyl aspartate diglyceride) polycation, heparin, and cargo GFs (i.e., VEGF and/or TGF-β3). The coacervate was coated onto a nanofibrous PLGA membrane for co-administration of dual GFs. In vitro proliferation of human dermal fibroblasts and endothelial tube formation using HUVECs indicated an enhanced bioactivity of released GFs when both VEGF and TGF-β3 were incorporated into coacervate-coated PLGA nanofibers (Coa-Dual NFs). Moreover, an in vivo study using a mouse skin flap model demonstrated that implantation of Coa-Dual NF reduced necrosis and enhanced blood perfusion in skin flap areas after 10 days, as compared to any single GF-loaded coacervate/PLGA fiber (Coa-Single NF) along with direct administration of the other GF onto the defect site. Moreover, Coa-Dual NFs exhibited a well-composed skin appendage and a significantly higher number of blood vessels. Based upon these results, we conclude that Coa-Dual NFs may stimulate cellular activity by enhancing the bioactivity of the released GF, leading to a synergetic effect of dual GFs for reducing necrosis in the random skin flaps.
STUDENTS RAPID FIRE SESSION (1)

- Thursday, July 13th
  - 14:00 to 15:00 – SR-01~SR-10
Development of Antioxidant Biodegradable In Situ Forming Drug Delivery System for Glaucoma Therapy

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Functionalization of therapeutic carrier biomaterials can potentially provide additional benefits in drug delivery for disease treatment. To alleviate oxidative stress-induced ocular hypertension, grafting of antioxidant molecules to drug carriers enables a dual-function mechanism to effectively treat glaucomatous intraocular pressure (IOP) dysregulation. Here, a series of gallic acid (GA)-grafted gelatin-g-poly(N-isopropylacrylamide) (GN) polymers were synthesized via adjusting redox reaction temperature and time. Our results showed that different processing conditions may control the GA grafting level, thereby determining antioxidant activity, water content, phase transition temperature, degradability, and drug encapsulation efficiency of carriers. The hydrophilic nature of antioxidant molecules was also found to strongly affect drug release behaviors. In an in vitro oxidative stress model, the polymer samples with high degree of GA functionalization exhibited significantly higher antioxidant activities. To protect against corneal aberration and retinal injury, sustained therapeutic drug concentrations in aqueous humor of rabbit eyes could be achieved after pilocarpine delivery using dual-function optimized GNGA carriers. Enhancement of retinal antioxidant defense system and preservation of histological structure and electrophysiological function indicated the contribution of GA-functionalized injectable hydrogels to prevent glaucoma development. This work highlights the dependence of physicochemical properties, drug release behaviors, and bioactivities on intrinsic antioxidant capacities of carrier biomaterials for glaucoma therapy.
Human Adipose Tissue-Derived Mesenchymal Stem Cells Alleviate Atopic Dermatitis via Regulation of B lymphocyte Maturation

Byung-Chul Lee1*, Tae-Hoon Shin1,2,3*, Hyung-Sik Kim1,2,3 and Kyung-Sun Kang1*

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Mesenchymal stem cell (MSC) has been applied for the therapy of allergic disorders due to its beneficial immunomodulatory abilities. However, their effects and mechanisms can be altered according to the source of cell isolation and the route of administration. We sought to investigate the safety and the efficacy of human adipose tissue-derived MSCs (hAT-MSCs) in mouse atopic dermatitis (AD) model and to determine the distribution of cells after intravenous administration. Murine AD model was established by multiple treatment of Dermatophagoides farinae. AD mice were intravenously infused with hAT-MSCs and monitored for clinical symptoms. The administration of hAT-MSCs reduced the gross and histological signatures of AD as well as serum IgE level. hAT-MSCs were mostly detected in lung and heart of mice within 3 days after administration and were hardly detectable at 2 weeks. All of fifty five mice administered with hAT-MSCs survived until sacrifice and did not demonstrate any adverse events. Co-culture of B lymphocytes with hAT-MSCs was performed to determine the change in B cell proliferation and maturation. Interestingly, hAT-MSCs significantly inhibited the proliferation and the maturation of B lymphocytes via cyclooxygenase (COX)-2 signaling. Moreover, mast cell (MC) degranulation was suppressed when hAT-MSCs were co-cultured. In conclusion, the intravenous infusion of hAT-MSCs can alleviate AD through the regulation of B cell function.
Tissue Adhesive, Injectable and Sprayable Hydrogel via Recombinant Tyrosinase Based Crosslinking

Su-Hwan Kim 1, 2, Sang-Hyuk Lee 1, 3, 4, Byung-Gee Kim 1, 2, 3, 4, and Nathaniel S. Hwang 1, 2, *

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2 School of Chemical and Biological Engineering,  
3 Institute of Bioengineering,  
4 Institute of Molecular Biology and Genetics, Seoul National University  
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We report tissue adhesives hydrogel based on recombinant tyrosinase mediated crosslinking. Furthermore we tailored our adhesive hydrogels to be injectable and sprayable for potential applications in tissue engineering and in minimal invasive surgery. Adhesive hydrogel were fabricated by combining tyramine-conjugated hyaluronic acid (HA-tyramine, 1% w/v) and gelatin (3 % w/v) and novel tyrosinase from Streptomyces avermitillis (SA-tyrosinase). The enzymatic crosslinking by SA-tyrosinase was fast, with less than 30 seconds for complete gelation, and the SA-tyrosinase based crosslinking significantly enhanced the physical properties and adhesive strength of the hydrogel with native tissues samples. Furthermore, by optimizing the injection condition, we tailored the adhesive hydrogel to be injectable and sprayable with medical synrigen and commercial airbrush nozzle, respectively. In vivo analysis of adhesive hydrogel showed low immune modulation and extended was demonstrated that the HG_gel has robust potential to apply in the field of tissue engineering and regenerative medicine.
Patient Specific In Vitro Assessment Tool Using Dental Stem Cell with Bioink for 3D Printer

Hyunmin Choi*, Kyu-Hyung Park^2 and Young-Bum Park^3

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It is now well accepted that initial response of bone cells in response to the certain surface type is mostly influenced by surface morphology. However, there is no single standardized protocol to accurately evaluate the response of bone cells in contact with differently surface treated material for implantation in bone tissue. Recently, 3D printing technology using stem cell as ‘bioink’ has offered a greater reproducibility and user-controllability compared with other tissue model.

In our laboratory, we have been developed ‘3D printing bioink’ to reproduce more accurate, dynamic in-vivo like environment that occurs during early stages of healing in the peri-implant region using patient’s own dental cells in combination with scaffold.

In this presentation, I will introduce the potential use of patients’ own dental stem cells in combination with scaffold as ‘3D printing bioink’ by discussing time-dependent and surface-dependent morphological and biological changes in comparison with conventional cell seeding procedure using differently surface-treated titanium discs.
Hypoxia Induced BMI1 Regulates Immunomodulatory Properties in Human Mesenchymal Stem Cell Aging

Jin Young Lee1,2*, Kyung-Rok Yu1,2,3,*, Insung Kang1,2, and Kyung-Sun Kang1,2†

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For the application of mesenchymal stem cells (MSCs) as clinical therapeutics, the regulation of cellular aging is important to protect hMSCs from an age-associated decline in their function. In this study, we evaluated the effects of hypoxia on cellular senescence and the immunomodulatory abilities of hUCB-MSCs. Hypoxic-cultured hUCB-MSCs showed enhanced proliferation and had increased immunosuppressive effects on mitogen-induced mononuclear cell proliferation. We found that BMI1, a member of the polycomb repressive complex protein group, showed increased expression in hypoxic-cultured hUCB-MSCs, and the further knock down of BMI1 in hypoxic cells induced decreased proliferative and immunomodulatory abilities in hUCB-MSCs, along with COX-2/PGE2 down-regulation. Furthermore, the expression of phosphorylated p38 MAP kinase increased in response to the over-expression of BMI1 in normoxic conditions, suggesting that BMI1 regulates the immunomodulatory properties of hUCB-MSCs via p38 MAP kinase-mediated COX-2 expression. More importantly, we identified BMI1 as a direct repressor of MAP kinase phosphatase-1 (MKP-1)/DUSP1, which suppresses p38 MAP kinase activity. In conclusion, our results demonstrate that BMI1 plays a key role in the regulation of the immunomodulatory properties of hUCB-MSCs, and we suggest that these findings might provide a strategy to enhance the functionality of hUCB-MSCs for use in therapeutic applications.
14,15-Epoxyeicosatrienoic Acid Secreted from Intranasally Delivered hUCB-MSCs Restore Cholesterol Homeostasis and Autophagic Flux in Niemann-Pick Type C1 Disease Model

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Niemann-pick type C1 (NPC1) disease is a neurological disorder in which cholesterol and gangliosides accumulate in the late endosomes/lysosomes, followed by the rapid death of Purkinje neurons. We previously demonstrated that the direct transplantation of human umbilical cord blood-derived mesenchymal stem cells (hUCB-MSCs) into the dentate gyrus ameliorated the neurological symptoms of NPC1 transgenic mice. In this study, we administered hUCB-MSCs to NPC1 mice via the less invasive intranasal route to reduce the inevitable tissue damage caused by direct cell infusion and to maximize the therapeutic outcomes. After nasal delivery, most of the hUCB-MSCs had migrated into the olfactory bulb and the rostral migratory stream, while a few cells were found in the hippocampus and cerebellum. Given that motor function and Purkinje cell survival of the NPC1 mice were improved after hUCB-MSC intranasal infusion, we speculated that the therapeutic effects of hUCB-MSCs are mediated by paracrine factors rather than by cell-to-cell interaction. In this regard, we found that one of the cytochrome P450 metabolite, 14,15-Epoxyeicosatrienoic acid (14,15-EET), acts as a key mediator. Both hUCB-MSC and 14,15-EET treatment reduced cholesterol accumulation in human NPC1 patient fibroblasts in vitro by suppressing cholesterol synthesis and ameliorating the impaired autophagic signals. Administering hUCB-MSCs intranasally is a highly promising alternative to traumatic surgical transplantation, and this method highlights a promising potential therapeutic strategy for NPC1 patients by presenting 14,15-EET as a novel therapeutic candidate.
Gellan gum is widely applied in tissue engineering owing to its biocompatibility and outstanding physicochemical properties. In this study, we have fabricated modified gellan gum hydrogel scaffold using Cation Exchange Resin that remove cation (Na+ and Ca+2), to observe the effects on cartilage regeneration in New Zealand white rabbits and Nude mouse as models. The physiochemical and biological characteristics of scaffold was evaluated by compressive strength, FTIR, MTT, Bio-SEM and RT-PCR. As a result of EDS, cations remove from hydrogel scaffold that using Cation Exchange Resin. As time goes on, Bio-SEM shows extracellular matrix's growth and chondrocyte proliferation. Modified gellan gum scaffold’s MTT assay and RT-PCR dates confirm more effective proliferation and gene expression than normal scaffolds. Histologic specimen of human lung tissue stained with H&E shows tissue regeneration in vivo. Synthetically, the modified gellan gum scaffold was found excellent scaffold for cartilage tissue regeneration than normal scaffold and we identify various applications.

**Acknowledgment:** This research was supported by a grant of the Korea Health Technology R&D Project through the Korea Health Industry Development Institute (KHIDI), funded by the Ministry of Health &Welfare, Republic of Korea (grant number : HI15C2996), Republic of Korea
Fabrication of Collagen/Alpha-Tricalcium Phosphate/Silk-Fibroin Biocomposite 3D Scaffold for Bone Tissue Regeneration

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In tissue engineering, biomaterials must be biocompatible, biodegradable, and mechanically stable to be used for biomedical scaffold. Among various biomaterials, collagen, a natural polymer, is frequently used in bone regeneration since it is the most abundant organic component in human bone. Also, alpha-tricalcium phosphate (α-TCP) \([\alpha-Ca\sub{3}(PO\sub{4})\sub{2}]\), which has a composition similar to bone mineral, has been used frequently for preparing self-setting osteotransductive bone cement. α-TCP can induce a cement reaction under aqueous conditions in a neutral pH range, which form a calcium-deficient hydroxyapatite (CDHA) \([Ca_\sub{3}(HPO_\sub{4})(PO_\sub{4})\sub{5}OH]\). This hydrolysis reaction of α-TCP significantly increases the mechanical strength of biocomposites which is favorable for bone regeneration. Another biomaterial, silk-fibroin (SF), offers impressive mechanical properties, biocompatibility, and biodegradability for biomedical applications. In this study, we suggest a new biocomposite scaffold composed of collagen/α-TCP/SF which has a sufficient mechanical strength and high level of biocompatibility. We fabricated the collagen/α-TCP/SF scaffold using a low temperature 3D printing process. Then it was compared with a collagen/α-TCP scaffold to evaluate the effect of silk. Mechanical tests were carried out in each scaffold sample, and then, osteoblast-like cells were cultured on the fabricated scaffold to evaluate in vitro cellular activities for each scaffold.

Acknowledgment: This research was financially supported by the grant from the National Research Foundation of Korea grant funded by the Ministry of Education, Science, and Technology (MEST) (NRF-2015R1A2A1A15055305) also supported by a grant from the Korea Healthcare Technology R&D Project, Ministry for Health, Welfare and Family Affairs, Republic of Korea (Grant no. HI15C3000).
Osteoarthritis (OA) is a common chronic disease worldwide, caused by cartilage damage. So replacement is needed for damaged cartilage tissue. GG is a suitable biomaterial because of its easy processing and biocompatibility. Saponin (Sa) has anti-inflammatory, antioxidant and anticancer and Sa was used to treat joint diseases. Herein, we have fabricated saponin/gellan gum (Sa/GG) scaffolds with varying concentrations of Sa. As-fabricated Sa/GG scaffolds were analyzed using SEM, compressive strength, FTIR, MTT assay, RT-PCR, and sGAG content. All scaffolds were colorless, odorless and transparent. The porosity of the scaffolds increased and the compressive strength decreased as the content of Sa increased. In vitro results showed that chondrocytes seeded Sa/GG scaffolds were well grew as time goes by and among them, 0.025% Sa/GG has highest cell morphology, cell proliferation by SEM and MTT assay. sGAG contents of 0.025% Sa/GG was highest, too. mRNA expression assay was conducted using chondrogenic genes and result was same as well. We observed that with an increase in Sa content, the biological properties of the cells also improved. It was concluded that Sa/GG can be applied as alternative of cartilage.

Acknowledgment: This research was supported by a grant of the Korea Health Technology R&D Project through the Korea Health Industry Development Institute (KHIDI), funded by the Ministry of Health &Welfare, Republic of Korea (grant number : HI15C2996 ).
Substance P-Tethered Polyester Facilitates In Situ Vascular Regeneration by Endogenous Cell Mobilization and Recruitment

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Small-diameter vascular grafts have high failure rate due to thrombus formation, occlusion, and limited growth potential. A novel approach to achieve rapid endothelialization and vascular tissue regeneration is to attract endogenous stem/progenitor cells from peripheral blood into grafts. Inspired by this idea, we engineered polycaprolactone (PCL)-based vascular grafts containing neuropeptide substance P (SP) and heparin (Hep) immobilized star-shaped poly(L-lactide-co-ε-caprolactone) (PLCL) copolymers. Amino acid analysis and toluidine blue assays confirm successful conjugation of SP and heparin with the PLCL copolymers. Ex vivo results delineate that heparin can prolong thromboplastin and activated partial thromboplastin time. Moreover, heparin can also reduce platelet adhesion and activation, suggesting that heparin modification improve the hemocompatibility of the PCL grafts. The healing characteristics of PCL, PCL/PLCL-SP (SP group), and PCL/PLCL-SP/H-PLCL (Hep/SP group) grafts (n = 30) were evaluated by implanting them in rat abdominal aortas for 2 weeks and 4 weeks. SP and Hep/SP grafts show the presence of cobble stone-like cells on the lumen side, which organize along the direction of blood flow 4 weeks after implantation. In contrary, the surface of PCL grafts remain bare and not cover by cells. Histological and immunohistochemical analysis reveal higher cellular infiltration and homogenous cell distribution in SP and Hep/SP grafts in comparison with the PCL grafts. Furthermore, immunofluorescence staining show rapid endothelialization in SP and Hep/SP grafts compared with the PCL grafts 4 weeks after implantation. After 4 weeks, the numbers of α-smooth muscle actin (α-SMA)-positive cells were abundant in SP and Hep/SP grafts than that of the PCL grafts. Taken together, the present study indicates that SP and heparin-modified PCL grafts exhibit an improved remodeling and integration capability in revascularization.
STUDENTS RAPID FIRE SESSION (2)

- Thursday, July 13th
  - 15:20 to 16:20 – SR-11~SR-20
Functionalization of Porous Ceramic Scaffold by Generating Cell-Derived Extracellular Matrix

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Extracellular matrix (ECM) is a complex network of various structural and functional molecules secreted and accumulated by cells present in all tissues and organs. The objective of this study was to develop functional and modified scaffolds using in vitro generated ECM and determine its potential effect on osteogenesis. Rat derived bone marrow mesenchymal stem cells (RBMSCs) were cultured on porous BCP scaffolds for 3 weeks and decellularized with two different methods (freeze-thaw (F/T) or sodium dodecyl sulfate (SDS)). The decellularized ECM deposited scaffolds (dECM-BCP) were characterized through scanning electron microscopy, energy dispersive X-ray spectrometer, and confocal microscopy. The efficiency of decellularization was evaluated by quantifying remaining DNA, sulfated glycosaminoglycans (sGAGs), and collagens. Results revealed that F/T method was more effective procedure for removing cellular components of cultured cells than SDS treatment. Although significant loss of collagen was observed after decellularization with both F/T and SDS methods, F/T treated sample showed higher retaining amount of sGAGs content than SDS. In addition, we investigated the cell biocompatibility and osteogenic effect of dECM-BCP scaffolds using preosteoblasts. Compared to bare BCP scaffolds, dECM-BCP\(_{F/T}\) scaffolds showed improved cell attachment and proliferation based on immunofluorescence staining and WST assay. Moreover, dECM-BCP scaffolds showed increased osteoblastic differentiation of newly seeded preosteoblasts by up-regulating three types of osteoblastic genes (OPN, ALP, and BMP-2). This study demonstrated that functionalization of BCP scaffold using cell-derived ECM could be useful for improving the bioactivity of materials and providing suitable microenvironment, especially for osteogenesis. Further study is needed to determine the potential of dECM-BCP scaffold for bone formation and regeneration in vivo.

Acknowledgment: This study was supported by the Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Education (2015R1A6A1A03032522)
Role of Matrilin-3 in Mesenchymal Stem Cells for Nucleus Pulposus Cell Regeneration

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Adipose tissue derived mesenchymal stem cells (Ad-MSCs) have shown therapeutic promise in experimental and clinical models of intervertebral disc disease. However, a commonly reported feature of Ad-MSC transplantation is predominant fibrocartilage like-tissue regeneration. This is due to the fact that, Ad-MSCs are environmentally responsive and they secrete bioactive factors in response to local cues such as pro-inflammatory molecules, hypertrophic and degenerated nucleus pulposus cells (dNPs) at the transplanted site. Matrilin-3, an extracellular matrix component present in cartilage also exerts chondrocyte protective effects. Polymorphism in matrilin-3 shows the susceptibility towards intervertebral disc degeneration. Therefore, using matrilin-3, the priming strategies to enhance Ad-MSCs bioactive factor secretions which are favorable for dNPs regeneration and suppression of hypertrophy were investigated. Priming with matrilin-3 has not altered the proliferation as well as it does not induce cytotoxicity to Ad-MSCs. In addition, Ad-MSCs retained the similar expression levels of CD90, CD73, CD105, CD11b, CD34, CD45, and HLA-DR even after matrilin-3 priming. Cell cycle analysis showed that the priming has increased proportion of cells at S-phase. Cytokine array results suggested that, matrilin-3 priming has enhanced the bioactive factor secretion such as anti-inflammatory (Interleukin-10, IL-10), endogenous stem cell mobilization (Chemokine (C-C motif) ligand 5, CCL5) and cartilage specific tissue remodeling and regenerative (tissue inhibitor metalloproteinase inhibitor 2, TIMP2; matrix metalloproteinase-1, MMP1) factors compared to non-primed ad-MSCs. In the indirect co-culture system, primed Ad-MSCs has suppressed hypertrophic extracellular matrix (ECM) components and increased anabolic ECM components with the recovery of morphology in human dNPs. This study highlights the strategy of matrilin-3 priming to improve Ad-MSCs function for targeted intervertebral disc regeneration.

Acknowledgment: KHIDI, funded by the Ministry of Health & Welfare, Republic of Korea (HI16C0106).
Milk Protein-Shelled Gold Nanoparticle with Gastrointestinally Active Absorption for Targeted PTT of Brain Cancer

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Gold nanoparticle as a photothermal therapy agent has been reported in various application. If gold nanoparticle can be orally absorbed, its application may be extended. Unfortunately, it has low absorption efficiency from the gastrointestinal (GI) tract to blood stream. In general, lactoferrin receptor is highly expressed on the small intestinal epithelial cell. Therefore, to overcome its limitation orally, here we newly synthesized lactoferrin-conjugated gold nanoparticles (Lf-PEG-AuNP). Interestingly, glioblastoma in brain cancer highly express lactoferrin receptor, thus, we adapted nano-sized AuNP modified with the lactoferrin, glutathione and PEG for preparation of not only for GBM targeting efficacy but also long-circulating AuNP with improved half-life. Physicochemical properties of Lf-PEG-AuNP were evaluated with ICP-MS, HR-TEM, UV-vis spectrophotometer, and so on. Moreover, we confirmed the ratio of each compartment in our definitive synthesized Lf-PEG-AuNP particle by UV-vis and BCA assay. Oral absorption was evaluated with Caco-2 monolayer system through measurement of transepithelial electrical resistance. GBM targeting effect of Lf-PEG-AuNP was quantitatively measured by ICP-MS and IHC. 4W/cm2, 532nm laser were used for photothermal cancer therapy. U87MG was used for stereotaxic orthotopic GBM mouse modeling. Through this study, we successively confirmed conjugation between Lf-PEG and GSH-AuNP through disulfide bond formation with more advanced oral administration compatibility and GBM targeting efficiency. This novel gold nanoparticle formulation with Lf overcame the obstacle for absorption through GI tract, and also accomplished specific GBM targeting. Sequential irradiation with 532nm laser once it accumulated into GBM cell, it has dramatic photothermal therapy effect by reducing tumor volume. Both in vitro and in vivo toxicology test showed that the material do not reveal toxicity to other organs besides irradiation with NIR laser. Therefore, this study presented the possibility of oral formulation PTT agents for GBM treatments.

Acknowledgment: This study was supported by a grant from the Korea Health Technology R&D Project through the Korea Health Industry Development Institute (KHIDI), funded by the Ministry of Health & Welfare, Republic of Korea (grant number: HI14C2099), Basic Science Research Program (NRF-2015R1A2A1A05001832) and partially by the Bio & Medical Technology Development Program (NRF-2015M3A9E2030125) through the National Research Foundation (NRF) & funded by the Korean government (MSIP & MOHW).
Fabrication of Biomechanically Enhanced Collagen/dECM/Silk-Fibroin Scaffold for Bone Tissue Regeneration

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For tissue engineered scaffold fabrication, biomaterials should possess several characteristics such as biocompatibility, biodegradability and mechanical stability. Recently, naturally derived biopolymers such as collagen have been widely applied due to its outstanding biocompatibility. However, the low mechanical properties of these natural polymers have been a challenge in the field of tissue engineering. Therefore, it is challenging to fabricate a complex 3D porous structure with proper physical strength. To overcome this limitation, in this study, we employed a low temperature 3D printing process for the fabrication of 3D porous scaffold composed of collagen (for biocompatibility), decellularized extracellular matrix (dECM) (for enhanced cellular activities), and silk-fibroin (SF) (for enhanced mechanical properties). Furthermore, various in vitro cellular activities such as cell proliferation and differentiation were compared using pre-osteoblast (MC3T3-E1) cells cultured on pure collagen, collagen/dECM, and collagen/dECM/SF scaffolds for various periods.

Acknowledgment: This research was financially supported by the grant from the National Research Foundation of Korea grant funded by the Ministry of Education, Science, and Technology (MEST) (NRF-2015R1A2A1A15055305) also supported by a grant from the Korea Healthcare. Technology R&D Project, Ministry for Health, Welfare and Family Affairs, Republic of Korea (Grant no. HI15C3000).

{Only One Page}
Effect of Taurine/Silk Fibroin Film Scaffolds on Regeneration of Corneal Endothelial Cell

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Silk fibroin (SF) was reported that it is suitable scaffolds for tissue engineering because it helps cell adhesion and cell viability. Taurine (Ta) was enhances the expression of connective tissue growth factor which repairs damaged articular cartilage. Herein, we have fabricated Taurine/Silk fibroin (Ta/SF) films with various Ta contents i.e. 0, 0.25, 0.5, 1 and 2mM. As-fabricated Ta/SF scaffolds were analyzed by SEM, contact angle, transparency, FTIR, MTT assay, mRNA expression, etc. All Ta/SF films were transparent and got a similar hydrophlicity and maintained chemical properties of SF. It was observed that 0.25mM Ta/SF film scaffold has the highest cell viability and proliferation. Also, Ta/SF film scaffolds were found to maintain cell morphology and cell functions. To analyze a gene expression, RT-PCR was conducted. Beta-actin was used as a housekeeping gene and corneal specific genes were expressed higher on 0.25mM Ta/SF film scaffold. These results suggest that Ta/SF film scaffolds can be used as a suitable alternative for corneal endothelial cell regeneration.

Acknowledgment: This research was supported by the National Research Foundation (NRF) funded by the Korean government (MEST) (2012M3A9C6050204 and 2017R1A2B3010270), Republic of Korea.
H$_2$O$_2$-Activatable and Fibrin-Targeting Antithrombotic Polymeric Nanoparticles as A Theranostics for Thrombosed Vessels

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When a blood vessel is injured, a thrombus (blood clot) is formed inside a blood vessel, obstruction of blood vessels by thrombosis slows blood flow, leading to death of tissues fed by the artery and is the main culprit of various cardiovascular diseases. Herein, we report a reasonably designed nanomedicine which is able to specifically target thrombus, scavenge H2O2 and inhibit thrombus formation in injured vasculature. On the basis of the physicochemical and biological characteristics of thrombi such as an plenty of fibrin and hydrogen peroxide (H2O2), we developed a fibrin-targeted imaging and antithrombotic nanomedicine, termed FTIAN, as a theranostic system for obstructive thrombosis. FTIAN suppressed the expression of tumor necrosis factor-alpha (TNF-α) and soluble CD40 ligand (sCD 40L) in activated platelets and inhibited the generation of H2O2, indicating its intrinsic antioxidant, anti-inflammatory, and antiplatelet activity. In in vivo mouse model of ferric chloride (FeCl3)-induced carotid thrombosis, FTIAN specifically targeted the obstructive thrombus and significantly enhanced the fluorescence/photoacoustic signal When anti-thrombotic drug, tirofiban was loaded in the FTIAN, they exerted remarkable anti-thrombotic effects. Given their excellent biocompatibility, antioxidant and anti-inflammatory activity, FTIAN has great potential as an imaging and therapeutic agent for obstructive thrombosis.

Acknowledgment:
This work was supported by the Basic Research Program 2013R1A1A2A10061828) through National Research Foundation funded by the Ministry of Education and Technology Innovation Program (10049029 and 10052749) funded by Ministry of Trade, Industry and Energy, Republic of Korea.
Keratin-Crosslinked Hyaluronic Acid for Efficient Intratumoral Delivery of An Oncolytic Vaccinia Virus on Breast Cancer

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Oncolytic vaccinia virus, JX-929 has been engineered for targeted anti-cancer therapy against various types of tumor through gene-mediated mechanisms as cancer cell-selective replication and cell lysis. However, the clinical efficacy of oncolytic virus has been limited for complete remission of cancer due to complex immunological reactions of the human body, high dose-dependency of oncolytic viruses, and difficult distribution throughout the dense tumor cells. For these reasons, we developed an oncolytic virus delivery system using keratin-crosslinked hyaluronan hydrogels for both sustained releases of virus in the tumor tissue and synergetic anti-tumoral effects of human hair-extracted keratin. To enhance hydrophilicity and high-water content capacity, keratin proteins were synthesized with a natural hydrophilic polymer, hyaluronic acid (HA). The keratin-crosslinked HA allows the hydrogels to be injectable and provides the hydrophilic interaction with oncolytic viruses.

In this study, keratin was extracted from human hair by Shindai method. In order to conjugate hydrophilic polymer chain of hyaluronic acid with keratin proteins, amino groups of human hair-extracted keratin are crosslinked with carboxylic acid groups of hyaluronic acid by 4-(4,6-Dimethoxy-1,3,5-triazin-2-yl)-4-methylmorpholinium chloride (DMTMM) coupling mechanism. Oncolytic viruses were loaded in the hydrogels with a dose of 1x10⁷ plaque-forming units and the sustained release profile was measured until 5 days by gene replication level in real-time qPCR. As different multiplicity of infection (MOI) of 0.01, 0.1 and 1 of JX-929 loaded in the Keratin-crosslinked hyaluronan hydrogels, proliferation of cancer cells affected by the hydrogel-released viruses was compared to naked viruses of the same MOI doses as control and the hydrogel-released viruses showed better ability to induce cancer cells apoptosis rather than naked virus groups.
New Concept of 3D Printed Bone Clip (Polylactic Acid/Hydroxyapatite/Silk Composite) for Internal Fixation of Bone Fractures

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Open reduction with internal fixation is commonly used treatment for bone fractures. However, postoperative infection associated with internal fixation devices (intramedullary nails, plates and screws) remains a significant complication, and it is technically difficult to fix multiple fragmented bony fractures using internal fixation devices. In addition, drilling in the bone to install devices can lead to secondary fracture, bone necrosis associated with postoperative infection.

In this current study, we developed bone clip type internal fixation device using 3D printing technology. Standard 3D model of the bone clip was generated based on CT scan of the femur in the rat. Polylactic acid (PLA), hydroxyapatite (HA), and silk were used for bone clip material. The purpose of this study was to characterize 3D printed PLA, PLA/HA, and PLA/HA/Silk composite bone clip and evaluate the feasibility of these bone clips as an internal fixation device. Based on the results, PLA/HA/Silk composite bone clip showed similar mechanical property, and superior biocompatibility compared to other types of the bone clip. PLA/HA/Silk composite bone clip demonstrated excellent alignment of the bony segments across the femur fracture site with well-positioned bone clip in the animal study. Our 3D printed bone clips have several advantages: (1) relatively noninvasive (drilling in the bone is not necessary), (2) patient-specific design (3) mechanically stable device, (4) it provides high biocompatibility. Therefore, we suggest that our 3D printed PLA/HA/Silk composite bone clip is feasible internal fixation device.
Cytoprotective Effect of RGD-Peptide Incorporated Film for In Vivo Stem Cell Transplantation

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Mesenchymal stem cells (MSCs) have been mainly used for clinically research to treat diverse type of diseases containing immune-related diseases or cancer therapy. When MSCs are systemic injected into patient body, the cells are danger of high velocity of blood and attachment-deprived state due to lack of proper mechanical support, resulting in cell necrosis. To solve these problems, we have prepared multilayer film which is incorporated arginine-glycine-aspartic acid (RGD-peptide) and biomacromolecules on MSCs surface. The film did not entirely block the cell plasma membrane surface and successfully adsorbed onto cell surface confirmed by CLSM and computer dynamic simulation. The RGD peptide is a small peptide which can bind with integrin, the cellular transmembrane protein, which has various functions of cell attachment, proliferation and survival. By depositing RGD peptide incorporated films on MSCs, we found that the film coated MSCs showed significantly increase cell survival during agitation culture which is mimicked blood vessel, having cytoprotective effect of multilayer film which could be also supported by the activation of survival-related protein, Akt. In addition, the multilayer film does not interfere cell migration, differentiation potential of stem cells. Finally, we tested in vivo stability of RGD peptide coated MSCs, we injected film coated MSCs to mice via tail vein and collected whole blood from heart at certain period time to count percentages of live MSCs into the blood. By fluorescence-activated cell sorting (FACS) analysis, we found that the survival rate of film coated MSCs was significantly higher than bare MSCs. Furthermore, we also checked increased stem cell recruitment at injured area after film preparation. Therefore, in this report, we concluded that the RGD peptide multilayer film could enhance cell viability under unstable condition without cytotoxicity and this approach is suitable for in vivo transplantation of MSCs for cell therapy.
Phosphates Stabilizer Based Aqueous-Phase Synthesis for Metal Nanoparticles

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We describe a simple, aqueous-phase route to the synthesis of metal nanoparticles including Pt, Pd, Ru, and Au based on the aqueous-phase reduction of metal salts with NaBH4. In this approach, various phosphates were applied as new type of stabilizers for the synthesis of metal nanoparticles thanks to its negatively charged functional group (PO−). We report a simple aqueous-phase route to the synthesis of metal nanoparticles including Pt, Pd, Ru, and Au by reducing metal salt with NaBH4 in the presence of phosphates as stabilizers. In this approach, phosphate ions can act as new type of stabilizer thanks to their negatively charged functional group. In addition, the morphology of the metal nanoparticles could be easily controlled by using different kinds of phosphates, such as disodium phosphate, disodium pyrophosphate, tetrasodium pyrophosphate, and trisodium tripolyphosphate.
POSTER SESSION (1)

- Wednesday, July 12th

  - 9:00 to 18:00 – PO-01~PO-45
**PO-01**

**Biomimetic Matrix-Based Cues for Re-Differentiation of Chondrocytes**

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2 Institute of Tissue Regeneration, College of Medicine, Soonchunhyang University, Cheonan-si, Chungcheongnam-do 31151, Republic of Korea

The native extracellular matrix (ECM) of cartilage tissue could modulate cell-cell and cell-matrix interactions of chondrocytes to maintain their phenotypes and cartilage tissue homeostasis. However, due to the intrinsic nature of cartilage tissue, its regeneration potential is limited and cells presented within cartilage tissues undergo dedifferentiation during in vitro expansion. Here, we aim to develop a biomimetic matrix to support in vitro expansion of chondrocytes while maintain their phenotypes by employing various biomimetic matrix-based cues, such as matrix rigidity, surface charge density, surface roughness, and internal pore structures. Our findings reveal that biomimetic matrix could support initial attachment, their round cell morphology, and cartilage-specific extracellular matrix productions. Such a biomimetic matrix that is easy to synthesize and cost-effective can offer an ideal tool to promote the outcomes of cell-based therapies.

Acknowledgment: This research was supported by the Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Education (2015R1A6A1A03032522, 2015R1D1A1A010108890, 2016K1A4A3914725), the Functional Districts of the Science Belt support program, Ministry of Science, ICT and Future Planning (2015K000278), and partially supported by Soonchunhyang University Research Fund.

**PO-02**

**Two-Stage Photothermal-Controlled Release Platform by Silk Fibroin Film Containing with Polydopamine Nanoparticles**

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In this study, we developed a two-stage controlled drug release platform based on silk fibroin (SF) film containing SF/polydopamine (PDA) nanoparticles (SD). We loaded curcumin and BSA as model drugs into SD particles by simple oxidative self-polymerization of dopamine under alkaline condition. Both macromolecular and small molecular drugs could easily incorporated in SD particles. The sustained drug release rates were achieved, and the near infra-red (NIR) light could successfully trigger the drugs delivery for the second stage release. Then, the SF film containing SD particles (SDSH) was loaded with model drugs secondary for the rapid release at the first stage, and the SDS film was treated with ethanol to improve the crystallinity and mechanical property. Besides, we also absorbed the heparin outside the film (SDDH), and the results showed that the SDDH film could prevent the formation of blood clot. These results suggest that the SDDH film exhibited both antioxidant and antiagulant abilities, and the two-stage controlled release platform would be a promising system for variety kind of drug delivery.

Acknowledgment: The authors would like to thank the National Science Council of the Republic of China, Taiwan, for financially supporting this research under Contract No. NSC 104-2221-E-010-004-MY3.

**PO-03**

**Relationships between Deacetylation Degree of Chitosan Coating and Keratocyte Spheroid Fabrication**

Jui-Yang Lai

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Cell spheroid fabrication has important implications to the advance in tissue engineering while stimulation from interface of a biopolymer coating has the ability to modulate this event. This study aims to investigate the dependence of keratocyte migration, proliferation, and differentiation on surface roughness/stiffness of chitosan coatings through modifications by deacetylation degree (DD). Chitosan coatings with increasing DD exhibited significantly decreased surface roughness and increased surface stiffness. During in vitro cultivation, the relationships between the behaviors of rabbit corneal keratocytes (RCKs) and biopolymer coatings with varying DDs (between 75% and 96%) were found. Both the surface roughness increase and stiffness decrease led to enhanced cell migration, which is the main driving force for the early stage spheroid formation on chitosan substrates (e.g., within 8 h). With these stimulations from substrates, the size and morphology of RCK spheroids were greatly affected by DD of chitosan. When fabricated on a lowered DD of chitosan material, the spheroids had a larger size with abundant extracellular matrix production. At a later stage of spheroid cultivation (e.g., 5 days), significantly higher amount of RCKs on chitosan coatings was noted with increasing DD, indicating the interface effects on cell proliferation. The keratocyte expression of RCK spheroids grown on a lowered DD of chitosan was up-regulated, suggesting that both surface roughness increase and stiffness decrease may facilitate the microenvironment for preservation of cellular phenotype. Overall, our work contributes to the scientific understanding of keratocyte behaviors and spheroid fabrications in response to DD-mediated surface roughness/stiffness of chitosan coatings.

**PO-04**

**Stem Cell Properties of Human Clonal Salivary Gland Stem Cells Are Enhanced in Three-Dimensional Spheroid Culture**

1 Hyun-Soo Shin, 1 Songyi Lee, 1 Hye Jin Hong, 1 Won-Gun Koh, 1 Jae-Yol Lim

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(* jilm@yuhs.ac) Human salivary gland stem cells (hSGSC) aggregate to form 3D spheroids on nonadherent surfaces. We investigated whether generation of 3D spheroids could enable promotion of stem cell properties of hSGSC. We examined the stem cell properties of hSGSC spheroids formed in microwells in terms of morphological changes, self-renewal, salivary stem or epithelial gene/protein expression, differentiation potential, and paracrine secretory function when compared with adherent 2D plastic culture. Microwells were fabricated by photopatterning of hydrophobic hydrogel on the bottom of an electropun nanofibrous scaffold. hSGSC spheroids formed in 3D microwells exhibited enhanced self-renewal activity and increased expression of salivary stem cell markers (Lgr5 and CD90) and pluripotency markers (Oct4 and Nanog). Upon a differentiation induction, the hSGSC spheroids showed better differentiation potential into salivary epithelial cells than 2D culture. hSGSC spheroids secreted higher levels of paracrine factors such as HGF, IGF-1, EGF, and BDNF. Microarray data showed Wnt levels were significantly elevated in hSGSC spheroids and the stem cell properties were alleviated by inhibition of Wnt signaling. hSGSC spheroids exhibited enhanced radio-protective properties in a coculture system as well as in vivo transplantation. A potential key molecule contributing to therapeutic potential was also identified. The 3D spheroid assembly of hSGSC can enhance stem cell function as well as paracrine secretion by Wnt activation. The 3D culture system is suggested to contribute to regenerative therapies for restoration of salivary function after irradiation.
PO-05
Bioglass-Incorporated GelMA Cryogel for Improved Osteogenic Effect on Mesenchymal Stem Cells
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Bioglass is well known as an excellent biomaterial due to its osteo-inducing effect and biocompatibility despite its brittleness. To fix this problem and maximize its merits, bioglass was embedded in 3D scaffold. Characteristics of ideal scaffold are biocompatibility, pore size, biodegradability, and mechanical property. GelMA, which is modified gelatin form, retains cell adhesion site, which is a well-suited material for scaffold fabrication. Herein, we fabricated bioglass-incorporated GelMA scaffold for testing osteogenic effect. We demonstrated that as doses of bioglass concentration in scaffolds increases, osteogenic effect on mesenchymal cells increases in in vitro testing. Furthermore, in vivo testing supports that bioglass incorporated GelMA cryogel induces stronger osteogenic differentiation on mesenchymal stem cells than the control group, GelMA cryogel. It is believed that hydroxyapatite layer formation on bioglass-embedded scaffold helps cell adhesion of mesenchymal stem cell, providing favorable condition for bone formation.

The enhancement of osteogenic effect using bioglass embedded GelMA scaffold will be presented.

PO-06
Bilirubin Nanoparticles as Nanomedicine for Liver Fibrosis Therapy
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In our laboratory, we successfully created hepatic fibrosis model to study the treatment effect of pegylated bilirubin. Bilirubin is hydrophobic in nature and polyethylene glycol (PEG; molecular weight, 2,000) was covalently attached to this compound via a stable amide bond resulting in PEGylated bilirubin (PEG-BR). PEG-BR is found to have ability to undergo a solubility switch from hydrophobic to hydrophilic in response to intrinsic ROS. PEG-BR is a novel nanovesicle system which is studied for its multi-stimuli-responsive mechanism utilized as ROS/drug-delivery carriers. Advanced liver fibrosis is a condition characterized by ROS stress and metabolic effects in hepatocytes. In our study we use PEG-BR as a ROS quenching, anti-inflammatory agent which also have ability to load hydrophobic or hydrophilic drug against progression of fibrosis. We have developed liver fibrosis model in C57/HeN mice by administering thioacetamide and ethanol. PEG-BR was injected through intravenous route in 3 dosages for a period of 9 days. Finally, we analyzed hepatic histopathology and biochemical estimation, respectively. We observed a dosage dependent improvement of hepatic fibrosis and biochemical examination (AST/ALT ratio) in the PEG-BR treated group. PEG-BR nanovesicles might be useful in reduction of mice hepatic fibrosis and hepatic histopathology and biochemical estimation, respectively. We concluded that as doses of bioglass concentration in scaffolds increases, osteogenic effect on mesenchymal stem cells than the control group, GelMA cryogel. It is believed that hydroxyapatite layer formation on bioglass-embedded scaffold helps cell adhesion of mesenchymal stem cell, providing favorable condition for bone formation.

PO-07
Synthesis and Characterization of Nature-Originated Nano Fiber Dressing Using Electrospinning Method
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In this study, we have been synthesized nano fiber dressings with natural origins such as collagen, sodium hyaluronate and so on. Also, in order to improve property and get stable spinning condition, we are trying to add hydrogenated polysorbate, ppg-15 stearyl ether and peg-40 sorbitan peroleate. Especially, hydrogenated polysorbate, which is being used for various cosmetics, can increase viscosity and improve moisturizing ability. And we used ppg-15 stearyl ether and peg-40 sorbitan peroleate as a surfactant.

In this presentation, I will introduce the manufacturing method of nano fiber dressings synthesized with natural origin materials and synthetic polymer which has low or zero hazard grade of EWG database.

PO-08
Functionalized Hydrogel Patch-Based Skin Therapy: Wound Regeneration and Transdermal Drug Delivery
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Hydrogel-based therapy has been widely used in skin regeneration and/or transdermal drug delivery. Hydrogels, hydrophilic polymeric network, have excellent water-containing capacity, which can provide moisture environment at wound sites, encapsulate bioactive molecules and control release kinetics of the molecules. Through taking these advantages of hydrogel, in this research, we have developed hydrogel patch by incorporating it into functional membranes. Using chemical/physical modification of the membrane, the hydrogels were immobilized on the membranes, and the functionalized hydrogel patch has been applied into skin-related therapies: skin wound regeneration and transdermal drug delivery. For wound regeneration, Janus membrane that has both-sided property has coupled with gelatin-based hydrogel. Hydrophobic layer of the membrane displayed excellent antibacterial property, while hydrogel-incorporated hydrophilic layer enhanced wound healing rate. For transdermal drug delivery, we have developed electrically conductive hydrogel patch in order to utilize iontophoresis technique that induces electric current for facilitating drug penetration into dermal layer. Thin film of carbon paste was used by electrode, which was formed on various substrates, such as polyimide (PI) and cotton fabric, via heat-assisted screen printing method. Drug-contained hydrogel patch was fabricated by adhering the hydrogel to the substrate, and effects of iontophoresis was estimated when turning on/off the electric current using Franz diffusion cell. These hydrogel-immobilized functional patch system suggests innovative strategies for skin therapy in tissue engineering and transdermal drug delivery strategy.
**PO-09**

Understanding Roles of Biomimetic Matrix-Based Cues on Regulation of Myogenic Differentiation

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The cell-matrix interactions of myoblasts with their extracellular microenvironment have shown to play a crucial role in regulating their in vitro myogenic differentiation and in vivo skeletal muscle regeneration processes. Since hydrogel-based matrix has great advantages in tuning various material-based cues, such as matrix rigidity, chemical compositions, and biofunctionality, here we aim to develop a novel synthetic matrix to understand roles of material-based cues on regulation of various cellular behaviors of murine myoblasts ($C_{57BL/6}$) as an in vitro skeletal muscle wasting disease model. We also used the heparin-based biomimetic matrix to evaluate its effects on adhesion, proliferation, fusion, and differentiation of myoblasts in association with TNF and WNT signaling pathways. Our findings reveal that hydrogel-based synthetic matrix could support initial cell adhesion and proliferation. Interestingly, our results demonstrated that the presence of heparin moieties could function as an inhibitor for fusion of mononucleated myoblast into multinucleated myotubes through activation of TNF signaling pathway, whereas inhibition of WNT signaling pathway. Such a biomimetic matrix-based cues have shed light into the novel signaling pathways involved in fusion and maturation of myoblast during terminal differentiation.

**PO-10**

Maximizing Stem Cell Activity by Non-Epigenetic Approach Mimicking Cell-Substrate Interaction

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Utilization of adherent stem cells for tissue regeneration by trophic effect or immune-modulation purpose involves the procedure of detachment of the cells from substrate and injection in a cell suspension state. To maximize the cell survival and activity in this attachment-detachment of the cells from substrate and injection in a cell suspension state. To maximize the cell survival and activity in this attachment-detachment state, bone marrow stromal cells (BMSCs) were coated with components of extracellular matrix molecules to mimic the cell-substrate interaction. The first layer of ECM coating started with cationic organic polymer/matrix molecules to facilitate its binding on negatively charged phospholipid bilayer surface. On the first layer, anionic hydrogel molecules were bound and keep repeating this alternative binding created layer-by-layer (LbL) assembly on plasma membrane surface of the cells. When FITC-labeled LbL component was coated on the cells, fluorescence intensity increased as the number of deposited layer increased. The cells with LbL assembly on plasma membrane surface showed increased survival even in attachment-deprived state and showed activated survival signal, indirectly indicating that the deposited matrix molecules were bound to their corresponding receptor, integrin or CD44 to mimic the cell-ECM interaction. Interestingly, deposition of LbL assembly on cell surface did not compromised cell attachment on plastic dish surface, and the number of colony-forming unit fibroblast (CFU-F) was not reduced by LbL assembly. Functionality of LbL assembly-deposited BMSCs were confirmed by evaluating in vitro differentiation potentials and in vivo homing ability in mouse muscle-injury model. Detailed characteristics of membrane bound LbL assembly and their effect on cell functionality will be discussed in this presentation.

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**PO-11**

Modulating Effect of Stem Cell Plasma Membrane Surface Modification on Differentiation Tendency

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Based on our observation that extracellular matrix (ECM) molecules coated by layer-by-layer (LbL) assembly method on plasma membrane surface of bone marrow stromal stem cells (BMSCs) potentiate cell functionality, we investigated the effect of differing ECM composition on differentiation tendency of BMSCs. While LbL assembly composed of poly-L-lysine (PLL) and hyaluronic acid (HA) potentiated the colony forming ability confirmed by colony forming unit-fibroblast (CFU-F) assay, LbL assembly composed of type I collagen (Col I) and HA showed no significant difference compared with BMSCs without LbL assembly. When osteogenic differentiation potential of surface-modified BMSCs were compared with non-coated control group, LbL assembly composed of PLL and HA showed no significant difference, while LbL assembly composed of Col I and HA showed tendency of increased accumulation of calcium-rich granule compared with non-coated BMSCs. As for chondrogenic differentiation potential of surface-midified BMSCs, LbL assembly composed of PLL and HA showed tendency of slightly increased chondrogenesis compared with non-coated BMSCs. These results indicate that the composition of LbL assembly deposited on cell surface shows characteristics-editing effect.

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**PO-12**

Beta-Carotene/PLGA Particle Loaded Silk Fibroin Film for Corneal Endothelial Cell Regeneration

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Herein, we have designed transparent, stable and insoluble silk films by blending with beta-carotene/PLGA particles as an alternative scaffold for bioengineering cornea. The morphological and structural properties of films were analyzed using contact angle, field emission scanning electron microscope (FESEM) for film surface, MTT assay for cell proliferation, reverse transcription polymerase chain reaction (RT-PCR) for expression of mRNAs and histological analysis. Furthermore, In vitro biological compatibility was studied using rabbit corneal endothelial cells (rCEnCs) as models. No significant difference in the film morphology was found with the addition of particles. We observed a decreased transparency and increased contact angle with increasing particle content in the films. In vitro studies showed that cell proliferation and initial attachment were increased with rising particle content. Notably, cell proliferation and initial attachment are higher in 50 % BCT/5% silk. Taking into account all the obtained results, we envision that the as-fabricated beta-carotene/PLGA particles can be envisioned for further cornea regeneration studies.

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PO-13
Silk Fibroin Sponges Obtained by N2O Gas Foaming as Scaffolds for Bone TE
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Silk fibroin has acquired in the last years increasing attention for applications in tissue engineering and for the fabrication of biomedical prostheses, thanks to its noticeable biocompatibility and the possibility to tune its architecture and physical properties. Fibroin porous scaffolds or sponges are generally prepared by the salt leaching method or by freeze-drying starting from fibroin concentrated solutions or gels. These processes either require porogen removal in post-processing or do not allow porosity size control.

In this work we present a single-step method for making foams or foam-like structures, and therefore sponges, starting from fibroin/gelatin (80:20 w) water solutions and using low pressure N2O gas. The technique allows for the production of porous scaffolds with tunable porosity and permits the easy incorporation of hydroxyapatite in the foams, thanks to the emulsifying properties for gelatin.

Combined fibroin/gelatin sponges with or without the incorporation of nanometric hydroxyapatite powder have been prepared, characterized by SEM and micro-CT to evaluate morphology and porosity and tested as scaffolds in vitro with adipose derived stem cells for 14 days.

Scaffolds biological performances were evaluated by confocal microscopy, viability and proliferation assays, ALP, Bcl2, Caspase 3, Cyclin D1, Mcm5 and OC gene expression was measured by PCR analysis.

PO-14
In vitro Study of Lysophosphatidic Acid/Silk Fibroin Film for Cornea Endothelium Regeneration
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Silk biomaterials have been quite popular in tissue engineering and regeneration studies owing to its biodegradability, biocompatibility and provides favorable environment for cell proliferation, and differentiation. Lysophosphatidic acid (LPA) is a multifunctional intercellular phospholipid messenger and serves as a signaling molecule, promoting cell viability. In this study, we have fabricated LPA/SF films with or without 20µM LPA loadings and applied for regeneration of corneal endothelium. As-fabricated LPA/SF films were analyzed by FESEM, contact angle, transparence, FITR, initial density, MTT assay, mRNA expression, etc. LPA/SF films were flat and transparent and 20µM LPA/SF film was more hydrophilic and there is no difference with 0µM LPA/SF film even under condition of seeding and non-seeding. In vitro results showed 20µM LPA/SF film was higher cell adhesion as a result of initial density. And 20µM LPA/SF film got good cell proliferation and hexagonal morphology with maintaining functionality. Gene expression of corneal endothelium cells showed that 20µM LPA/SF film was higher than the other. Collectively, the LPA/SF films can be applied as an alternative for corneal endothelium regeneration.

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PO-15
Bone Regeneration Evaluation of Parathyroid Hormone Impregnated PLGA Scaffolds
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Parathyroid hormone (PTH) is a bone formation medicine proven to increase bone density and protect bone fracture. In this study, we evaluated the ability of PTH impregnated scaffolds for bone differentiation and bone formation of PTH impregnated scaffolds. We have prepared 0.005wt%, 0.01wt%, 0.02wt% PTH/PLGA scaffolds using salt-leaching methods. To evaluate physical property of scaffolds, SEM and compressive strength were performed. SEM showed that highly porous and hexagonal morphology of the scaffold. The biocompatibility and osteogenic differentiation capacity of PTH/PLGA scaffolds were investigated after culturing BMSC on scaffold using MTT, ALP and RT-PCR. The biological evaluation showed that 0.01% PTH/PLGA scaffold with a higher ALP activity and increased phenotype of type 1 collagen, osteocalcin, Runx2 compared than the other groups. In vivo histological staining was performed in SD-rat skull. At 2, 4, and 8 weeks post-surgery, micro computed tomography analysis was performed using µ-CT system. Regeneration of bone defects analyzed as values of bone mineral density (BMD) and bone volume (BV). The BMD and BV of 0.01% PTH/PLGA were increased compared to control group. Conclusively, it can be envisioned that the 0.01% PTH/PLGA scaffolds as a promising scaffold of bone tissue engineering.

PO-16
A 3D Printed Polycaprolactone Supplemented with Fish Frame Peptide for Hard Tissue Regeneration
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The fish frame that generated from fishery processing is composed of amounts of the protein, calcium and other minerals. The objectives of this study were to investigate the osteogenic effects of the peptide from marine fish frame, Johnius belengier, as well as the molecular mechanism underlying the peptide’s effect in the pre-osteoblast, and the osteogenic effect on fabricated 3D scaffolds. Using consecutive purification by liquid chromatography, a potent osteogenic peptide FFP is composed of three amino acids, Lys-Ser-Ala (KSA, MW: 304.17 Da). The fish frame peptide (FFP) promoted cell proliferation, alkaline phosphatase (ALP) activity, mineral deposition and levels of the osteoblast differentiation phenotype markers in MC3T3-E1 pre-osteoblast. To elucidate the mechanism underlying the osteogenic effect of the FFP on the mitogen-activated protein kinases (MAPKs) and Smad pathways. The FFP was significantly induced the phosphorylation of MAPKs and Smad 1/5/8. In addition, we designed scaffolds consisting of the biodegradable polymer (polycaprolactone; PCL) and FFP fabricated by three axis plotting system for bone regeneration. The effect of the FFP/PCL scaffolds on various mechanical properties and characteristics including the morphology image, FT-IR analysis, and tensile properties were investigated. Moreover, the in vitro biocompatibilities of FFP/PCL scaffolds were examined using MC3T3-E1 pre-osteoblast. At the results, the FFP/PCL scaffolds show significantly higher cell proliferation, mineral deposition and mRNA expression of the osteogenic markers than the PCL scaffold. Consequently, the FFP has a potential pharmacological substance for bone metabolism. Moreover, FFP/PCL scaffold suggests further investigation a potential biomedical engineering field due to promotion of the osteogenesis.

Acknowledgment: This research was supported by grant from Marine Biotechnological Program (20150220) funded by Ministry of Oceans and Fisheries, Republic of Korea.
Gellan gum is a heterosaccharide composed of rhamnose, glucuronic acid and glucose. It is a colorless tasteless odorless powder extracted from aquatic plants in Erodium. It is a biomaterial mainly used in modern tissue engineering. The chondroitin sulfate(CS) has been found to induce slow, sustained relief for osteoarthritis(OA) patients worldwide. It has been also proven structurally improved arthritis drug that can relieve, delay or stabilize joint inflammation in many animal experiments and clinical trials, thus providing symptom relief in long-term. In this study, we investigated the effect of gellan gum scaffolds containing chondroitin for treating osteoarthritis in vitro. The content of chondroitin hybride in the scaffolds were set to 10, 20 and 30%, and scaffolds was prepared by hydrogel type. SEM was performed to characterize the scaffolds. The cell adhesion and proliferation rate were confirmed by MTT assay and gene expression by RT-PCR. In addition, the compressive strength test were performed to confirm mechanical strength. Overall results showed that 0.1 wt% gellan gum/silk microfibers scaffolds was best suitable for adhesion, proliferation rate and gene expression and can be potentially applied for cartilage regeneration.

This research was supported by Bio-industry Technology Development Program (112007-05-4-S8010), Technology Commercialization Support Program (814005-03-2-HD020), Republic of Korea.

PO-18 Gellan Gum/Silk-Microfiber Hybrid Scaffolds for Efficient Chondrification

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In this study, we have fabricated gellan gum & silk-microfibers scaffolds in order to evaluate its efficiency for neo-regeneration of cartilage tissues using rabbit cartilage cells as models. The as-prepared scaffolds were characterized using SEM, compressive strength, MTT assay, RT-PCR, etc. The physiochemical results showed an increase in scaffolds porosity and decrease in compressive strength with an increase in silk-microfiber content. In vitro studies showed that cell proliferation and chondrogenic differentiation were increased with enhanced silk-microfiber content in the GG/SM scaffolds. Cell initial adhesion was also highest at 0.1 wt% gellan gum/silk-microfibers scaffolds. Notably, cell proliferation and chondrogenic differentiation were found to be highest in 0.1 wt% gellan gum/silk-microfibers scaffolds. Thus, we considered that 0.1 wt% silk-microfibers content is most helpful for chondrocyte proliferation.

Acknowledgement: This research was supported by a grant of the Korea Health Technology R&D Project through the Korea Health Industry Development Institute (KHIDI), funded by the Ministry of Health &Welfare, Republic of Korea (grant number: HI15C2996).

PO-19 Evaluation of Silymarin/Duck’s Feet-Derived Collagen/Hydroxyapatite Scaffolds for Bone Tissue Regeneration

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Tissue engineered scaffolds are promising alternative for bone regeneration. In this study, we have designed biocompatible and biodegradable collagen sponges by blending silymarin and hydroxyapatite as an alternative for bone regeneration. The morphological and structural properties of scaffold were analyzed using scanning electron microscope (SEM), fourier transform infrared spectroscopy (FTIR) and MTT assay for cell proliferation, ALP assay for osteogenic differentiation of cell, reverse transcription polymerase chain reaction (RT-PCR) for expression of mRNAs and histological analysis. Furthermore, in vitro biological compatibility was studied using rabbit bone marrow stem cells (rBMSCs). The prepared scaffold showed high porosity and have a sponge - like compressive strength. Results showed that the 50%/DC/HAp scaffold efficiently enhances the rBMSCs adherence, growth and maintains cell morphology, formation of cell junctions and gene expression required for functional rBMSCs. Thus, the results suggest that collagen sponge has an excellent environment as carrier and silymarin plays a role to improve biological properties. Overall results showed that incorporation of 50%/DC/HAp can be positively applied as suitable alternative for high level bone tissue expansion and transplantation.

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PO-20 Decellularization of Extracellular Matrix as A Potential 3D Bio-Ink for Tissue Engineering

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Recently, numerous research groups have developed 3D bio-printing processes for tissue engineering and regenerative medicine. The bio-ink used in 3D bio-printing is usually a combination of synthetic and natural materials. However, synthetic materials have several limitations, such as low biocompatibility and long term biodegradation in the body. Moreover, only a few materials can be used for printed thermoplastic materials. Therefore, numerous studies have developed bio-inks using natural materials in this study. In this study, we prepared 3D printable bio-inks containing extracellular matrix (ECM) isolated from decellularized porcine dermis tissue. The ECM was extracted by mechanical, enzymatic, and chemical treatments of porcine dermis tissue. After decellularization, no nucleic acids residue was detected by DAPI fluorescence staining and, hematoxylin and eosin staining. Moreover, major ECM components were measured, including acid/pepsin soluble collagen, sulfated glycosaminoglycan (GAG), and soluble elastin. We evaluated the properties of these bio-inks for their suitability in bio-printing applications. ECM mixed bio-inks were analyzed chemical structure and mechanical property to comparison with of rat tail collagen hydrogel (Sigma). To assess the biocompatibility of the bio-inks, bio-ink/cells (NIH3T3 fibroblast cell line & human adipose derived mesenchymal stem cells) printed structures were measured by live/dead assay and WST-1.

Acknowledgment: This work was supported by the Technology Innovation Program, 10053020, Development of in-situ 3D bio-printing system for wound-tailored skin regeneration funded by The Ministry of Trade, Industry & Energy (MI), Republic of Korea. The abstract must be typed in English with the body limited with 350 words, including the title, abstract text, author names, and affiliations.
PO-21
Effect of Cell Directionality on Aligned Conducting Nanofiber Scaffolds
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Biomaterials are of great interest in the tissue engineering applications and the pursuit of biomimetic extracellular matrix structures for proliferation, differentiation, and directional of cells. In this study, conductive nanofiber scaffolds were fabricated by electrospinning a mixed solution of polyaniline and chitin for tissue engineering applications. We investigated not only basic characterizations but also cell directionalities using the aligned conductive nanofiber scaffolds. The aligned chitin/polyaniline (Chi/PANI) nanofiber scaffolds were characterized using scanning electron microscopy, Fourier transform-infrared spectroscopy, wettability analysis, mechanical testing, and electrical conductivity measurements. In addition, we evaluated the viability of human dermal fibroblasts cultured on aligned Chi/PANI nanofiber scaffolds using MTT assay. The cell growth was higher on aligned Chi/PANI nanofiber scaffolds than those random scaffolds. Cells on aligned nanofiber scaffolds spread in the direction of the aligned nanofibers as bipolar patterns, whereas cells on the random nanofibers confirmed no spreading or multipolar patterns. These results suggest that the alignment of nanofiber scaffolds may act synergistically with electrical conductivity in order to improve the viability and directional of the cells.  
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PO-22
Preparation and Characterization of Phlorotannin/PCL-Coated Endotraheal Tube for Treatment of Tracheal Stenosis
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The phlorotannins extracted from Ecklonia cava is known to have a variety of biological activities such as antioxidant and anti-inflammation. The objective of this study was to investigate the preventive effect of phlorotannins (PHT)/poly (ε-caprolactone) (PCL) coated endotraheal tube on endotraheal intubation-induced stenosis in vivo model. The PHT/PCL coated endotraheal tube was developed using a 1.5 cm segment of Levintube (16 French) coated with PCL and then coated with phlorotannins. Drug release analysis of PHT/PCL coated endotraheal tube showed that phlorotannins were continuously released for a period up to 7 days. In vivo study, grade of trachea stenosis and granulation tissue of the endotraheal tube using endoscopic examination, as well as the collagen deposition and submucosa thickness by histological analysis, was investigated. The PHT/PCL coated endotraheal tube intubation group inhibited grade of trachea stenosis, granulation tissue, collagen deposition and submucosa thickness compared to the PCL coated endotraheal tube intubation group. PHT/PCL coated endotraheal tube intubation group also reduced the mRNA and protein expression of stenosis related factors such as collagen type I, a-SMA and TGF-β1 compared to the PCL coated endotraheal tube intubation group. Based on these results, the PHT/PCL coated endotraheal tube showed preventive effects of tracheal stenosis caused by endotraheal intubation. Phlorotannins may be considered as a candidate material to be coated at the endotraheal tube to prevent tracheal stenosis.  
Acknowledgment: This research was supported by grant from Marine Biotechnology Program (20150220) funded by Ministry of Oceans and Fisheries, Republic of Korea.

PO-23
Bone Formation and Osseointegration Efficacy Enhanced by Hydroxyapatite–Heparin–BMP-2 on Modified Titanium Surfaces In Vitro & In Vivo Study
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In the present study, surface-modified Ti samples with hydroxyapatite (HAp) and heparin (Hep)–bone morphogenetic protein-2 (BMP-2) complex were prepared and the effects of the samples on the enhancement of bone formation and osseointegration in vitro and in vivo were investigated, as compared to Ti/HAp and Ti/Hep/BMP-2. Surface-modified titanium (Ti) samples with hydroxyapatite (HAp) and heparin (Hep)–bone morphogenetic protein-2 (BMP-2) complex (Ti/HAp/Hep/BMP-2) were prepared, and their efficacies on the enhancements of bone formation and osseointegration in vitro and in vivo were examined as compared to Ti/HAp and Ti/Hep/BMP-2. The modified surfaces were characterized by X-ray photoelectron spectroscopy (XPS), scanning electron microscopy (SEM) and contact angle goniometry. In vitro studies revealed that MG-63 human osteosarcoma cell lines grown on Ti/HAp/Hep/BMP-2 increased the amount of alkaline phosphatase (ALP) activity, calcium deposition and the levels of OCC mRNA gene expression as compared to those grown on Ti/HAp, Ti/Hep/BMP-2 or pristine Ti. Moreover, Ti/HAp/Hep/BMP-2 exhibited higher bone volume (BV), bone volume/tissue volume (BV/TV), removal torque value and bone–implant contact (BIC) than Ti/HAp, Ti/Hep/BMP-2 or pristine Ti in vivo. Histological evaluations showed that many desirable features of bone remodeling existed at the interface between Ti/HAp/Hep/BMP-2 and the host bone. Consequently, Ti/HAp/Hep/BMP-2 may have potential for clinical use as dental or orthopaedic implants.  
Acknowledgment: This study was supported by a grant from the National Research Foundation of Korea (NRF-2014R1A1A1002630 and NRF-2016R1A2B4014600).

PO-24
Can Nano-Layered Growth and Differentiation Factor-5 Coated onto Zirconia Enhance Osteogenic Differentiation?
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Zirconia (Zr) is also known as a bioincompatible material with favorable mechanical properties as well as low plaque adhesion. In this study, we examined the efficacy of Zr coated with growth and differentiation factor-5 (GDF-5) bonded via click reaction as a substrate to support osteogenic differentiation of MC3T3-E1 cells. Pristine and surface-modified Zr surfaces were characterized by scanning electron microscopy (SEM) and X-ray photoelectron spectroscopy (XPS), resulting that GDF-5 was successfully coated to the pristine Zr surface. GDF-5 coated to Zr surfaces was released for 28 days in a sustained manner. New bone formation onto GDF-5 coated Zr (Zr/GDF-5) surface was confirmed by in vivo test including cell proliferation, alkaline phosphatase activity and calcium deposition assays, and in vivo test including real-time polymerase chain reaction (qPCR) assay including ostein (OSX), runt-related transcription factor 2 (Runx 2), COL 1 (type I collagen) and osteocalcin (OC). Cell proliferation, alkaline phosphatase activity, and calcium deposition of MC3T3-E1 cells were significantly enhanced when the cells were cultured on Zr/GDF-5.
Additionally, the results of qPCR revealed that genes related with osteogenic differentiation were up regulated when the cells were cultured on Zr/GDF-5. Our findings demonstrate that Zr/GDF-5 could be used as a material for enhancing the efficacy of osteogenic differentiation.

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PO-25 Development of Porcine Hybrid Bone Block for Bone Grafting in Dentistry

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The purpose of this study was to develop hybrid bone block using porcine-derived collagen and low crystalline porcine-derived hydroxyapatite to overcome the disadvantages of commonly used bone grafts in dentistry. We added collagen to hydroxyapatite particles to increase the spatial integration of particulate bone grafts. Moreover, we reduced the possibility of transmission of zoonotic disease such as bovine spongiform encephalopathy by using porcine-derived materials. Porcine hybrid bone block had an irregular and interconnecting macroporous structure that was adequate for bone regeneration and bone ingrowth, and it showed a good space-occupying ability to become well positioned. In addition, porcine hybrid bone block showed higher angiogenesis and biodegradability than Bio-Oss Collagen®, a commercialized bone graft used in dental clinics. Principally, high vascularization indicated enhanced bone regeneration by increasing the blood supply to the transplanted site. Our results suggest that the porcine hybrid bone block can be a good alternative to other commercialized dental bone grafts, particularly bovine-derived xenografts and particulate bone grafts.

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PO-26 Preparation of Osteogenic Poly Lactic-co-Glycolic Acid Nanofiber Scaffold Attached Gold Nanoparticles

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Poly(lactic-co-glycolide) (PLGA) is a biocompatible and biodegradable polymer that has been widely used in devices for tissue engineering and drug delivery applications. Gold nanoparticles (GNPs) have also been used as biomaterials and have been found to have a positive effect on bone formation. In this study, we synthesized thiol end-capped PLGA (PLGA-SH) and used it for binding GNPs. This PLGA was processed into a sheet form via electrospinning. GNPs were attached onto the PLGA-SH sheet surface (PLGA-GNPs). Characterization results of the fabricated membranes show that the GNPs are well attached on the PLGA-SH sheet and it is possible to control the amount of attached GNPs. In addition, the in vitro results showed that PLGA-GNPs had good biocompatibility and osteogenic effects towards human adipose derived stem cells. Through these results, we found that the PLGA-GNP fiber can be useful as materials for bone regeneration and can also potentially serve as drug carriers.

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PO-27 Fabrication and Characterization of Phlorotannins/Poly(Vinyl - Alcohol) Hydrogel for Wound Healing Application

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Phlorotannins (PH) derived from brown algae has been shown to have biological effects. However, the application of PH in biomedical materials has not been investigated. Here, we investigated the cell proliferation of PH in normal human dermal fibroblasts (NHDFs), and fabricated composite hydrogel consisting PH and poly (vinyl alcohol) (PVA) (PVA/PH) by a freezing-thawing method for wound healing application. Cell proliferation was significantly higher in PH-treated (0.01 and 0.02%) than cells in non-treated cells. Based on mechanical properties, PVA/PH hydrogel significantly increased swelling ratio and ultimate strain compared to PVA hydrogel, but ultimate tensile strength and tensile modulus was decreased. Additionally, cell attachment and cell proliferation of the composites were evaluated using NHDFs. The result showed that after 1 and 5 days cell attachment and cell proliferation were significantly increased on the PVA/PH hydrogel compared with PVA hydrogel. The findings from this study suggest that the PVA/PH hydrogel may be used as candidate biomedical materials for wound healing applications.

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PO-28 Inorganic Metal Nanorod-Based Dermal Patch for Skin Wound Treatment

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Current treatments for wound healing engage in passive healing processes and rarely participate in stimulating skin cell behaviors for active wound healing. Electric potential difference-derived electrical fields (EFs) are known to modulate skin cell behaviors. Here, a piezoelectric dermal patch is developed that can be applied on skin wound site and EF is generated to promote wound healing. The one-directionally aligned zinc oxide nanorod based piezoelectric patch generates piezoelectric potential upon mechanical deformations induced by animal motion, and induces EF at the wound bed. In vitro and in vivo data demonstrate that the piezoelectric patch promotes the wound healing process through enhanced cellular metabolism, migration, and protein synthesis. This modality may lead to a clinically relevant piezoelectric dermal patch therapy for active wound healing.
PO-29
Fabrication of Mechanically Improved Hydrogel Scaffolds by Incorporating Polymeric Nanorods for Nerve Electrode Application
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Hydrogel-based integral nerve electrodes have been studied as an effective implant strategy for recovery after a spinal cord injury (SCI). However, a weak physical connection between the hydrogel and nerve electrode can lead to implant failure. In this study, we introduce Poly(L-lactic acid) (PLA) nanorods (PLANRs) as a new approach to improve the physical property, i.e. stability of agarose hydrogel-based integrated neuro-electrodes. The hydrogels were characterized by scanning electron microscope (SEM), rheometry, and tensile test machine. Thus, the hydrogels containing PLANRs displayed high mechanical properties. These interesting findings suggest that PLANRs enhance the mechanical properties of integral nerve electrode hydrogels making them useful materials in neural tissue engineering.

PO-30
Tissue Adhesive and Injectable Hydrogel Using Novel Recombinant Tyrosinase for TBI Model
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Therapy with hydrogel scaffold has shown to be promising due to its function, such as tissue adhesive, injectable and anti-inflammation property. In this study, we investigated the therapy effects of biomimetic hydrogel in mouse Traumatic Brain Injury (TBI) model. In this study, we report immune modulating, tissue adhesive and injectable hydrogel based on hyaluronic acid (HA) and (-)-epigallocatechin-3-gallate (EGCG). EGCG, extracted from green tea, is well known for anti-inflammation molecule, and it is composed of multiple phenol groups. With novel recombinant tyrosinase from Streptomyces avermitilis, HA conjugated with EGCG mixed with tyramine conjugated HA formed to gel in a few seconds. This gelation mechanism is differentiated from basic tyrosinase reaction mediated oxygen. Additionally, abundant of quinone groups by tyrosinase reaction made hydrogel tissue adhesive. This newly developed hydrogel will have potential to apply in field of tissue engineering.

PO-31
Comparison of Osteoblast and Osteoclast Differentiation between Magnesium and Machined Surfaced Titanium
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This study focused on in vitro cell differentiation and surface characteristics in a magnesium coated titanium surface implanted on using a plasma ion source. At commercial made pure titanium discs were prepared to produce Ti oxide machined surface (M) and Mg-ncorporated Ti oxide machined surface (MM). Surface properties were analyzed using a scanning electron microscope (SEM). On each surface, alkaline phosphatase (ALP) activity, alizarin red S staining for mineralization of MC3T3-E1 cells, and quantitative analysis of osteoblastic gene expression, were evaluated. Actin ring formation assay and gene expression analysis of TRAP and GAPDH performing RT-PCR were performed to characterize osteoclast differentiation on mouse bone marrow-derived macrophages (BMMMs). MM showed similar surface morphology and surface roughness with M, but was slightly smoother after ion implantation at the micron scale. M was more hydrophobic than MM. No significant difference between surfaces on ALP activity at 7 and 14 days were observed. Real-time PCR analyses showed similar levels of mRNA expression of the osteoblast phenotype genes; osteopontin (OPN), osteocalcin (OCN), bone sialoprotein (BSP), and collagen 1 (Col 1) in cell grown on MM at 7, 14 and 21 days. Alizarin red S staining at 21 days showed no significant difference. BMMMs differentiation increased in M and MM. Actin ring formation assay and gene expression analysis of TRAP showed osteoclast differentiation to be more active on MM. Both M and MM have a good effect on osteoblastic cell differentiation, but MM may speed the bone remodeling process by activating on osteoclast differentiation.

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PO-32
Enhanced MC3T3-E1 Osteogenic Differentiation on rhBMP-2-Imobilized Titanium via Click Reaction
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We report about the efficacy of titanium surface-immobilized with bone morphogenetic protein-2 (BMP-2) via click reaction on enhanced osteogenic differentiation of MC3T3-E1 cells. Surface propargylation(Ti-3), surface heparinization (Ti-6) was done. Scanning electron microscopy observation, static contact angle measurements, surface chemical composition measurements, quantitative analysis of heparin, practical immobilizing amount of BMP-2 on Ti-6, release kinetics of rhBMP-2 from Ti-6, MC3T3-E1 cell proliferation assay, Alkaline phosphatase (ALP) activity assay, Calcium deposition assay, and Real-time polymerase chain reaction (real-time PCR) were initiated. All experiments were carried out three times. The surface was characterized by static contact angles and XPS measurements, which indicated that pristine titanium (Ti-3) was successfully surface-modified via click chemistry (aminated titanium, Ti-4). By quantitative analysis of heparin immobilized on aminated titanium (Ti-4), we found that the Ti-4 can be used as a good candidate to immobilize biomolecules such as heparin. BMP-2 from titanium immobilized with BMP-2 (Ti-6) was released for a period of 28 days in a sustained manner. The highest proliferation rate of MC3T3-E1 cells was observed on Ti-6. Through in vitro tests including alkaline phosphatase (ALP) activity, calcium deposition and real-time polymerase chain reaction (real-time PCR), we found that Ti-6 can be used as a good implant to enhance the osteogenic differentiation of MC3T3-E1 cells.

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PO-33
Gold Nanoparticle–Hydrogel Complex Can Enhance Bone Regeneration
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Gold nanoparticles (GNPs) are widely used in diagnostics, drug delivery, biomedical imaging, and photothermal therapy due to their surface plasmon resonance, fluorescence, and easy-surface functionalization. According to recent studies, GNPs display a positive effect on the osteogenic differentiation of mesenchymal stem cells.
(MSCs) and MC3T3-E1 osteoblast-like cells. The aim of this study was to develop a new approach for bone tissue regeneration based on the utilization of a biodegradable hydrogel loaded with GNPs.

We used photo-curable gelatin hydrogels (Gel) in order to provide a proof of principle of GNPs in regeneration strategies for bone tissue repair. We investigated the effects of these Gel-GNP composite hydrogels both in vitro and in vivo. The hybrid hydrogel was formed by irradiating a mixture of a photo-initiator, methacrylated gelatin (GelMA) and GNPs with ultraviolet (UV) light. The content and distribution of GNPs in the GelMA solution and hydrogel were determined by UV-Vis spectroscopy, differential scanning calorimetry (DSC) and thermograms analysis (TGA). The GNPs embedded in a gelatin hydrogel were evaluated for their capacity to induce osteogenic differentiation of human adipose-derived stem cells (ADSCs). The in vitro results showed that the hydrogels loaded with GNPs promote proliferation, differentiation, and alkaline phosphate (ALP) activities of human adipose-derived stem cells (ADSCs) as they differentiate towards osteoblast cells in a dose-dependent manner. Moreover, the in vivo results showed that these hydrogels loaded with high concentrations of GNPs had a significant influence on new bone formation.

The Gel-GNP displayed significantly higher new bone formation in animal tests. Through these in vivo and vitro tests, we found that the Gel-GNP can be a useful material for bone tissue engineering. Acknowledgment: This study was supported by a grant from the National Research Foundation of Korea (NRF-2014R1A1A1002630 and NRF-2016R1A2B4014600)

PO-34
Osteogenic Differentiation Stimulated by Alendronate-Eluting Biphasic Calcium Phosphate (BCP) Scaffolds

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This study was to investigate whether ALN/BCP scaffolds can effectively improve in vitro osteoblast activity and osteogenic differentiation and to demonstrate whether ALN/BCP scaffolds have great potential for bone regeneration.

We developed ALN-eluting BCP (ALN/BCP) scaffolds as local delivery system for improving bone formation. Based on the fact that ALN has a high binding affinity to the bone mineral hydroxyapatite (HAp), we fabricated ALN/BCP scaffolds by simply mixing BCP scaffolds with ALN. The coating of ALN on BCP scaffolds was confirmed by scanning electron microscopy (FE-SEM), energy-dispersive X-ray spectroscopy (EDS) and in vivo because both HAp and simvastatin have the characteristic of osteogenic induction. The timing of cranioplasty was sequentially surface-treated with NaOH, 1,3-carboxyramidineazone (CD), beta-cyclodextrin-immobilized HAp powders (CD/HAp), and simvastatin before analysis using scanning electron microscopy (SEM), X-ray photoelectron microscopy (XPS), and static contact angle measurement. Simvastatin was released continually for up 28 days. Modification of the Ti surface with nano-sized HAp and simvastatin (Ti/CD/HAp/Sim) discs enhanced the osteogenic differentiation of MC3T3-E1 cells in vitro. Furthermore, Ti/CD/HAp/Sim discs can effectively enhance bone formation in vivo and in vivo because both HAp and simvastatin have the characteristic of osteogenic induction. The aim of the present study was to evaluate whether coating pristine titanium (Ti) with nano-sized hydroxyapatite (HAp) and simvastatin could enhance bone formation and osseointegration in vitro and in vivo because both HAp and simvastatin have the characteristic of osteogenic induction. The timing of cranioplasty and method of bone flap storage are known risk factors of non-union and resorption of bone flaps. In this animal experimental study, we evaluated the efficacy of cranioplasty using frozen autologous bone flap, and examined whether the timing of cranioplasty after craniectomy affects bone fusion and new bone formation.

The Gel-GNP displayed significantly higher new bone formation in animal tests. Through these in vivo and vitro tests, we found that the Gel-GNP can be a useful material for bone tissue engineering. Acknowledgment: This study was supported by a grant from the National Research Foundation of Korea (NRF-2014R1A1A1002630 and NRF-2016R1A2B4014600)

PO-35
Preliminary Report on New Bone Formation & Fusion Relevant to Timing of Cranioplasty via Frozen Autologous Bone Flaps in Rabbits: Micro-CT Scans & Tissue Staining Analysis

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Photo-therapeutic cancer therapy (PTT) is a light based molecular targeted cancer therapy, which uses electromagnetic radiations most often in infrared wavelength for the treatment of cancer. In this study, we are proposing NIR dye loaded CD 44 targeted micelles of 280 nm size. Upon injection into the body, NIR dye loaded CD 44 targeted micelles will be distributed throughout the body and selective accumulate in tumor by the over-expression of CD 44 receptor on the tumor cell surface. Upon irradiation with an 808 nm laser (2W/cm2) for 5min, tumor cells in the area of illumination would be killed by the heat produced by the NIR dye loaded CD 44 targeted micelles and subsequently reduced the tumor burden. The results of tumor reduction study demonstrated significant tumor reduction by CD 44 targeted micelles upon laser irradiation, however CD 44 targeted micelles without laser irradiation don't elicit any tumor reduction. Therefore, the present study suggests that the CD 44 targeted micelles have better tumor targeting abilities displaying their potential for targeted PTT for cancer therapy.

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PO-38
Photo and Redox Responsive Albumin-Polyplex Nanocomplex for Enhanced Gene Delivery in Breast Cancer Cells
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Photo-triggered gene release can play a pivotal role in enhancing gene transfection efficiency with minimum toxicity. In the current study, a photothermally controlled gene releasing nanocomplex was developed by complexing peptide conjugated cationic polyplex with NIR dye loaded protein. This nanocomplex forms a stable nano-sized complex with plasmid DNA and shows higher gene transfection efficiency without any sign of cell toxicity in metastatic breast cancer cells. Moreover, the nanocomplex demonstrates an enhanced gene transfection efficiency upon NIR irradiation from 808 nm laser, which is attributed to accelerated endosomal escape of polyplexes augmented by locally induced heat in endosomal vesicles. To investigate the endosomal escaping effect and redox triggered gene release of the nanocomplex, proton sponge and glutathione inhibitors were employed and the endosomal escape of polyplexes augmented by nanocomplex upon irradiation and redox mediated gene release from the polyplex was confirmed. With addition of cell penetrating peptide to the nanocomplex, tumor penetration was achieved in tumor spheroid upon irradiation and redox mediated gene release from endosomal escape mediated by the local heat generated by the NIR dye loaded polyplex.

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layer was grafted on the PHBV mat by electron beam irradiation. The average diameter of the nanofibers was determined by SEM. ATR-FTIR and ESCA were used to confirm the grafting of PIPAAm onto the PHBV nanofiber surface. Water contact angles on the mats were measured. Human adipose-derived stem cells (ADSCs) were cultured on the PIPAAm-grafted PHBV mat to investigate cell proliferation, recovery, and functionality during repeat subculture. Detached ADSCs from each surface by low temperature treatment and trypsin-EDTA were compared by a fluorescence-activated cell sorter (FACS) using expression of stem cell membrane-specific markers such as CD-13 PE, CD-29 PE, and CD-90.

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PO-42

Conversion from 2D to 3D Cell Culture Using Micro-Patterned Responsive Materials

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Cell therapy which could overcome limitations of chemical and protein drugs suggests new paradigm. Cell therapy is the treatment in which therapeutic cells are injected into a patient. To deliver cells to patient, direct injection of cell suspension is commonly used. However, it has limitations that cells are easily diffused, have low survival rate and hard to sustain on target tissue. Therefore, cell sheet delivery method and cell spheroid therapy could be alternative cell delivery modality to efficiently deliver cells to patient. Cell spheroid has various advantages such as excellence in mimicking cellular microenvironment and increase in ECM secretion. Thus, it is being used for in vitro model studies and regenerative medicine. To effectively utilize cell spheroid in regenerative medicine, we need a large amount of cell spheroid with uniform size. Although many methods have been developed for spheroid formation, such as, hanging drop culture, spinner flask culture and ultra-low attachment plate, there are some limitations in respect for control over spheroid size and mass production. And these techniques are labor intensive.

To overcome these limitations, we developed a system that can control uniformly distributed spheroid size in a bulk production. We fabricated micro-patterned thermo-responsive hydrogels using micro contact printing technique using mussel inspired molecules for regulation of cell adhesion, which was able to be detached and re-contact printing technique using mussel inspired molecules for Future Planning.

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PO-43

Fabrication of Plasma Filtration Membrane Comprising Photo-Crosslinkable Zwitterionic Polymers with Anti-Biofouling Properties

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The purpose of this research is to fabricate anti-biofouling plasma filtration membrane with average pore diameter of less than 2μm via electropinning process. In order to achieve this, random-type terpolymer consisting of zwitterionic phosphorylcholine (PC) group and UV-crosslinkable phenyl azide group was synthesized. Zwitterionic PC group was adopted for providing anti-biofouling property and phenyl azide group was chosen as stable crosslinker for hydrophobic PC group in aqueous medium. The membrane containing zwitterionic PC group showed remarkably decreased protein adsorption and platelet adhesion. The membrane’s blockage resulting from the platelet adhesion was analyzed by the BET experiment. The filtration performance of the prepared membrane was tested by filtering Platelet-Rich-Plasma solution, and 95% of platelet was filtered by the prepared membrane. In conclusion, UV-crosslinkable zwitterionic polymer is useful in preparing anti-biofouling blood-filtration membrane.

PO-44

Surface Zwitterionization of Hydroxyapatite to Prevent Oral Bacterial Adhesion

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The purpose of the present study is to synthesize copolymers containing zwitterionic functional group capable of being immobilized on the tooth surface to inhibit oral bacterial adhesion. The strategy is to synthesize zwitterionic copolymers containing Ca2+-binding moieties for strong interaction with hydroxyapatite (HA), which is main component of enamel surface. To this end, a 2-methacryloyloxyethyl phosphate (MOEP) monomer was synthesized and copolymerized with three zwitterionic monomers, i.e., 2-methacryloyloxyethyl phosphorylcholine (MPC), sulfobetaine methacrylate (SBMA) and carboxybetaine methacrylate (CBMA), by free radical polymerization, respectively. The coating efficiency of the synthesized copolymers onto a HA surface was estimated by means of contact angle measurement and X-ray photoelectron spectroscopy (XPS). The anti-biofouling nature of zwitterionic copolymer-coated surfaces was estimated by analyzing protein adsorption and Streptococcus mutants adhesion. As a result, amounts of adsorbed protein and adhering Streptococcus mutants were remarkably decreased when HA disks were coated with zwitterionic copolymers. Furthermore, it was confirmed that MPC-containing copolymer showed the best anti-biofouling property among the three zwitterionic copolymers.

[References]
γ-poly(glutamic acid) (γ-PGA) is a representative ingredient of natto, produced by Bacillus subtilis, which made of glutamic acid units connected by amide linkages between α-amino and γ-carboxylic acid group. As a FDA GRAS (generally recognized as safe) material, it has been widely used in food industry. In biomedical field, γ-PGA has been widely studied as biomaterial due to its excellent muco-adhesive property, biocompatibility, and biodegradability. Recently, it has been reported to have the ability to prevent postsurgical tissue adhesion. Such properties are suitable for applications as surgical sealant that many trials were progressed for utilizing γ-PGA as a hydrogel-type biomedical material. In this study, we developed γ-PGA based in situ forming hydrogel as surgical sealant. Carboxyl group of γ-PGA was modified to NHS (N-hydroxysuccinimide) activated ester by carbodiimide chemistry. Then, NHS activated γ-PGA was mixed with multi-functional nucleophile (ε-polylysine) and 4-armed PEG-amine) to form crosslinked adhesive hydrogel. This hydrogel showed rapid gel formation (<1 min) as well as the high adhesiveness and cohesiveness. In addition, it degraded completely in PBS solution within 56 days. In conclusion, it is expected that this hydrogel can be used for in situ forming surgical sealant.

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POSTER SESSION (2)

- Thursday, July 13\textsuperscript{th} ~ Friday, July 14\textsuperscript{th}

- 9:00 to 18:00 – PO-46~PO-93
Acknowledgment: This work was supported by Brain Korea 21 Plus Future Biopharmaceutical Human Resources Training and Research Team PO-48

Evaluation of Electrospun Chitosan/PVP Nonwoven Nanofiber Fabric as Anti-Adhesion Membranes

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Post-operative peritoneal adhesions are common and give serious complications for human. They can cause pelvic pain, infertility, and potentially lethal bowel obstruction. There are many requirements for polymeric material forms such as film, membrane and hydrogel type to be used as tissue adhesion barriers. They should include flexibility, non-tissue adhesiveness, biodegradability and non-toxicity in the body. Chitosan is the deacetylated derivative of chitin, which is the second most abundant polysaccharide found on earth next to cellulose. It comprises copolymers of glucosamine and N-acetyl glucosamine and has a combination of many unique properties such as nontoxicity, biocompatibility and biodegradability. In this study, we fabricated and evaluated the effect of bilayer sheet containing non-steroidal anti-inflammatory drug on the prevention of post-surgical tissue adhesion. Bilayered nanofibrous sheets composed of chitosan and polyvinylpyrrolidone(PVP) were fabricated by electrospinning method. The bilayered Chitosan/PVP nanofibrous sheet was characterized by several spectoscopic methods, in vitro and in vivo test. From in vivo animal test, it was observed that nanofibrous sheets were significantly effective in preventing post-operative adhesion and wound healing.

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PO-49

Enzyme-Mediated Injectable CMC/Pullulan Hydrogels as Anti-Adhesion Barriers

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An injectable adhesive hydrogel composed of carboxymethyl cellulose (CMC) and pullulan is developed and evaluated as a postoperative anti-adhesion barrier. CMC was modified with tyramine to introduce crosslinking via an EDC-NHS reaction. The in situ hydrogel was developed by an enzyme-mediated reaction of tyramine-immobilized CMC with horseradish peroxidase (HRP) and hydrogen peroxide (H2O2). Pullulan was added to the hydrogel solution to improve adhesiveness to the wound area and accelerate biodegradation. The modified CMC was confirmed by ATR-FTIR spectroscopy. The gelation time, storage modulus (G'), and weight loss of the hydrogels were measured as functions of the amounts of HRP and H2O2. The hydrogel group showed negligible cell proliferation without cytotoxicity, compared to that shown by the control group. The in vivo animal test demonstrated that significant decrease of postoperative tissue adhesion by applying the hydrogels. The CMC-pullulan hydrogel could be a useful treatment as an injectable in situ anti-adhesive agent.

Acknowledgement: This research was supported by the Human Resource Training Program for Regional Innovation and Creativity funded by the Ministry of Education and National Research Foundation (NRF-2014H1C1A1066917); the Basic Science Research Program
PO-50
Stimuli-Sensitive Degradable Graphene Quantum Dots for Breast Cancer Therapeutics

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Graphene Quantum Dots (GQDs) have been widely used for theragnosis for cancer disease. However, one of the current challenges is considerably difficult to release therapeutic drugs to targeted site. In this study, we modified GQDs that introduce hereceptin through polyethylene glycol and disulfide bond to induce active targeting for specific cells and control the drug release. The resulting of UV spectroscopy, Fluorescence, Fourier Transform Infrared showed that GQD-complex was conjugated successfully. The cell viability was presented that GQD-complex had a substantial effect on HER2-overexpressing breast cancer cells. In conclusion, this optical imaging by confocal laser scanning microscopy indicated to increase a half-life and a stability of the BMP-2.

PO-51
BMP-2 Linked Thermosensitive Injectable Hydrogel for Osteogenic Differentiation

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Recently, bone morphogenetic proteins (BMP), BMP-2 and BMP-7, are used for bone treatments. However, the amounts of BMP for treatments is much higher than physiological concentration, because of short half-life and instability of the BMP. In this study, we prepared the MPFEG-b-(ε-caprolactone–ran-a-chloro-ε-caprolactone) (MC-CI), and then chlorides of the MC-CI are modified to azides (N 3). The BMP-2 including alkyne group was chemically introduced MC-CI by cycloaddition. BMP-2 linked MC-CI (MC-BMP2) was dispersed at distilled water. Microsphere solution was blended with human periodontal ligament stem cells (hPDLSC) and implanted to dorsum of nude mouse by subcutaneous incubation at 37 oC for 2 days, the HP became liquid. In contrast, HA remained solid for 30 days at 37 oC. The cumulative in vitro release of BMP-2 can help hTMSCs differentiation. Differ entiation to osteoblasts in vivo was evaluated by observing mineral matrix deposition. The hydrogel implants were stained with von Kossa (VK) and Alizarin Red S (ARS) to analysis mineralized bone formation associated with osteogenic differentiation of hTMSCs. As a result, electrostatic attraction affects osteogenic differentiation. In other words, BMP-2 complexation more effectively through sustained released BMP-2 and apply to tissue engineering fields in many ways.

Acknowledgment: This study was supported by a grant from a Basic Science Research Program (2016R1A2B3007448).

PO-52
Osteogenic Differentiation of Human Turbinate Mesenchymal Stem Cells in Cationic Hydrogel

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In tissue engineering, stem cell treatment can fundamentally regenerate the functions of various tissues and organs that have been damaged, unlike conservative treatment. Human turbinate mesenchymal stem cells (hTMSCs) can be used as such a solution. A polyester copolymer having a cationic functional group is forming an electrostatic attraction with a bone morphogenetic proteins-2 (BMP-2) having a negative charge. The copolymers were synthesized via the ring-opening. The goal of this experiment is to produce a polyester copolymer hydrogel with cationic functional groups, which makes conditions that sustained release of BMP-2 can help hTMSCs differentiation. Differentiation to osteoblasts in vivo was evaluated by observing mineral matrix deposition. The hydrogel implants were stained with von Kossa (VK) and Alizarin Red S (ARS) to analysis mineralized bone formation associated with osteogenic differentiation of hTMSCs. As a result, electrostatic attraction affects osteogenic differentiation. In other words, BMP-2 complexation more effectively through sustained released BMP-2 and apply to tissue engineering fields in many ways.

Acknowledgment: This study was supported by a grant from a Basic Science Research Program (2016R1A2B3007448).

In my laboratory, we describe the preparation of dexamethasone-loaded microsphere/in situ-forming hydrogels formulation to achieve desired therapeutic levels over a specific period. Dexamethasone-loaded microspheres were prepared using a mono-axial nozzle ultrasonic atomizer, varying a number of parameters to determine optimal conditions. The resulted in a dexamethasone encapsulation efficiency of ~ 63% and a particle size of ~ 70 um. Injectable formulations were prepared by mixing dexamethasone-loaded microspheres and pluronic(HP) or hyaluronic acid(HA) solution. All formulations were prepared as solutions and became gelation at 37 °C. However, after incubation at 37 °C for 2 days, the HP became liquid. In contrast, HA remained solid for 30 days at 37 °C. The cumulative in vitro release resulted in a sustained release of dexamethasone that maintained up to 28 days. In conclusion, we believe the results of the present study provide potential into sustained pharmacological performance and represent a useful experimental platform using microsphere/in situ-forming hydrogel combination system for future drug delivery system.

In this presentation, I will introduce the potential and useful experiment platform using drug-loaded microsphere/in situ-forming hydrogel combination system for future drug delivery system.

Acknowledgment: This study was supported by a grant from a Basic Science Research Program (2016R1A2B3007448).
PO-54
Preparation of Cross-Linked PCLG/Cartilage Acellular Matrix Film with Adjustable Mechanical Properties and Feasibility Test as Anti-Adhesive Film

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Many people suffer intestinal adhesion after an abdominal operation. Among them the study for producing the anti-adhesion agent is becoming noticeable. We are using only nature materials, it shows the limits that cannot withstand a sufficient degradation period. In this study, we made cross-linked cartilage acellular matrix film (Cx-CP film) using biodegradable PCLG cross-linker and treated by heating. The Cx-CP film showed we controlled mechanical properties through tensile strength and contact angle. Cx-CP and thermal-treated Cx-CP film have a good mechanical properties compared uncross-linked cartilage acellular matrix film (CAM film). Next, we investigated the in vitro experiment through the fluorescence image(PKH67), scanning electron microscopy(SEM), and MTT assay using human umbilical vein endothelial cells (HUVECs) to confirm that the anti-adhesive properties. In in vitro experiment, Cx-CP and thermal-treated Cx-CP film not represented attachment and proliferation compared CAM film.

In conclusion, we presented that the Cx-CP and thermal-treat Cx-CP film must be suitable anti-adhesive film with controllable mechanical properties.

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PO-55
Synthesis and Evaluation of Crosslinkable Ionic Functionalized Polyester Diblock Copolymers by Electrostatic Interaction

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Recently, various diblock copolymers consisting of methoxy (poly(ethylene glycol) (MPEG) and biodegradable polymers such as polycaprolactone, polylactide, polyglycolide, or their copolymers, have been actively conducted as potential candidates for DDS materials. MPEG-b-PCL (PCL) has been widely used as an active substance carrier, but it is so flexible and suitable for long-term delivery system because of its high crystallinity and low degradation rate. In this work, we focused on the preparation of PCfCL copolymers with carboxyl anionic groups (PCfCL-COOH) and amine cationic groups (PCfCL-NH2), and then we examined the physical properties of the mixture of PCfCL-COOH and PCfCL-NH2.

The PCfCL diblock copolymer was synthesized via the ring-opening polymerization of the monomer CL and FCL using the terminal alcohol of MPEG. Then PCfCL-OH, PCfCL-COOH and PCfCL-NH2 were prepared in intended ratio by using of PCfCL. The diblock copolymer solutions were prepared by dissolution in 20 wt% concentrations. Each diblock copolymer, the mixture of PCfCL-COOH and PCfCL-NH2, and diblock copolymer with crosslinkers containing counterion were individually characterized by rheometer. The viscosity of the mixture appeared between the two peaks of each copolymer. Especially, the viscosity of diblock copolymer with crosslinker containing counterion increased at low temperature depending on the equivalent weight of the crosslinker. The different behavior of sol-to-gel phase transition exhibited at PCfCL-COOH, PCfCL-NH2, the mixture of them and crosslinker added diblock copolymer solutions. In conclusion, we confirmed that the physical properties of the diblock copolymers can be controlled through the electrostatic interaction of the ion functionalized groups and the crosslinker, which indicated that the ionic functionalized PCfCL could be used as a potential material in the biomedical and cosmeceuticals fields.

Acknowledgment: This study was supported by a grant from a Basic Science Research Program (2016R1A2B3003744).

PO-56
Human Dental Pulp Stem Cells Loaded In Situ-Forming Hydrogel for In Vivo Osteogenic Differentiation

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In this research, human dental pulp stem cells (hDPSCs) are evaluated as a cellular source for bone tissue engineering using an in vivo-forming hydrogel. The hDPSCs are simply harvested in great quantities from extracted teeth. The stemness of harvested hDPSCs shows their relative tolerance to ex vivo handling in culture. The in vitro osteogenic differentiation of hDPSCs is characterized using alkaline phosphatase (ALP), Alizarin Red S (ARS), and von Kossa (VK) staining. The solution of hDPSCs and a methoxy polyethylene glycol-b-polycaprolactone block copolymer (PC) is readily prepared by simple mixing at room temperature and in no more than 10 s it forms in vivo hydrogels after subcutaneous injection into rats. In vivo osteogenic differentiation of hDPSCs in the in vivo-forming hydrogel is confirmed by micro-computed tomography (CT), histological staining, and gene expression. Micro-CT analysis shows evidence of significant tissue-engineered bone formation in hDPSCs-loaded hydrogel in the presence of osteogenic factors. Differentiated osteoblasts in vivo-forming hydrogel are identified by ARS and VK staining and are found to exhibit characteristic expression of genes like osteonectin, osteopontin, and osteocalcin. In conclusion, hDPSCs embedded in an in vivo-forming hydrogel may provide benefits as a noninvasive formulation for bone tissue engineering applications.

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PO-57

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Quercetin (Qtn) is a flavonoid materials and is known for enhancing the osteogenic differentiation of adipose-derived stem cell and osteoblastic MC3T3-E1 cells. Collagen is mainly used for cartilage, bone and skin regeneration due to its well-known biocompatibility, biodegradability. We prepared duck’s feet collagen solution and mixed quercetin with different ratios and then lophilized. We evaluated porosity, compressive strength, MTT assay, ALP assay, SEM, RT-PCR, and etc. We found tendency related decrease in porosity with increasing Qtn content in the sponges. In contrast, compressive strength was increased. Notably, cell proliferation and osteogenic differentiation are highest in 25μM. RT-PCR result showed that real-time quantitative (RQ) values of OCN, RUNX2 and COL1 on the 25μM Qtn/DC/HAp sponges displayed highest expressions. In vivo test showed that 25Qtn/DC/HAp is highest bone volume and bone mineral density. Conclusively, 25μM/DC/HAp sponges can be envisioned as a promising biomaterial for bone regeneration.

Acknowledgment: This research was supported by Technology Commercialization Support Program (814005-03-3-HD020), MIFAFF, Republic of Korea.
PO-58
Preparation of New Low Viscosity Urethane Dimethacrylates for Dental Composites

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In this study, three-dimensional scaffolds based on blends of duck’s feet collagen (DC) and Poly (lactic-co-glycolic acid) (PLGA) with different pore sizes i.e. 90-180, 180-250, 250-355 and 355-425 μm were prepared using solvent casting/salt leaching approach. As-fabricated scaffolds were characterized by SEM, pore size and porosity. The cell proliferation and gene expression were investigated after culturing costal chondrocytes on each scaffolds using 3-(4, 5-dimethylthiazol-2-yl)-2, 5 diphenyltetrazolium bromide (MTT) assay and qRT-PCR. In vivo histological staining was performed in nude mice as models. The biological evaluation showed a pore-size dependent chondrification at different time points. Especially, the 355-425 μm DC/PLGA scaffold showed a highest positive impact on maintenance of cell proliferation, costal chondrocyte phenotype and increased GAG accumulation than the other groups. These results indicated that DC/PLGA scaffolds with pore size ranging from 200-425 μm can be considered as highly-suitable constructs for enhanced chondrification. Acknowledgment: This research was supported by Technology Commercialization Support Program (B1400S-03-3-HD020), MIFAFF, Republic of Korea.

PO-59
A Comparative Study on Duck’s Feet and Porcine Collagen for Prompt Bone Regeneration

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Silk is a well-studied biomaterial for various biomedical applications owing to its properties biocompatibility and biodegradability. Quercetin (Qtn) is a type of flavonoids, mostly found in onion and apple skin, and has been reported to affect osteogenesis, anti-inflammatory and antioxidant. Hydroxyapatite (HAp) is biodegradable and osteo-conductive biomaterial, widely used in tissue engineering. In order to increase osteogenic differentiation, 0, 0.03, 0.05 and 0.1 wt% Qtn-functionalized silk fibroin/HAp scaffold was fabricated for bone regeneration study. In this study, cell proliferation was found to decrease with an increased Qtn content in the scaffolds, as shown by ALP, MTT, RT-PCR, and SEM results. In contrast, osteogenic differentiation strength was increased. However, osteogenic differentiation is higher in Qtn/SF/HAp scaffolds than SF/HAp scaffolds. Notably, osteogenic differentiations are highest in 0.03 wt% Qtn/SF/HAp scaffold. Acknowledgment: This study was the Bio & Medical Technology Development Program (NRF-2012M3A6C6050204) and Technology Commercialization Support Program (B1400S-03-3-HD020), Ministry for Food, Agriculture, Forestry and Fisheries, Republic of Korea.

PO-61
Evaluation of Quercetin Loaded Silk Fibroin/Hydroxyapatite Scaffolds for Bone Tissue Engineering

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Silk is a well-studied biomaterial for various biomedical applications owing to its properties biocompatibility and biodegradability. Quercetin (Qtn) is a type of flavonoids, mostly found in onion and apple skin, and has been reported to affect osteogenesis, anti-inflammatory and antioxidant. Hydroxyapatite (HAp) is biodegradable and osteo-conductive biomaterial, widely used in tissue engineering. In order to increase osteogenic differentiation, 0, 0.03, 0.05 and 0.1 wt% Qtn-functionalized silk fibroin/HAp scaffold was fabricated for bone regeneration study. In this study, cell proliferation was found to decrease with an increased Qtn content in the scaffolds, as shown by ALP, MTT, RT-PCR, and SEM results. In contrast, osteogenic differentiation strength was increased. However, osteogenic differentiation is higher in Qtn/SF/HAp scaffolds than SF/HAp scaffolds. Notably, osteogenic differentiations are highest in 0.03 wt% Qtn/SF/HAp scaffold. Acknowledgment: This study was the Bio & Medical Technology Development Program (NRF-2012M3A6C6050204) and Technology Commercialization Support Program (B1400S-03-3-HD020), Ministry for Food, Agriculture, Forestry and Fisheries, Republic of Korea.

PO-62
Microwave-Assisted Preparation of Silk Fibroin-Based Carbon Quantum Dots

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A biocompatible silk fibroin-based carbon quantum dot (SF-CQD) was first synthesized under microwave irradiation with a reaction time of only 20 min. FTIR, XPS, and XRD results indicate that SF-CQDs have N, O-containing functional groups on the surface which results in good water solubility and biocompatibility. The good photoluminescence stability and optical properties indicate the potential of using SF-CQDs as bio-imaging probes. Due to its small particle size, the SF-CQDs were rapidly spread and cleared out from the animal body within 18 h after intravenous injection and no undesired accumulation of SF-CQDs in the organs were observed. These properties show the great potential of these SF-CQDs for use in biomedical applications including bio-imaging, bio-sensing, and drug delivery systems.

**PO-63**

**Vertical Bone Augmentation Using rhBMP2-Loaded Dental Implant Combined with 3D-Printed Scaffolds: Experimental Study in Rabbit Calvarial Model**

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The aim of this study was to determine the effect of recombinant bone morphogenetic protein-2(rhBMP2)-loaded dental implant fixture in combination with 3D-printed scaffolds that were placed for vertical bone augmentation in rabbit calvarium. In this study, 3D-printed scaffold(with average macropore sizes of 100 µm) were placed with dental implants installation with or without rhBMP2 to the calvarial bone surface of rabbits. The used scaffold frame was made with polycaprolactone(PCL) by applying 3D plotting technology and then it was fabricated by filling particles inside. The particles were composed of hydroxyapatite(HA), tricalcium phosphate(β-TCP), polycaprolactone(PCL), polyethylene oxide(PEO) and sodium chloride powder. Polyethylene oxide(PEO) and sodium chloride were removed by leaching out in distilled water for 24 hours to form pores inside. The experimental sites of rabbits were divided into three groups: dental implant with scaffold only(G1, control), rhBMP2-loaded dental implant with scaffold(G2, test 1), and dental implant with rhBMP2-loaded scaffold(G3, test 2) groups. After 8 weeks, histologic and histomorphometric analysis were performed to evaluate the resulting bone-to-implant contact and new bone formation. The BIC(bone-to-implant contact ratio) and newly formed bone area within the augmented area were significantly greater in specimens containing rhBMP2(G2, G3) than in the control group(p<0.05). Group 2 and 3, rhBMP2-loaded groups, and there was no significant difference statistically.

In conclusion, rhBMP2-loaded 3D-printed scaffold and dental implant fixture exhibited enhanced osteoinductive potential, and they could be a good candidate as a carrier of rhBMP2 for bone regeneration.

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**PO-64**

**Colorimetric Contact Lens Containing Cerium Oxide Nanoparticles for Detecting Glucose in Tear**

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A contact lens is ideal to monitor glucose levels in tear. We designed a contact lens-based biosensor comprised of glucose oxidase (GOX) and cerium oxide nanoparticle (CNP) to detect glucose levels in tear. GOX catalyzes the oxidation of glucose to H2O2 and gluconolactone. Then, CNP catalyzes the reduction of H2O2. At this moment, Ce3+ being colorless shift to Ce4+ state that is shown yellow color. Glucose levels can be determined by analyzing the change of color. B value of RGB color is used to determine glucose levels, being shown the correlation with glucose concentration. To confirm the synthesized CNP structure, we perform the XPS, XRD, HR-TEM. GOX is immobilized on a modified-CNP using PEG spacer; it is CNP-PEG-GOX. The formation of CNP-PEG-GOX is determine via quantitative analysis of GOX. The contact lens sensor maintains its mechanical properties compared with HEMA contact lens and has correlation with glucose levels in buffer and artificial tear.

**PO-65**

**Determination of Human Induced Pluripotent Stem Cells into Corneal Epithelium Like Cell**

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Human iPSCs (RBTC-HPS0063) were maintained under feeder free culture systems, on which coated cell culture plates with vitronectin, in Essential 8 medium. Confluent iPSCs were gradually changed to epithelial differentiation medium with combination of BMP4/IWP2/KGF treated iPSCs. Whereas, corneal stem cell marker, ABCG2, is more strongly in BMP4/IWP2/Wnt3a treated iPSCs. Moreover, we obtained multilayered corneal epithelial cells by air-lift culture assay in both treated cells. This differentiation system and the resulting hiPSCs-derived cornea cells will also offer opportunity to study the molecular and cellular mechanisms underlying human cornea development.

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Cell-Encapsulated Photocurable Gelatin/β-Tricalcium Phosphate Hydrogel Scaffold for Bone Regeneration

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Bone defect generally has been emerged by inherited factors, unpredictable accident and critical disease. Patients who had bone defects were disordered physical or functional side. There are many bone graft materials which had a difficult to maintain their form itself have been used to fill up bone defect sites. To overcome this disadvantage of bone graft materials, we were manufactured gelatin-based hydrogel which were retained its form and shape-controlled without other assistance tool. Hydrogel-forming natural polymers include proteins such as collagen, gelatin and polysaccharides have been used in the tissue engineering because of their hydrophilic structure and biocompatible characteristic. Gelatin, derived from collagen is plentiful and biocompatible materials for cell-responsive hydrogel platform for creating cell-encapsulated devices.

In this presentation, we introduced photocurable and biodegradable Gelatin Methacrylate (Gel-MA) blended with pure phase β-tricalcium phosphate (β-TCP) hydrogel. Using cell cytotoxicity assay, this scaffold showed a remarkable value. The natural polymer gelatin based scaffold satisfies the requirements of biofunctionality and mechanical tenability to a reasonable extent, particularly compared with other available hydrogel-foaming biomaterials. By using 3D cell culture platform, it provides the possibility to generate well-defined 3D tissue constructs. Therefore, our photocrosslinkable Gel-MA/β-TCP hydrogel is helpful material for patient who has defect bone sites.

Cytotoxicity Evaluation of Black Phosphorus Against Fibroblastic Cells

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During the past decades, various types of nanomaterials have been introduced and suggested for biomedical applications, such as cellular imaging, diagnosis, therapeutics, and drug delivery. Black phosphorus (BP) has recently emerged as one of the most attractive novel nanomaterials due to its unique optical and electronic properties, including tunable energy gap, relatively high carrier mobility and intrinsic anisotropy. BP is a two-dimensional nanomaterial where phosphorines are stacked together by van der Waals interactions. Because of its excellent optical and electronic properties, there have been significant efforts to employ BP as an optoelectronic material. However, the biocompatibility and biological effects of BP remain largely unknown.

In the present study, the potential cytotoxicity of BP in three different types of fibroblastic cells (i.e., primary cultured fibroblast, fibroblast cell line and fibrosarcoma cell) was investigated. The physicochemical properties of BP were characterized by scanning electron microscopy, Raman spectroscopy, and zeta size. The cytotoxicity of BP was examined by assessing metabolic activity and plasma membrane integrity. Our results showed that the BP had spherical morphology with a nanometer-scale diameter. In addition, it was demonstrated that the cytotoxicity of BP was highly dependent on its concentration and cell type. In conclusion, our findings suggest that the BP can be very toxic at sufficiently high concentrations, and that further comprehensive studies must be conducted to evaluate the biocompatibility and biological effects of BP.

Effect of Serum Types on Chondrogenic Differentiation of Adipose Derived Stem Cells

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Fetal Bovine Serum (FBS) is the most important supplement for cell proliferation, function, metabolism and differentiation. But due to limited demands and rising prices, many researchers have studied replaceable sera to substitute FBS. In this experiment, chondrogenic differentiation ability of ADSC using Bovine Serum (BS), Newborn Calf Serum (NCS) in chondrogenic medium was evaluated using Live and Dead assay, DNA assay and Real-Time PCR. ADSCs were cultured in 12-well plate for 2 weeks using chondrogenic medium consisting of different serum and added IGF-1 and TGFβ3 or not. And at day7 cell passage was performed to prevent cell stress due to lack of space. At day 7 and day 14, live and dead assay, DNA assay and RT-PCR were performed. Live and Dead and DNA assay results showed that at FBS group was good at proliferation regardless of exogenous IGF-1 and TGFβ3. Chondrogenic medium containing BS group showed slower proliferation than other serum supplements. RT-PCR results showed significant gene expression of Col II, Aggrecan and Sox-9 in FBS and BS group with exogenous growth factors at day 7 and day 14. Otherwise, NCS group showed least chondrogenic gene expressions. In conclusion, it is clear that FBS is an excellent component in cell growth and differentiation, but BS and NCS do not appear to have a significant effect on chondrogenesis.
Demonstrated that functionalization of BCP scaffold using cell-derived types of osteoblastic genes (OPN, ALP, and BMP-2). This study Moreover, dECM-BCP scaffolds showed increased osteoblastic proliferation based on immunofluorescence staining and WST assay. BCP scaffolds using preosteoblasts. Compared to bare BCP scaffolds, decellularization with both F/T and SDS methods, F/T treated sample procedure for removing cellular components of cultured cells than SDS collagens. Results revealed that F/T method was more effective confocal microscopy. The efficiency of decellularization was evaluated by scanning electron microscopy, energy dispersive X-ray spectrometer, and chemical analysis. The ECM deposited scaffolds (dECM-BCP) were characterized through PO-70 Controlled Synthesis of Folate-Thioglycolate-Gold Nanoconjugates Using Citric Acid PEG Hyper Branched Polymer

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The development of folate (FA) functionalized gold nanoparticles (AuNPs) has greatly attracted in recent years because of their potentiality in cancer treatment. Since, surface functionalization of nude AuNPs with thiol groups will resulting in agglomeration and precipitation, the AuNPs must be stabilized with an efficient stabilizer or polymer. The citric acid PEG hyper branched polymer (CPEG) was synthesized by a direct melt polycondensation of citric acid and PEG6000. The CPEG acted as a reducing agent as well as stabilizing agent in the synthesis of AuNPs with 10 nm of diameter. Thiol group of thioglycolic acid (TGA) was attached on the CPEG stabilized AuNPs to avail free carboxylic acid group on the spherical TGA-AuNPs nanoconjugates. The carboxylic acid group on surface of AuNPs was used to attach the FA via EDC/NHS coupling reaction. Stable FA-TGA-AuNPs nanoconjugates were obtained only with the CPEG stabilized AuNPs and not with citrate stabilized AuNPs. The in vitro cytotoxicity studies indicated that the FA-TGA-AuNPs are nontoxic up to 200 μg/mL but they are potentially toxic towards MCF-7 cancer cell line at a low concentration of 25 μg/mL after 3 days of incubation. It indicated that the CPEG stabilized FA-TGA-AuNPs can be used for the treatment of breast cancer.

PO-71 Functionalization of Porous Ceramic Scaffold by Generating Cell-Derived Extracellular Matrix

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Extracellular matrix (ECM) is a complex network of various structural and functional molecules secreted and accumulated by cells present in all tissues and organs. The objective of this study was to develop functional and modified scaffolds using in vitro generated ECM and determine its potential effect on osteogenesis. Rat derived bone marrow mesenchymal stem cells (RBMSCs) were seeded on porous BCP scaffolds for 3 weeks and decellularized with two different methods (freeze-thaw (F/T) or sodium dodecyl sulfate (SDS)). The decellularized ECM deposited scaffolds (dECM-BCP) were characterized through scanning electron microscopy, energy dispersive X-ray spectrometry. Contact angle measurement was performed to determine surface energy and effect of the presence of collagen. The contact angle of sample membranes were tested for mechanical property and wettability respectively. Contact angle measurement showed that the dECM-BCP scaffolds had an average fiber diameter of 100-250 nm. Tensile strength and elongation were determined to be 30-40 MPa and 10-15%, respectively. Tensile strength and elongation were determined to be 30-40 MPa and 10-15%, respectively. Therefore, dECM-BCP were suitable for bone tissue engineering due to their high strength and ductility. In addition, the dECM-BCP scaffolds were found to be biocompatible with osteoblasts, as determined by Alamar Blue and MTT assays. The dECM-BCP scaffolds were found to support the attachment and proliferation of osteoblasts, as determined by Alamar Blue and MTT assays. The dECM-BCP scaffolds were found to support the attachment and proliferation of osteoblasts, as determined by Alamar Blue and MTT assays. Therefore, the dECM-BCP scaffolds were found to be suitable for bone tissue engineering due to their high strength and ductility.

PO-72 Evaluation of Release Properties and Biocompatibility of Gallium-Indium Eutectic Liquid Metal

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Liquid metal (LM) has a low melting point to form at eutectic. Eutectic Gallium (Ga)-Indium (In) (EGaIn, 75.5% Ga and 24.5% In) has recently attracted much interest among various liquid metals. EGaIn is more stable and transformable as compared with mercury, which has high surface tension due to the formation of gallium oxide surface. Therefore, EGaIn is more applicable than mercury in fabrication of stretchable electrodes, strain sensors, restoration application, microfluidics, electronics, reconfigurable devices and drug delivery system that require deformation and processing. In this study, it is demonstrated that a release profile of Ga and In ions from EGaIn was dependent on surface area and sonication time (0 (no sonication), 5, and 20 min) after 24 hr dissolution in aqueous environment. The amount of Ga and In ions were detected by inductively coupled plasma mass spectrometry. In addition, in vitro cytotoxicity of EGaIn liquid metal releasates in aqueous solutions after various sonication time was investigated by WST-1 assay and live & dead staining. Hela cells and human adipose-derived stem cells exhibited less than 50% proliferation after 3 days of culture in the presence of releasates in 20 min sonication, while neonatal fibroblast showed less than 10% proliferation in the same culture condition. Therefore, these results could be utilized for the further development and fabrication of various EGaIn LM based-applications.
PO-74 Mechanical Steff and Bioactive Hydrogels Composed of Polyacrylamide, Polysaccharide, and Silica-Based Glass

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Due to localized bone defects or diseases, congenital deformation, and surgical reconstruction, bone tissues need a proper regeneration under native 3D micro-/nano-environment. Thus, the designing and preparation of ideal scaffolding system is a great challenge, in terms of cell attachment, proliferation, and differentiation for the formation of new bone tissues. Although, the search for an ideal scaffolding system for bone tissue regeneration is still continues. In this case, hydrogel as 3D polymeric network that may provide a suitable 3D micro-/nano-environment (i.e., resemblance of natural bone tissues) for needful regeneration of damaged bone tissues. However, the application of hydrogels in bone tissue engineering is limited due to their low mechanical properties (toughness and stiffness) that continue the posing challenges in designing and preparing of tough and stiff hydrogels. For this purpose, our lab synthesized polyacrylamide-based hydrogels by involving polysaccharides and silica-based glass. The results showed improved mechanical properties, in vitro bioimineralization and in vitro cytocompatibility that show good potential to be used in bone tissue engineering applications.

Keywords: Hydrogels, polyacrylamide, polysaccharide, silica-based glass, bone tissue engineering

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PO-75 Tissue Shaped Structure Printing Using Natural ECM Materials.

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The 3D bioprinting is used for manufacturing of scaffold which is customized patient-specific. However, it is difficult to find an available bioink for cell included 3D bioprinting. The hydrogel is found be biocompatible materials because of high content of water. The alginate which was regarded as representative example of hydrogels should not high laminating because of low mechanical property. Thus, the backbone should be there to support of hydrogel for cell printing. Natural materials are cell friendly and biodegradable and then can be more alternative with be generated ECM (extracellular matrix). This study is trying to develop the natural polymer bioink for the cell and material dual printing.

As main backbone materials to support the alginic hydrogel, tissue derived ECM and silk fibroin composite material was utilized in this study. Experimental 3D printing groups were divided by the alginic only (group1), PCL/alginate (group 2) and ECM-silk/alginate (group 3). The stability and degradability of printed 3D structure and cell viability were evaluated in this study to verify the superiority of ECM-silk based natural bioink. In the results, Group 2 showed the swollen alginic layer between PCL layers. However, Group 3 only appeared the well maintained alginic layer in the 3D structure. Analysis of ICT confirmed the similar degradation tendency like gross observations. In addition, ECM-silk bioink showed the good printing resolution to imitate the specific tissue shapes for customized scaffold fabrication. This suggested the ECM based natural bioink to fabricate the 3D structure which could support the maintaining of cell delivery hydrogel. In the future, this kind of natural bioink would be utilized for the implantable 3D organ fabrication.

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PO-76 Surface Functionalization of Microsystem with Polymer Hybrid Materials for Biological Detection

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Microsensing of chemical and biological molecules using microfluidic devices received a great deal of attention recently. However, it is still challenging to control of the surface properties of these devices on demand. Here, we utilized layer-by-layer deposition method to modify the surface of the micro-channel of the device in order to control cellular interactions inside of the channel. We have been studied cellular interactions on various polyelectrolyte multilayer film-covered surfaces. The results of those study indicated that the coatings having neutral or negatively charged hydrophilic surface exhibited excellent cell-blocking ability with non-cytotoxic nature. We applied these excellent biocompatible coatings with micro-contact printing for the study of cellular activities including adhesion, motility, proliferation, cell-cell networking (in the case of neuronal cells) both on open flat surface and on inner surfaces of micro-channeled devices. Multilayer films comprised of weak polyelectrolytes exhibit different surface properties as they were assembled at different pH conditions. Therefore, cellular interactions including adhesion can be shown differently by depending on the PEM surfaces. Polyelectrolytes including biodegradable polymers were investigated for this study, and we also include the potential application of this polymeric coating for membrane technology.

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PO-77 Green Synthesis of Silver Nanoparticles and Their Cytotoxic Effect on Human Keratinocytes

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Eco-friendly synthesis of metal nanoparticles using plant extracts plays a vital role in green nanotechnology. Metallic nanoparticles have been used in catalysis, electronics, and in biological, chemical, optical, and biomedical fields. They exhibit wide ranging properties, including anticancer, antimicrobial, anti-diabetic, antioxidant, and antibacterial activities. In this presentation, a green method for the synthesis of silver nanoparticles (AgNPs) is described by treating silver ions with the aqueous bark extract of Acanthopanax sessiliflorus at ambient temperature. The synthesized AgNPs were characterized by UV–Vis spectrophotometry, X-ray diffractometry (XRD), Fourier transform infrared spectroscopy and transmission electron microscopy (TEM). The formation of AgNPs was monitored using a UV–Vis spectrophotometer, X-ray diffractometry (XRD), Fourier transform infrared spectroscopy and transmission electron microscopy (TEM). The formation of AgNPs was monitored using a UV–Vis spectrophotometer, which exhibited a maximum absorption peak (Amax) at 435 nm, and also a color change from light yellowish to yellowish-brown was observed. Powder XRD analysis revealed the formation of fcc crystals, and TEM analysis revealed formation of roughly-spherical shaped AgNPs with an average diameter of 20 nm. Thermogravimetric analysis showed a two-step thermal decomposition of AgNPs, which majorly started at 150 °C and continued gradually until 700 °C. In vitro cytotoxic assay revealed dose-dependent toxicity of these AgNPs in human keratinocytes at higher concentrations. The described green synthesis of these catalytic AgNPs is cost-effective, sustainable, and compatible for industrial and biomedical applications.

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PO-78
Synthesis and Characterization of Gelatin/Chitosan Nanosilver Composite for Wound Healing
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In this study, gelatin/chitosan/nanosilver composite were prepared for their application in wound healing. Silver nanoparticles (AgNPs) were biosynthesized using the oriental medicinal plant Lytocium barbarum, and embedded into chitosan/gelatin scaffolds, which were prepared by the freeze drying method. Silver nanoparticles were characterized by UV-vis spectroscopy, X-ray diffraction, Fourier transform infrared spectroscopy (FT-IR) and TEM, before their incorporation into chitosan/gelatin sponges. The Cyto-compatibility of AgNPs was checked on 3T3 fibroblast cells by using different concentrations of nanoparticles. Their antimicrobial activities were tested against Pseudomonas aeruginosa and Staphylococcus aureus by disc diffusion method. The synthesized chitosan/gelatin/AgNPs scaffolds were evaluated for their degradation rate, swelling and water adsorption capacity. The morphology of the composite scaffolds was evaluated by scanning transmission electronic microscopy (SEM) and FT-IR. To check cyto-compatibility and antimicrobial activities of chitosan/gelatin/AgNPs composite scaffolds, 3T3 fibroblast cells were seeded onto the composite scaffolds, their interaction and viabilities were checked by performing a colorimetric MTT assay and staining with DAPI. The results obtained suggest that the chitosan/gelatin/AgNPs scaffolds are non-toxic to the cells and possess strong antimicrobial activities, thus may be used as a potential material for wound dressing.

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PO-79
Fabrication of Gelatin/PVA Scaffold Using Low-Temperature 3D Printing for Bone Tissue Regeneration
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In tissue engineering, scaffolds have been developed to promote various cellular activities for repairing damaged tissues/organs. The scaffold should be biocompatible and biodegradable while appropriate mechanical properties are reserved. Also, the biomaterials composing scaffolds should be able to maintain three-dimensional (3D) structure until cells successfully proliferate and differentiate on the surface of scaffold. Therefore, gelatin has been emerged to construct the scaffold with high biocompatibility and biodegradability. However, low mechanical strength of gelatin has been an obstacle for tissue engineering applications. In this study, we propose a mechanically enhanced scaffold fabricated with gelatin and Poly (vinyl alcohol) (PVA). By a low temperature 3D printing process, the scaffolds were built in 3D mesh structure, and crosslinked with polyphosphoric reagent. Then, various mechanical properties of the scaffold were evaluated. As a result, mechanical strength was low for pure gelatin scaffold but was enhanced with the addition of PVA. To observe biocompatible properties, osteoblast (MC3T3-E1) cells were cultured on the scaffolds. High viability demonstrated that the gelatin/PVA scaffold was a biocompatible platform for osteoblasts. Based on these results, we expect that gelatin/PVA scaffold can be used for various tissue regeneration.

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PO-80
Label-Free Multicolor Fluorescent Mesoporous Bioactive Glass for High Drug Loading, Controlled Release, Bioimaging and Photothermal Therapy
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Here we report for the first time the development of a straightforward and label-free approach to preparing multi-color fluorescent mesoporous nanospheres with bioactive glass for simultaneous applications in drug delivery, bioimaging and NIR photothermal therapy. We found that calcination at 400 °C provided mesoporous organosilica nanospheres with strong fluorescence of great photo- and chemical-stability. The luminescence was found to originate from the carbon dots (C-dots) generated from calcination due to 3-aminopropyl triethoxy silane (APTES), rather than from intrinsic defects in the silica-calcium matrix. We demonstrated that the anticancer drug doxorubicin (DOX) was efficiently encapsulated at high quantities due to the mesoporosity and existence of Ca content, and the drug was released pH-dependently and sustainably over a couple of weeks and pH/NIR-dependent release ability. This novel multifunctional bioactive nanosphere will find potential applications in drug delivery, bioimaging and photothermal therapy.

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PO-81
pH-Sensitive Maltodextrin-Based Nanoparticles for Drug Delivery
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Chemotherapy is routinely used in treatment of cancer. However, anticancer drugs mostly result in severe adverse effects. General anticancer drugs affect both cancer and normal cells. Here, we developed maltodextrin of natural polysaccharide based polymer prodrug which helps it low the dose of anticancer drugs that can induce toxic side effects. Maltodextrin has properties such as biodegradability, nontoxicity and biocompatibility that make it promising matrix. Hydroxyl groups in this polymer backbone are cinnamaldehyde-conjugated through acetal linkage. Cinnamaldehyde inhibits growth of human cancer cells. It generates ROS (reactive oxygen species) that results in apoptosis of cells. Manufactured nanoparticles release the cinnamaldehyde in low pH of cancer cells. Cinnamaldehyde-conjugated maltodextrin(CMD) has therapeutic effect itself. In addition, CMD is available for drug delivery system by encapsulating anticancer agents such as the FDA-approved camptothecin(CPT). CPT loaded CMD nanoparticles exhibit combined effects with anticancer activity of encapsulated anticancer drug and CMD nanoparticles themselves.
PO-82  
Hydrogen Peroxide(H$_2$O$_2$)-Scavenging Polymeric Prodrug Nanoparticle for Wound Healing Effect

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Wound scar is affected by a number of factors, including infection, smoking and diabetes. Hydrogen peroxide is a biomarker that excessively appears in wound site. Reactive oxygen species(ROS), Hydrogen peroxide is vulnerable to infection if tissue damage is caused by an excess of skin during the healing process of the wound. Vanillyl alcohol(VA) is well-known for antioxidant material, the main component of vanillin. In this study for the first time, we confirmed the use of poly (vanillyl alcohol-co-oxalate) (PVAX) nanoparticles, Hydrogen peroxide scavenger for exisisional wound mice model. PVAX nanoparticles reduced morphologically wound size and tremendous reduction of cytotoxic protein Nf-2 and HO-1. Also, PVAX nanoparticles is showed a significant reduction in the wound scar by reserpithelialization and collagen deposition. Drugs for treating wounds are present in diverse forms such as bands, hydrogels, and patch. This PVAX nanoparticles are very simple to use in the form of powder, as a new type of wound healing agents. We expected to be great potential for the new development of future wound treatments and benefits of wet and dry dressing.

PO-83  
Smart Wireless Contact Lens for Ocular Theranosis

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Among various wearable devices, a contact lens is especially noticeable for healthcare applications because it can be used as an efficient interface between a human body and the electronic device. One of the key issues for the application of contact lens as a wearable biomedical device is to deliver required drugs to patients in response to the embedded sensor output. Here, we developed a smart contact lens for theranosis of diabetic retinopathy as a model for wirelessly powered healthcare systems. The smart contact lens is composed of four miniaturized components: a real-time electrochemical biosensor, a self-regulated pulsatile drug delivery system (DDS), a wireless power transfer system by resonant inductive coupling, and a complementary metal-oxide-semiconductor (CMOS) integrated circuit (IC)-based microcontroller chip. Connected with a wireless communication electronic device, tear glucose level could be measured as a non-invasive alternative to the conventional blood glucose tests. Furthermore, we successfully demonstrated the controlled pulsatile drug delivery from gold coated reservoirs integrated within the remotely powered lens for various ocular theranostic applications. In this presentation, I will introduce an innovative integrated bio-compatible smart contact lens system has been developed for ocular diabetic theranosis.

PO-84  
Bioimaging of Peanut Agglutinin–Hyaluronate for the Detection of Colon Cancer

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Two-photon fluorescence microscopy has been attractive to many researchers for its specific properties like second harmonic generation, deep-tissue imaging, and autofluorescence. PNA has a high binding affinity to 3'-O-galactosyl-(1-3)-N-acetyl-D-galactosamine [Gal-(β1-3)GalNAc], which is known as a Thomsen-Friedenreich (TF) antigen expressed on the hyperplastic and malignant epithelial colon cancer cell. Meanwhile, hyaluronate (HA), which is a biodegradable, biocompatible, and non-immunogenic polysaccharide, has been widely investigated for target-specific drug delivery to epithelial tumor cells. Epithelial cancer cells have over-expressed HA receptors like cluster determinant 44 (CD44). Especially, the isoform CD44v6 is over-expressed in colon cancers. In this work, we developed a facile theranostic system using PNA conjugated HA for colon cancer. HA-PNA conjugates were synthesized by coupling reaction of aldehyde modified HA (HA-ALD) with N-terminal primary amine group of PNA. ADM-SS induced colitis is disrupted by inflammation, which has been recognized as a model of human ulcerative colitis. The intestinal barrier in colon epithelium revealed the opening of epithelial gaps. HA-PNA conjugates were expected to accumulate in these epithelial gaps of polylys. After labeling with a red fluorescence dye of Rhodamine B (Rhod), we carried out TPM of intraluminally administered to HA-PNA conjugates to the healthy and diseased colon tissues. These findings are discussed for further development of a novel target-specific imaging system of colon cancer using endoscopy.

PO-85  
Bioimaging of Hyaluronate–Flt1 Peptide Conjugate Nanoparticles for Therapeutic Applications to Ocular Diseases

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The eyeball has a complex structure with tight barriers limiting ocular penetration of topicaly delivered drugs. The residence time of drug carrier in the cornea must be prolonged to enhance the bioavailability of ocular therapeutics. In this work, we carried out bioimaging of hyaluronate (HA) - Flt1 peptide conjugate nanoparticles for therapeutic applications to ocular diseases. Flt1 peptide is a hydrophobic VEGFR1-specific antagonist peptide, and HA-Flt1 peptide conjugates can form micelle-like nanoparticles due to hydrophobic interactions between the peptides. The nanoparticles were labeled with Hilo3 647 amine, and a model drug of hydrophobic 5(6)-carboxyfluorescein diacetate N-succinimidyl ester (CFSE) was encapsulated into the nanoparticles. After solution of these nanoparticles was dropped into rodent eyes, their long-term distribution in the cornea was clearly visualized by in vivo real time bioimaging via two-photon microscopy as well as confocal microscopy of the sectioned tissues after enucleation. HA – Flt1 peptide conjugates showed prolonged residence time on corneal surface and deeper penetration into the corneal layer. Taken together, we could confirm the feasibility of eye drop formulations of HA – Flt1 peptide conjugate nanoparticles for the treatment of corneal diseases such as corneal neovascularization.

PO-86  
Efficacy of Thermo-Responsive GFOGER-Conjugated MPEG-b-PCL Hydrogels on The Proliferation and Chondrogenic Differentiation of Human Mesenchymal Stem Cells

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Articular cartilage cannot be automatically regenerated once it is injured or diseased. Therefore, the regeneration of articular cartilage faces significant challenges for recreating the dynamic biochemical and biomechanical functions of the native tissue. Biodegradable hydrogel systems provide platforms that can assist adhere, proliferate and differentiate encapsulated cells. Among hydrogel systems, thermo-responsive methoxy polyethylene glycol-b-poly(l-lysine)(PEG-b-PCL) diblock copolymer undergoes a reversible sol-gel transition around body temperature by controlling the molecular weights of the polymers. Due to the merit of MPEG-b-PCL, the polymer can be used as injectable hydrogel scaffolds for tissue engineering applications. Nevertheless, MPEG-b-PCL lacks cell-binding sites, and therefore it may have limitations in use as tissue engineering scaffolds. In this study, collagen mimetic peptide Gly-Phe-Hyp-Gly-Glu-Arg (GFOGER) was conjugated to MPEG-b-PCL and the polymer hydrogels containing
GFOGER (MPEG-b-PCL-GFOGER) as a function of GFOGER concentration were prepared for improving the interaction with human meniscal stem cells (hMSCs). The conjugation of GFOGER to MP and the viscosity of the hydrogels were characterized by 1H NMR spectroscopy and rheological measurement, respectively. The morphology of hMSCs in the hydrogels was observed using F-actin staining, resulting in cell spreading and viscous force mainly influenced movements of cells suspended in a liquid plug. We experimentally determined that MSCs could readily be delivered via an airflow (~1 mL/s) using a mechanical ventilator. Gravity involved the cell delivery within geometrically complex lung airway networks. We investigated the hydrodynamics of cells carried by a liquid plug through the lung airways. In addition, we developed imaging modalities that allowed minimally invasive in situ visualization of cells seeded in the airways.

Lung diseases are responsible for ~10 million premature deaths worldwide each year. Therapeutic stem cells administered into the pulmonary airways can be an effective treatment strategy for treating lung diseases and injuries [1, 2]. For maximized clinical outcomes, seeding the cells to local target regions is critical. Unfortunately, this has been challenging due to limited understanding in the mechanisms involving the cell delivery within geometrically complex lung airway networks. We investigated the hydrodynamics of cells carried by a liquid plug through the lung airways. In addition, we developed imaging modalities that allowed minimally invasive in situ visualization of cells seeded in the airways.

We first studied theoretically the transport and deposition mechanisms of mesenchymal stem cells (MSCs) administered through the airways via liquid infusion. Using a custom-made fluorescent imaging system, we then demonstrated experimentally the delivery and visualization of MSCs in the rat lungs. The cell-suspended liquid plug was infused via an airflow (~1 mL/s) using a mechanical ventilator. Gravity and viscous force mainly influenced movements of cells suspended in a liquid plug. We experimentally determined that MSCs could readily follow the fluid flow and be deposited on the airway surface via liquid layer generated by the traveling liquid plugs. Using the liquid instillation approach, we showed delivery of cell sheets resulted in vascularized 3D tissue. HUVECs formed extensive networks and expressed CD31, a marker of endothelial cells. Cell sheets formed on nanofiber mesh have a number of advantages, including manipulation and stacking of multiple cell sheets for constructing 3D tissues and may find applications in a variety of tissue engineering applications.

Acknowledgments: This research was supported by a grant of the Korean Health Technology R&D Project, Ministry of Health & Welfare, Republic of Korea (Grant No.HN1400090) and the National Research Foundation funded by the Ministry of Education (NRF-2015R1A2A1A0056562 & NRF-2015K1A3A1A14021299).

PO-87

Hemostatic Effect of Thrombin-Imobilized Poly(Lactic-co-Glycolic Acid) by Argon Plasma Treatment

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Surgical methods, such as suture, cautery and stapling, are ineffective for covering organ laceration. Therefore, recent studies have been focused on the development of hemostatic patches for overcoming the drawback. In this study, thrombin-immobilized poly(lactic-co-glycolic acid) (THR-PLGA) meshes as a function of THR concentration (1, 2 and 4 IU/cm²) were prepared by argon plasma treatment concentration (THR-PLGA, THR-PLGA and THR4-PLGA) and their efficacies on hemostasis were evaluated in vitro and in vivo. The surface chemical composition and surface contact angle measurement, respectively. Thrombin activity on PLGA/THR was evaluated using a chromogenic substrate assay. The FXIIa activity was detected in rat plasma by measuring the transglutaminase activity via the production of ammonia. A rat tail injury model was used for measuring time to hemostasis of the samples. The in vitro and in vivo tests exhibited that THR-PLGA meshes exhibited higher thrombin and FXIIa activities than pristine PLGA. In particular, THR4-PLGA showed a rapid hemostatic effect. Our findings suggested that THR4-PLGA may have a potential as hemostatic agent for clinical use.

Acknowledgments: This research was supported by the grant of ministry of Trade, Industry and Energy(MOTIE) (Grant no. 10047811).

PO-88

3D Tissue Formation by Stacking Detachable Cell Sheets with Nanofiber Mesh

Byungjin Lee1, Min Sung Kim1, Suryong Kim1, Seokyoung Bang1, Sukhee Park1, and Noo Li Jeon1*

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We present a novel approach for assembling 3D tissue by layer-by-layer stacking of cell sheets formed on aligned nanofiber mesh. A rigid frame was used to repeatedly collect aligned electrospun PCL (polycaprolactone) nanofiber to form a mesh structure with average thickness between fibers 6.4um. When human umbilical vein endothelial cells (HUVECs), human foreskin dermal fibroblasts, and skeletal muscle cells (C2C12) were cultured on the nanofiber mesh, they formed confluent monolayers and could be handled as continuous cell sheets with areas 3x3cm² or larger. Thicker 3D tissues have been formed by stacking multiple cell sheets collected on frames that can be nested (i.e. Matryoshka dolls) without any special tools. When cultured on the nanofiber mesh, skeletal muscle, C2C12 cells oriented along the direction of the nanofibers and differentiated into uniaxially aligned multinucleated myotube. Myotube cell sheets were stacked (up to 3 layers) in alternating or aligned directions to form thicker tissue with ~50 um thickness. Sandwiching HUVEC cell sheets with two dermal fibroblast cell sheets resulted in vascularized 3D tissue. HUVECs formed extensive networks and expressed CD31, a marker of endothelial cells. Cell sheets formed on nanofiber mesh have a number of advantages, including manipulation and stacking of multiple cell sheets for constructing 3D tissues and may find applications in a variety of tissue engineering applications.
PO-91
Biodegradable Polymers and Polymer-Based Composites for ACL Reconstruction Screws: Advantages, Limitations and Current Trends
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Various biodegradable and biocompatible polymers, of both synthetic and natural origin, have been developed for orthopedic applications. To overcome the limitations of metallic implant, biocompatible and biodegradable polyactic acid polymer implants were developed for orthopedic surgical interventions like anterior cruciate ligament (ACL) reconstruction. Polyactic acid polymer interference screws are commonly used in ACL reconstructions, especially in proximal tibia fixation. However, several concerns have been raised, including the acid products during its degradation in vivo.

The analysis of retrieved ACL reconstruction screw appears to be a useful tool to evaluate the performance of these implants in human body environment. Until now, the main option to improve the mechanical properties and biodegradation of polymeric ACL screw was to develop new composite materials by reinforcing the polymeric matrix with biodegradable ceramics like β-tricalcium phosphate (βTP) or hydroxyapatite (HA). The addition of βTP or HA, can accelerate the incorporation of tendon grafts into bone tunnels and provide better mechanical properties. Use of composite interference screws may lead to earlier and stronger graft incorporation, replacement of the screws with cancellous bone, and easier revision surgery. But the degradation kinetics differ substantially among different bioabsorbable polymers and numerous factors affect degradation rates, including molecular weight, sterilization, implant size, self-reinforcement, copolymer or stereocopolymer ratios, and processing techniques.

The presentation summarizes the recent progress in PLA-based biomaterials for bone, ligament, cartilage, and meniscus regeneration.

PO-92
Preparation of Injectable Hydrogels Based on Hyaluronic Acid Calcium Complexes for Immunosuppressive Drug Delivery
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Hyaluronic acid calcium complex (HA-Ca) gelation was completed within about 3–60 min indicating a high potential of hydrogel delivery by injection in vivo. Hyaluronic acid calcium complex (HA-Ca) was characterized by 1H-NMR (nuclear magnetic resonance spectroscopy), FT-IR (Fourier transform infrared spectroscopy), and TGA (thermogravimetric analysis). SEM analysis of the HA-Ca-Alg hydrogels showed irregularly porous morphology with interconnected pores of width in the range of 100–300 μm. The sol-gel transition phase diagrams were determined, as well as the variation of viscosity as a function of time. The maximum viscosity of HA-Ca-Alg hydrogel was measured to be 10000 cP. CsA was efficiently entrapped in HA-Ca-Alg hydrogel through a single step sol-gel process and a sustained release pattern of CsA was observed through the in vitro observation of the activity of skin T-cells for 2 weeks. These results show that the developed injectable HA-Ca-Alg hydrogel can be used effectively as a sustained delivery system for immunosuppressive drugs.

Keywords: immunosuppressive drug delivery; hyaluronic acid calcium complex; biodegradable injectable hydrogels; sustained release; cyclosporine A

Acknowledgment: Department of Nanobiomedical Science & BK21 PLUS NBM Global Research Center for Regenerative Medicine, Institute of Tissue Regeneration Engineering (ITREN)

PO-93
Modification of Natural Origin Materials for Scaffold Materials Using Bioactive Molecules for Regenerative Medicine
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So far, mesoporous silica in nanomedicine is exploited extensively for drug delivery. In present study, the focus is drawn towards the advantage of hollow core and uniformly distributed magnetic shell attributing to their invading property under magnetic field through the most abundant cancerous niche component; the collagen, while targeting breast cancer cells. Uniform monodispersed hollow silica nanospheres are synthesized from tetraethoxyorthosilicate (TEOS) and functionalized with 3-(trimethoxysilyl)propyl methacrylate (TMSPMMA) contributing the mesoporosity by a coating layer of poly(N-isopropylacrylamide-co-N-vinylimidazole-co-acrylic acid) (pNIPAM-AA) in the presence of magnetic nanoparticles (MNPs). At 42 °C temperature (LCST) and/or low pH(5), the pNIPAM-AA/MNP shell undergoes a definite transition from open swollen state to collapse state; facilitating diffusion of loaded model drug Doxorubicin hydrochloride (DOX) in-and-out through pores of MNP channels. The pH-temperature dependent “turn-on/off” regulation of porous channels control the drug loading-release capacity of the particle; exhibiting approximate 17.5% drug embedding efficiency. The pathological features of cancer is associated with low pH at tumor micromilieu; herein, attributes in control release of therapeutics from carrier at cancer niche. Considerably high cytotoxicity is experienced by human breast adenocarcinoma cells (MCF7) treated with DOX-particle at 42 °C compared to 37 °C, while virtually non-toxic to untreated cells; indicative of stimuli-responsive release of loaded drug from the particles apparently. The remarkable feature of the fabricated nanomaterials, thereby, compromises between pH-temperature sensitivity imparted by pNIPAM-AA and deep tissue invading property of magnetic nanoparticles to eradicate specific delivery of therapeutic molecules using standard equipment like MRI; causing minimal toxic side-effects for host.

Acknowledgment: Basic Science Research Program through the National Research Foundation of Korea (NRF), Ministry of Education (grant number: 2009-0093829).
5th TERMIS 2018
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The Japan Society for Regenerative Medicine

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Cell Freezing

CBP SET FOR BLOOD COMPONENT PROCESSING AND FREEZING

- Freezing bag is designed with flat sides and radiused periphery to assure a homogenous, controlled freezing rate for maximum cell viability
- Covered membrane ports provide sterile access
- Freezing bag tubing is RF or heat sealable
- The Transfer/Freezing Bag set with convenient spike and luer connector
- The freezing bag has a recommended fill volume of 24–26ml

CRYOWRAP FOR PROTECTING FREEZING BAG

- Overwrap for valuable samples to be cryopreserved in liquid nitrogen
- Provides a barrier to liquid nitrogen and contaminants
- Working useful temperature range from -240°C to +200°C
- Remains flexible in liquid nitrogen
- It’s biologically, chemically and immunologically inert
- Optically clear and so strong

Tissue Freezing

CRYOBAG FOR TISSUE PRESERVATION

- Clarity making inspection of the contents easy
- Easily sealed with standard RF or impulse heat seal equipment
- Cryobag is both very elastic and has a high puncture resistance
GSRAC aims to accelerate the commercialization of innovative technologies in stem cell & regenerative medicine

Global Stem Cell & Regenerative Medicine Acceleration Center (GSRAC) was established in January 2011, commissioned by the Ministry of Health and Welfare (MOHW)

The role of GSRAC is to accelerate commercialization of innovative stem cell and regenerative medicine technologies through policy & commercialization support, establishment of network connections, and information & trend analysis.

Hereby, it will enable implementation of the world’s best R&D strategy and accelerated commercialization, aiming for the world’s top 3 nations in stem cell & regenerative medicine.

Core Capabilities

- Formulate strategies to accelerate R&D
- Formulate strategies to reinvigorate the industry
- Become a patient advocate (Outreach Program)
- Run coaching programs for technology commercialization
- Develop and provide education programs for technology commercialization
- Support Patent Design
- Provide Technology Transfer Information (Tech Market)
- GSRAC Trend Analysis Report
- Weekly newsletters (e-Brief)
- Provide up-to-date information through GSRAC website
- International conferences
- Business Forum, Clinical Research Forum and KOL meetings
- Global networking (International Advisory Board)

Mission & Vision

Mission

To become among the world’s top 3 nations in stem cell & regenerative medicine, we provide support for strategic planning of R&D, strategic analysis of information & trends, and commercialization acceleration

Vision

To establish T2B platform in stem cell & regenerative medicine at global standard

Objective in each phase

Phase 1 (Foundation phase)
TRM preparation & stabilization of result analysis system

Phase 2 (Growth phase)
Creation of commercialization output & acquisition of global leadership

Phase 3 (Take-off phase)
Designation as the world’s top 3 nations & diffusion of output
“기운내세요”
이 맘연했던 응원의 말을 삼양은 현실로 바꿉니다
꽃다발과 편지 대신 신기술 의약품으로

축하합니다
[생명공학, 의약분야의 첨단치료기술개발]
삼양이 당신과 이야기하는 방법입니다
All biofabrications are possible!

ORGAN REGENERATOR

INVIVO
Biocompatible collagen

- High Biocompatibility with Triple-Helix Structure
- Manufactured with Propriety Technologies
- The Least Immunogenicity with Telopeptide Cleavage
- Highly Purified Porcine Type I Collagen

Advantages of RMS Atelocollagen

<table>
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<tr>
<th>Advanced manufacturing processes</th>
<th>Safety verification</th>
<th>Wide variety of uses</th>
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<tbody>
<tr>
<td>Telopeptide cleavage with pepsin for removal of antigenicity</td>
<td>Ensuring safety of raw materials through strict quality management (HACCP certificate, Slaughter inspection certificate)</td>
<td>Used as medical devices and for research due to the medical grade raw materials</td>
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<td>Low temperature processing and freeze-drying for a stable triple helix collagen structure</td>
<td>Highly biocompatible : immune-free collagen</td>
<td>A variety of forms such as sponge, film, hydrogel and fiber</td>
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<tr>
<td>Strict management of manufacturing environment (ISO13485 and GMP for medical devices)</td>
<td>Introduction of validated virus inactivation process</td>
<td>Applications: Bone grafting material, ligament healing, wound dressing, hemostasis, as 3D porous scaffolds, a coating material, artificial corneas, cosmetics, and many more</td>
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Application of RMS Atelocollagen

Membrane  Implant  Gel  Hydrogel
Cell culture  Cell Delivery Vehicle (CDV)  3D print Bio-ink  3D scaffold

Products

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*Research work of the Theracol-D.F. was supported by Ministry for Food, Agriculture, Forestry and Fisheries, Republic of Korea (114-0053).*
대웅 줄기세포 Open Collaboration 프로그램

▲ 대웅은 줄기세포 연구에 관심이 많은 임상의 또는 기초 연구자와의 협업 연구를 통해 줄기세포 치료제의 개발을 진행하고자 합니다.
▲ 대웅은 줄기세포 연구자분들에게 배아 유래 중간엽줄기세포(ES-MSC)를 제공하고 있습니다.

대웅 줄기세포의 장점

🔗 ES-MSC (Embryonic Stem Cell derived Mesenchymal Stem Cell)

▲ 단일 소스 기반의 대량제한: 1개의 세포 소스에서 1천만 명까지 투약 가능한 치료제 생산기술 보유, 동일한 품질의 세포치료제 지속 공급 가능

🔗 1 Embryonic Stem Cell
🔗 MCB [100 vials]
🔗 WCB [10,000 vials]
🔗 Product [10 million vials]

▲ 분열한 시크리션(secretion): LPS로 유도된 엔증 환경에서 타 세포 소스와 비교 시 훨씬 낮은 결과를 나타냄

🔗 Intensity (%)

🔗 Expected Therapeutic Effect
• Neuroprotection
• Spine development
• Angiogenesis
• Hematopoietic stem cell mobilization
• Anti-apoptosis

AD : Adipose derived MSC
BM : Bone Marrow derived MSC
ES : Embryonic Stem Cell derived MSC

대웅과의 Open Collaboration에 관심 있는 연구자분들께서는 7107140@daewoong.co.kr로 연락 부탁드립니다.
"불"을 사용하지 않고 당사 고유의 특수 전기허터로 고온의 과열증기를 만들어 모든 유기물을 과열증기 최고온도 700℃에서 탄화·추출·소독, 살균·세정·건조·감응·소성·가스화·표면처리·분해 등 다양한 처리가 가능한 독립은 용도로 활용할 수 있는 시스템입니다.

화석연료는 전혀 사용하지 않기 때문에 탄산가스(CO2)가 발생하지 않으며, 인화와 폭발 등의 위험성이 전혀 없어 안전하며 환경적으로 우수하고 강인한 탄화처리 장치입니다.

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반도체, 액정, 기판관련의 표면처리나 세정과정에서 사용할 수 있습니다. 또한 프린트 기판으로부터 귀금속(회토류)을 회수하는 효과를 기대할 수 있습니다.

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<td>과열증기온도</td>
<td>최대 700도 (*임의의 온도 영역을 설정 가능)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>전원/소비전력</td>
<td>3상 200V / 9Kw</td>
<td>3상 200V / 12Kw</td>
<td>미 정</td>
<td></td>
</tr>
<tr>
<td>승운 UNIT</td>
<td>*특허 취득 세라믹 + 전기 허터</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>보일러</td>
<td>자동급수식 전기 보일러 내장</td>
<td>본체 내장 또는 별도 설치</td>
<td></td>
<td></td>
</tr>
<tr>
<td>배기이슈 대책 (표준장치)</td>
<td>배기시스템 축압 필터 배기 내 수증기응의 증기액체 분리장치( 당사의 특수필터 장치)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

※ 대형사이즈 (100ℓ TYPE 등), 연속처리 TYPE 등과 특별 사양은 주문 시 별도 협의가 필요합니다.
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- 고분자의 응용 의료분야 소재기술 개발
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1차 면접 (서류전)
2차 면접 (입원전)
전장검진 및 최종합격

지원방법 및 문의처
지원서 접수 및 문의처: E-mail 접수 recruit@genoss.com

제출서류: 이력서 (자기소개서, 첨부파일 포함), 자기소개서, 연구경력서, 성적증명서, 졸업증명서, 영어성적증명서

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경기도 수원시 영통구 광교로 105 경기 R&D센터 (광교테크노밸리 내)

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