International Conference on Biofabrication

BIOFABRICATION 2019 COLUMBUS

FINAL PROGRAM

October 20–22, 2019
Ohio Union, The Ohio State University
Columbus, Ohio, USA

PROGRAM-AT-A-GLANCE

Please note that all times are in Eastern Daylight Savings Time (EDT) -0500 UTC.

<table>
<tr><th colspan="5">Afternoon</th><th>Evening</th></tr>
<tr>
<td rowspan="2">Plenary Session 1
by
Jos Malda
AGB
1:00 - 2:00 pm</td>
<td>Sessions 1 - 3
AGB
PHA
USB
2:00 - 4:00 pm</td>
<td>Snack & Exhibits
WBR
4:00 - 4:30 pm</td>
<td colspan="2" rowspan="2">Poster Session 1
PHA
4:30 - 6:30 pm</td>
<td rowspan="2">Conference Reception
BWH
7:00 - 9:30 pm</td>
</tr>
<tr><td colspan="2">Technology Exhibition</td></tr>
<tr>
<td rowspan="2">Plenary Session 3
by
Anthony Atala
AGB
1:00 - 2:00 pm</td>
<td>Sessions 7 - 9
AGB
PHA
USB
2:00 - 4:00 pm</td>
<td>Snack & Exhibits
WBR
4:00 - 4:30 pm</td>
<td>Poster Session 2
PHA
4:30 - 5:30 pm</td>
<td rowspan="2">ISBF Annual Business Meeting
AGB
5:30 - 6:30 pm</td>
<td>YSF 2 ++ Reception
CHU
7:30 - 10:00 pm

Workshop: Federal Funding Landscape for Biofabrication and the Power of ARMI
PHA 6:30 - 8:30 pm</td>
</tr>
<tr><td colspan="3">Biofabrication Technology Exhibition</td><td></td></tr>
<tr>
<td rowspan="2">Plenary Session 5
by
Ali Khademhosseini
AGB
1:00 - 2:00 pm</td>
<td>Sessions 13 - 15
AGB
PHA
USB
2:00 - 4:00 pm</td>
<td>Snack & Exhibits
WBR
4:00 - 4:30 pm</td>
<td rowspan="2">Awards & Closing Ceremony
AGB
4:30 - 5:30 pm</td>
<td rowspan="2">University of Wollongong Reception
WBR
5:30 - 6:30 pm</td>
<td rowspan="2">Champagne Reception
CAM
7:00 - 8:00 pm

Gala Dinner
CAM
8:00 - 11:00 pm</td>
</tr>
<tr><td colspan="2">Technology Exhibition</td></tr>
</table>

Conference Activites:

++ YSF: Young Scientist Forum

TECHNICAL PROGRAM

Please note that all times are in Eastern Daylight Savings Time (EDT) -0500 UTC.

Abstracts are available in the meeting app and may be downloaded from www.**biofabrication2019.org**.

Sunday October 20th, 2019

4:30 to 6:30 pm Poster Session 1

"3D bioprinting for future space exploration – the European perspective" by Michael Gelinsky

"3D BioPrinting in Suspension Media as a Disruptive Technology in Tissue Engineering" by Ferry Melchels

"3D Bioprinting of a Mechanically Reinforced Hybrid Tissue Construct for Advanced Fibrocartilaginous Regeneration" by Sang Jin Lee

"3D bioprinting of hybrid and gradient structures for critical size bone defects" by Bahattin Koc

"3D Bioprinting of multiphasic and multicellular osteochondral tissue substitutes featuring a spatially defined distribution of cell types and differentiation factors" by David Kilian

"3D Bioprinting with Light Active Tissue-specific Bioink to Improve Structural Fidelity and Tissue Function" by Se-Hwan Lee

"3D Cell Printing of Perfusable and Vascularized Human Skin Equivalents Composed of Epidermis, Dermis, and Hypodermis for Better Recapitulation of Skin Anatomy" by Byoung Soo Kim

"3D Hydrogels and Bioinks for Realistic In-Vitro Modelling and Bioprinting" by Elia Lopez-Bernardo

"3D printing of chitosan-based scaffolds for wound healing" by Sulokshana Marks

"3D-patient derived ovarian tumour model to investigate early stages of high-grade serous ovarian cancer" by Francesca Paradiso

"A Bioprinted Multicellular Glioblastoma Model" by Nathalie Dusserre

"A Comprehensive Study towards a Scalable and Reproducible Synthesis of Bioinks and its Sterilisation " by Sanjeev Gambhir

"A High-throughput Approach for the Investigation of 3D-printed Hydrogel Materials for Biocatalytic Reactors" by Lukas Wenger

"A Multifunctional DNA-origami platform for Biomolecular Detection in Cellular Microenvironments" by Melika Shahhosseini

"A Novel Controllable Cell Array Printing Technique on Microfluidic Chips" by Sheng Li Mi

"A Surgical Robotics Based Additive Manufacturing Tool for Intracorporeal Tissue Engineering" by Andrej Simeunovic

"A Versatile, Enabling Platform for Vascularizing Tissues and Tissue Models" by James Hoying

"Aligned Electroconductive Electrospun Patch as a Novel Biomaterial for Cardiac Tissue Engineering" by Chiara Mancino

"Altered myeloid-derived cell populations by bisphosphonates results in changes to the development of tissue engineered vascular grafts." by Gabriel Mirhaidari

"Application of Additive Manufacturing for Novel Transcatheter Heart Valve Stents" by Megan Heitkemper

3D Bioprinting with Light Active Tissue-specific Bioink to Improve Structural Fidelity and Tissue Function

Se-Hwan Lee[1], Byeongmin Kang[1], Khoon Lim[2,3], Hyeonji Kim[4], Geunseon Ahn[4], Kyung-Hyun Min[4], Minkyung Kim[4], Dong-Woo Cho[5], Tim B.F. Woodfield[2,3] and Jinah Jang[1,5,6]*

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Introduction: Soft tissues, (e.g. the heart, liver, pancreas and blood vessels) are usually associated with difficulties in fabricating 3D construct having low mechanical properties (< 10 kPa). In addition, other existing drawbacks in the utilization of synthetic polymers include its stiffness mismatch to the target tissue. Development of tissue-derived decellularized extracellular matrix (dECM)-based bioinks that can possess the biochemical and biophysical properties of target tissues has recently gained attraction in providing cells a biomimetic microenvironment and is increasingly emerging as a next generation bioink for 3D bioprinting. However, it is associated with challenges pertaining to the fabrication of multilayered 3D bioprinted construct with structural fidelity as a result of inferior mechanical properties. Photo-crosslinking utilizing light could offer a promising and alternative strategy to enhance the mechanical properties. Although photo-crosslinking of extracellular matrix-based bioinks have shown significant performances in layer-by-layer deposition, the exposure of UV light (365 nm) has an issue of its cytotoxicity, restricting the viability and function of the encapsulated cells. On the other hand, the visible light (> 400 nm) photoinitiators, such as ruthenium/sodium persulfate (Ru/SPS) has been investigated as a mild photoinitiator for cell printing purposes. In this study, we investigate the novel method to find proper combination of the cytocompatible visible light photoinitiators (Ru/SPS) and dECM-based bioinks for the fabrication of complex-shaped 3D bioprinted constructs with high aspect ratio, improved shape fidelity, and enhanced tissue functions.

Materials and Methods: Heart dECM (hdECM)-based constructs were fabricated using a 3D bioprinter equipped with a customized LED light module containing visible light. In addition, an Archimedean spiral g-code generator was developed in house. We designed and fabricated a spiral-shaped patch by using hdECM bioink mixed with Ru/SPS at a concentration of 1/10 mM and exposed light at a light intensity of 50 mW/cm^2. Live/Dead assay was carried out to assess the cell viability of encapsulated murine endothelial cell line (MS-1) in the fabricated construct.

Results and Discussion: Height of the fabricated 2 % hdECM construct with hollow cylinder shape was measured to be 4.06 mm. This means that it is possible to fabricate high aspect ratio using soft material-based printing. Moreover, spiral shaped patch was fabricated by co-axial extrusion printing. Clearly separated core and shell regions of the fabricated spiral patch were confirmed. Cells remain viable within the fabricated constructs within 5 minutes, indicating minimal cytotoxicity. In the future, cytotoxicity assessments will be assessed for at least 48 hours.

Conclusion: Results demonstrated successful fabrication of visible light crosslinked hdECM-based constructs with improved printability. In addition, we fabricated various patterned patches for drug delivery by co-axial extrusion printing.

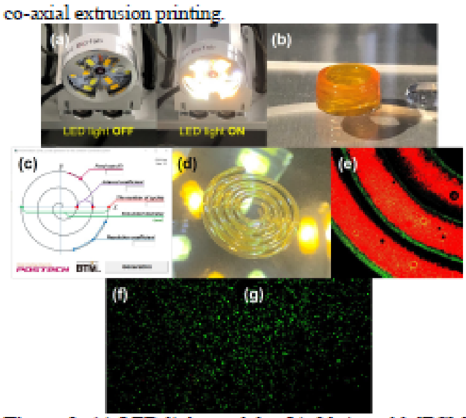

Figure 1. (a) LED light module, (b) fabricated hdECM construct with hollow cylinder type, (c) developed Archimedean spiral g-code generator, (d) hdECM spiral patch fabricated by co-axial extrusion printing, (e) fluorescence microscope image of the fabricated hdECM spiral patch (Red: core, green: shell), Live/Dead assay images (× 4): (f) 3 min after printing, (g) 5 min after printing

Acknowledgment: This research was supported by Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Education (2015R1A6A3A04059015) and 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). This work was supported by Electronics and Telecommunications Research Institute (ETRI) grant funded by the Korean government [19ZD1130].

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- 3D Bioprinting with Light Active Tissue-specific Bioink to Improve Structural Fidelity and Tissue Function-

(Oct 20 – 22, 2019)

Se-Hwan Lee[1], Byeongmin Kang[1], Khoon Lim[2,3], Hyeonji Kim[4], Geunseon Ahn[4], Kyung-Hyun Min[4], Minkyung Kim[4], Dong-Woo Cho[5], Tim B.F. Woodfield[2,3] and Jinah Jang[1,5,6*]

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6. Division of Integrative Biosciences and Biotechnology, Pohang University of Science and Technology (POSTECH),

Abstract

Development of tissue-derived decellularized extracellular matrix (dECM)-based bioinks is increasingly emerging as a next generation bioink for 3D bioprinting. However, it is associated with challenges pertaining to the fabrication of multilayered 3D bioprinted construct with structural fidelity as a result of inferior mechanical properties. Photo-crosslinking utilizing light could offer a promising and alternative strategy to enhance the mechanical properties. the visible light (> 400 nm) photoinitiators, such as ruthenium/sodium persulfate (Ru/SPS) has been investigated as a mild photoinitiator for cell printing purposes. In this study, we investigate the novel method to find proper combination of the cytocompatible visible light photoinitiators (Ru/SPS) and dECM-based bioinks for the fabrication of complex-shaped 3D bioprinted constructs with high aspect ratio, improved shape fidelity, and enhanced tissue functions. Results demonstrated successful fabrication of visible light crosslinked hdECM-based constructs with improved printability. In addition, we fabricated various patterned patches for drug delivery by co-axial extrusion printing.

Conclusion

- The light active tissue-specific heart bioink and vessel bioink which blended with Ru/SPS were developed.
- The developed bioinks were cured under 1/10 Ru/SPS concentration and 30 W/cm2 light intensity properly.
- The complex structures requiring enhanced fidelity, such as hollow cylindrical structure with high aspect ratio and human ear structure, were successfully fabricated.
- By fabricating 3D patterned patch and spiral patch, it can be fabricated using multi head printing and co-axial printing technology.
- This technique could be an alternative to improve the fidelity of tissue specific dECM bioinks.

Reference

1. K. S. Lim, B. S. Schon, N. V. Mekhileri, G. C. J. Brown, C. M. Chia, S. Prabakar, *et al.* **New visible-light photoinitiating system for improve print fidelity in gelatin-based bioinks.** ACS Biomater. Sci. Eng. (2016)
2. J. Jang, T.G. Kim, B.S. Kim, S.-W. Kim, S.-M. Kwon, D.-W. Cho. **Tailoring mechanical properties of decellularized extracellular matrix bioink by vitamin B2-induced photo-crosslinking.** Acta Biomater., 33 (2016)
3. K. S. Lim, B. J. Klotz, G. C. J. Lindberg, F. P. W. Melchels, G. J. Hooper, J. Malda, *et al.* **Visible light cross-linking of gelatin hydrogels offers an enhanced cell microenvironment with improved light penetration depth.** Macromol. Biosci. (2019)

Acknowledgement

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