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춘계학술대회
KSPE 2019 SPRING CONFERENCE
2019. 5. 15 수 ~ 17 금 라마다프라자제주호텔

[주최] KSPE
설립: 한국정밀공학회
Korean Society for Precision Engineering

[후원] KOFST Jeju CVB SAMSUNG
제주특별자치도 제주컨벤션&미디어센터
제주석유화학

이 발표는 '전통의한국과학기술진흥기금 및 복권기금'으로 한국과학기술단체총연합회의 지원을 받아 발간되었음
This work was supported by the Korean Federation of Science and Technology Societies (KOFST) Grant funded by the Korean Government.
## 구두 발표 7

**일시 및 시간**: 2019년 5월 16일(목) / 13:50-14:50  
**장소**: 제7 발표장 (2층 잉마다홀 3)

### 적층제조시스템 3

<table>
<thead>
<tr>
<th>제목</th>
<th>내용</th>
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</table>
| 1950P140 | 13:50-14:05  
3D 프리팅 기계표준화 ISO/TC 261과 KS표준개발에 대한 연구  
최두산(한국기계연구원), 성우철(한국건설생활환경시험연구원), 박경호(한국건설생활환경시험연구원), 강승철(3D융합산업협회), 강태훈(3D융합산업협회) |
| 1950P141 | 14:05-14:20  
3D 바이오프린팅을 이용한 케토 세포 아스킨 미세 다공성 메크로 캡슐화 시스템의 제작  
황동규(PORCEH, 정현미(PORCEH)) |
| 1950P142 | 14:20-14:35  
3차원 바이오 프린팅 기술로 제작된 혈관화 된 조직 구조체의 제작 및 생기 조직 재생의 관찰  
이미정, 김지호(산토, 농문학(POSTECH), 정진아(POSTECH)) |
| 1950P143 | 14:35-14:50  
혈액생물 기계적 강성이 항상된 카고에 구조 세포지지체의 개발 및 기계적/생물학적 특성 분석  
이세환(POSTECH), 조영식(임상안과학교), 이상곤(서울아산병원), 조광상(원광대학교), 정용환(가톨릭대학교), 장군진(원광대학교), 정진아(POSTECH), 박용무(대한의학), 김영민(가톨릭대학교), 이부규(서울아산병원) |

## 구두 발표 8

**일시 및 시간**: 2019년 5월 16일(목) / 15:00-16:00  
**장소**: 제7 발표장 (2층 잉마다홀 3)

### 적층제조시스템 4

<table>
<thead>
<tr>
<th>제목</th>
<th>내용</th>
</tr>
</thead>
</table>
| 1950P144 | 15:00-15:15  
3D 프리팅 기술을 활용한 3차원 마이크로 세포 침 제작  
하형우(한국생산기술연구원), 손윤(한국생산기술연구원), 양동철(생물공학기술연구원) |
| 1950P145 | 15:15-15:30  
세포 스펙트로이드의 제작 및 점질 포지셔닝이 가능한 바이오 포인트 프리팅 기기의 개발  
강현욱(울산과학기술원), 전승규(울산과학기술원), 안주호(울산과학기술원) |
| 1950P146 | 15:30-15:45  
FDM 방식 3D 바이오 포인트로 유연 PLGA 필라멘트 제작 기술 개발  
한종혁(울산과학기술원), 김현욱(울산과학기술원), 전승규(울산과학기술원), 정현두(울산과학기술원), 손정현(울산과학기술원) |
| 1950P147 | 15:45-16:00  
식도 재건을 위한 드레싱 기법을 이용한 다층 복합 관 구성체 제작  
정호진(원광대학교), 이승재(원광대학교), 남효용(POSTECH), 조창현(POSTECH), 하동현(POSTECH), 김지현(가톨릭대학교), 정지희(가톨릭대학교), 조동우(POSTECH), 장진아(POSTECH) |
3D Bioprinting of Micro-Porous Macro Encapsulation System for Pancreatic Islet Transplantation

D. G. Hwang, J. Jang

Key words: 3D bioprinting, Type 1 diabetes mellitus, Islet transplantation, Macro-encapsulation, Micro-porous membrane

Type 1 Diabetes Mellitus (T1DM) is caused by an immune-mediated destruction of pancreatic islets. Islet transplantation is an alternative treatment for T1DM. After the transplantation, the islets produce insulin, regulating the level of glucose in the blood. However, after the implantation, islets die easily because of immune response. Encapsulation technique is considered as an emerging solution to solve this problem. There are two representative strategies: Macro- and micro-encapsulation. Macro-encapsulation contains large volume of islet in a single system. Thus, in this study, we suggest the 3D bioprinted micro-porous macro-encapsulation system. This system was fabricated using 3D bioprinting technology and widely used biocompatible material PCL. When one layer is printed, 50 µm pores were produced. By shifting the second layer at small distance and stacking, it was possible to fabricate porous membrane which has smaller pores. To avoid the thermal damage to the islets encapsulated in the bioink, we fabricated two parts (upper lid and lower bottom) separately. In addition, protrusions were made inside and outside of each parts to combine two parts. In the future, this system can be used for protecting endocrine cells from the immune system when combined with a micro-encapsulation system (endocrine cells in dECM bioink).

This research was supported by the MSIT(Ministry of Science and ICT), Korea, under the ICT Consilience Creative program(IITP-2019-2011-1-00783) supervised by the IITP(Institute for Information & communications Technology Planning & Evaluation) and the Bio & Medical Technology Development Program of the National Research Foundation (NRF) funded by the Korean government (MSIT) (No. 2017M3A9C6032067).

Optical Fluorescence Imaging-Based Monitoring of Myocardial Tissue Regeneration After Transplanting Pre-Vascularized Tissue Construct Fabricated by 3D Bioprinting Technology

U. Yong, J. Jang

Key words: 3D printing, Decellularized extracellular matrix, Stem cell, Tissue engineering, Optical fluorescence imaging

Stem cell therapy has been actively studied as a treatment for ischemic heart disease. Particularly, a patch-type carrier can improve the therapeutic effect by enhancing homing and engraftment of stem cells into damaged myocardial tissues. From a therapeutic point of view, longitudinal monitoring of living cells is essential to understand the mechanisms of neovascularization induced by stem cells. Optical fluorescence imaging can provide long-term live tracking of multiple target cells due to its high sensitivity and multimodal capability. Also, the recent development of molecular probes, which are target-specific and nontoxic with optical and physicochemical stability in the near-infrared (NIR) window, contributes to in vivo live cell tracking. Therefore, this study aims to monitor the efficacy of cardiac stem cell-laden patch in ischemic myocardial tissue by using optical fluorescence imaging based on the NIR probes. First, we used three sets of spectral filter and CCD sensor. Second, contrast agents were selected to observe ischemic tissue, mitochondria, and lipoprotein. Using 3D bioprinting technology, we fabricated a pre-vascularized tissue construct with bioink composed of decellularized extracellular matrix and stem cells. Finally, we observed the interaction between the delivered construct and the ischemic myocardial tissue after transplanting it into the heart of the rats.

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Abstract

Type 1 Diabetes Mellitus (T1DM) is caused by an immune-mediated destruction of pancreatic islets. Islet transplantation is an alternative treatment for T1DM. After the transplantation, the islets produce insulin, regulating the level of glucose in the blood. However, after the implantation, islets die easily because of immune response. Encapsulation technique is considered as an emerging solution to solve this problem. There are two representative strategies: Macro- and microencapsulation. Macro-encapsulation contains large volume of islet in a single system. Thus, in this study, we suggest the 3D bioprinted micro-porous macroencapsulation system. This system was fabricated using 3D bioprinting technology and widely used biocompatible material PCL. When one layer is printed, 50 μm pores were produced. By shifting the second layer at small distance and stacking, it was possible to fabricate porous membrane which has smaller pores. To avoid the thermal damage to the islets encapsulated in the bioink, we fabricated two parts (upper lid and lower bottom) separately. In addition, protrusions were made inside and outside of each parts to combine two parts. In the future, this system can be used for protecting endocrine cells from the immune system when combined with a micro-encapsulation system (endocrine cells in dECM bioink).

Conclusion

- Macro-encapsulation system was developed using 3D printing.
- The printing condition was safe to cells.
- Cells encapsulated in the developed system proliferated at a similar level of in pdECM.

Reference

1. Dino J. Ravnic et al., “Bioprinting and Cellular Therapies for Type 1 Diabetes”, Penn State Health Milton S. Hershey Medical Center, USA, Trends inBiotechnology, 2017

Acknowledgement

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