

2019 FALL MEETING SYMPOSIA

PROGRAM IS CURRENT AS OF: NOVEMBER 12, 2019

▶ TUTORIAL SESSION AVAILABLE WITH AFFILIATED SYMPOSIUM

BROADER IMPACT

| | | |
|------|---|---|
| BI01 | Materials Data Science—Transformations in Interdisciplinary Education | 2 |
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ELECTRONIC, PHOTONIC AND MAGNETIC MATERIALS

| | | |
|--------|---|-----|
| ▶ EL01 | Emerging Material Platforms and Approaches for Plasmonics, Metamaterials and Metasurfaces | 11 |
| EL02 | Molecular and Organic Ferro- and Piezoelectrics—Science and Applications | 78 |
| EL03 | Multiferroics and Magnetoelectrics | 98 |
| ▶ EL04 | Emerging Chalcogenide Electronic Materials—From Theory to Applications | 137 |
| EL05 | Diamond and Diamond Heterojunctions—From Growth and Technology to Applications | 178 |

ENERGY AND ENVIRONMENT

| | | |
|--------|--|-----|
| EN01 | Challenges in Battery Technologies for Next-Generation Electric Vehicles and Grid Storage Applications | 207 |
| EN02 | Materials for High-Energy and Safe Electrochemical Energy Storage | 231 |
| EN03 | Green Electrochemical Energy Storage Solutions—Materials, Processes and Devices | 309 |
| EN04 | Advanced Membranes for Energy-Efficient Molecular Separation and Ion Conduction | 342 |
| EN05 | Chemomechanical and Interfacial Challenges in Energy Storage and Conversion—Batteries and Fuel Cells | 371 |
| EN06 | Development in Catalytic Materials for Sustainable Energy—Bridging the Homogeneous/Heterogeneous Divide | 405 |
| EN07 | Materials Science for Efficient Water Splitting | 448 |
| ▶ EN08 | Halide Perovskites for Photovoltaic Applications—Devices, Stability and Upscaling | 484 |
| EN09 | Advances in the Fundamental Science of Halide Perovskite Optoelectronics | 552 |
| EN10 | Emerging Light-Emitting Materials and Devices—Perovskite Emitters, Quantum Dots and Other Low-Dimensional Nanoscale Emitters | 609 |
| ▶ EN11 | Silicon for Photovoltaics | 664 |
| EN12 | Structure-Function Relationships and Interfacial Processes in Organic Semiconductors for Optoelectronics | 694 |
| EN13 | Flexible and Miniaturized Thermoelectric Devices Based on Organic Semiconductors and Hybrid Materials | 749 |
| EN14 | Thermoelectric Energy Conversion (TEC)—Complex Materials and Novel Theoretical Methods | 772 |
| EN15 | Nanomaterials for Sensing and Control of Energy Systems—Processing, Characterization and Theory | 802 |
| EN16 | Advanced Materials, Fabrication Routes and Devices for Environmental Monitoring | 838 |
| ▶ EN17 | Structure-Property Processing Performance Relationships in Materials for Nuclear Technologies | 863 |

FABRICATION OF FUNCTIONAL MATERIALS AND NANOMATERIALS

| | | |
|--------|---|------|
| ▶ FF01 | Beyond Graphene 2D Materials—Synthesis, Properties and Device Applications | 890 |
| FF02 | 2D Nanomaterials-Based Nanofluidics | 975 |
| ▶ FF03 | Building Advanced Materials via Particle-Based Crystallization and Self-Assembly of Molecules with Aggregation-Induced Emission | 994 |
| FF04 | Crystal Engineering of Functional Materials—Solution-Based Strategies | 1029 |
| FF05 | Advanced Atomic Layer Deposition and Chemical Vapor Deposition Techniques and Applications | 1061 |
| ▶ FF06 | Advances in the Fundamental Understanding and Functionalization of Reactive Materials | 1103 |

MATERIALS FOR QUANTUM TECHNOLOGY

| | | |
|--------|--|------|
| ▶ MQ01 | Coherent and Correlated Magnetic Materials for Hybrid Quantum Interfaces | 1122 |
| ▶ MQ02 | Materials for Quantum Computing Applications | 1139 |
| MQ03 | Predictive Synthesis and Advanced Characterization of Emerging Quantum Materials | 1153 |

MECHANICAL BEHAVIOR AND STRUCTURAL MATERIALS

| | | |
|--------|--|------|
| MT01 | Advanced Atomistic Algorithms in Materials Science | 1168 |
| ▶ MT02 | Closing the Loop—Using Machine Learning in High-Throughput Discovery of New Materials | 1197 |
| ▶ MT03 | Automated and Data-Driven Approaches to Materials Development—Bridging the Gap Between Theory and Industry | 1234 |
| ▶ MT04 | Advanced Materials Exploration with Neutrons | 1266 |
| MT05 | Emerging Prospects and Capabilities in Focused Ion Beam Technologies and Applications | 1286 |
| MT06 | <i>In Situ</i> Characterization of Dynamic Phenomena During Materials Synthesis | 1302 |
| MT07 | <i>In Situ/Operando</i> Studies of Dynamic Processes in Ferroelectric, Magnetic and Multiferroic Materials | 1337 |

MATERIALS THEORY, COMPUTATION AND CHARACTERIZATION

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|------|--|------|
| MS01 | Extreme Mechanics | 1353 |
| MS02 | Mechanically Coupled and Defect-Enabled Functionality in Atomically Thin Materials | 1387 |
| MS03 | Mechanics of Nanocomposites and Hybrid Materials | 1407 |
| MS04 | High-Entropy Alloys and Other Novel High-Temperature Structural Alloys | 1456 |

SOFT MATERIALS AND BIOMATERIALS

| | | |
|--------|--|------|
| SB01 | Multifunctional Materials—From Conceptual Design to Application-Motivated Systems | 1477 |
| SB02 | Multiscale Materials Engineering Within Biological Systems | 1576 |
| SB03 | Smart Materials, Devices and Systems for Interface with Plants and Microorganisms | 1615 |
| SB04 | Hydrogel Materials—From Theory to Applications via 3D and 4D Printing | 1632 |
| SB05 | Light-Matter Interactions at the Interface with Living Cells, Tissues and Organisms | 1671 |
| ▶ SB06 | Bringing Mechanobiology to Materials—From Molecular Understanding to Biological Design | 1686 |
| SB07 | Bioelectrical Interfaces | 1705 |
| SB08 | Advanced Neural Materials and Devices | 1748 |
| SB09 | Interfacing Bio/Nano Materials with Cancer and the Immune System | 1766 |
| SB10 | Electronic Textiles | 1794 |
| SB11 | Multiphase Fluids for Materials Science—Droplets, Bubbles and Emulsions | 1820 |
| X | Frontiers of Materials Research | 1842 |

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of PEGDA samples were immersed into the water and both weight and dimension measurements were also done in every hour for four hours. At the end, the third PEGDA samples were immersed into the 99% ethyl alcohol and their weight and dimensions were measured in every hour. Our results indicate that, as the PEGDA percentage increases, its degradation rate decreases. Also, PEGDA degrades away the most in the 99% ethyl alcohol more than limonene and water. Our research to study the degradation rate of PEGDA will extend to the use of hot-stir plate to study investigate the temperature affect.

SB04.08.22

Designing of Three-Dimensional Hybrid Scaffolds for Tissue Regeneration Olga Urbanek-Swidarska and Dorota Kolbuk; Institute of Fundamental Technological Research PAS, Poland

Application of electrospun nonwovens is limited due to its two-dimensional (2D) architecture. Hybrid scaffolds consisting of electrospun fibres and other 3D techniques are formed to overcome this problem. Those scaffolds are able to combine advantages of both materials' forms [1]. Electrospun nanofibers mimic the biopolymer network of native tissue very well and provide significant surface area for attaching bioactive components for local stimulation of cellular activity. On the other hand, hydrogels and its freeze-dried forms provide 3D architecture. An example of 3D tissue are bones cavities, occurring in the result of disease or injuries. For this purpose fibres may be coated with hydroxyapatite, in order to stimulate osteoblasts proliferation and activity [2]. The aim of this research was to develop 3D hybrid scaffold from the electrospun fibres and hydrogel. Poly(lacide-co-glicolide)(PLGA) fibres were formed via electrospinning technique and subjected to ultrasounds in order to increase the nonwoven dimensions. Additionally, this procedure was used to cover one group of the nonwovens with hydroxyapatite (nHAp). Finally, fibres were immersed in gelatine solution, crosslinked and subjected to both, materials characteristic and *in vitro* biological tests.

The contribution of fibres to hydrogel mass after lyophilisation was 50/50 w/w. SEM imaging confirmed presence and homogenously distributed PLGA and PLGA-nHAp coated fibres in the pore walls. FTIR, EDS analysis as well as WAXS measurement confirmed presence of nHAp crystal in the scaffolds, its distribution and structure. DSC analysis revealed no significant changes in glass transition temperature nor melting temperature of PLGA. The weight loss of 3D scaffolds was conducted per one month. During the first week of incubation the weight loss was ca. 5%. Moreover, the mechanical tests and *in vitro* tests were conducted. The biological tests confirmed constant proliferation of cells in the analysed time points, as well as proper cell morphology and spreading on the scaffold surface.

Summarizing, presented technique is an effective method of 3D hybrid scaffolds preparation, based on ECM mimicking electrospun fibres.

Acknowledgments: This work was supported by the National Centre of Research and Development within the grant No. 388/L-6/2014.

References: [1] Bosworth, L. A. et al. *Nanomedicine: Nanotechnology, Biology and Medicine* 2013, 9(3), 322-335. [2] Kolbuk, D. et al. *Journal of Biomedical Materials Research Part A* 2019.

SB04.08.23

3D Printed Cochlea Models for Cochlear Implant Studies Iek Man Lei, Chen Jiang, Manohar Bance and Yan Yan Shery Huang; University of Cambridge, United Kingdom

Since the mid-1980s, cochlear implants have been used to treat severe hearing loss, remarkably improving patients' quality of life. Despite its successful clinical translation, several issues of the current cochlear implants remain. These are such as the frequency distortion problem caused by the current spread within cochlea, and the enormous individual differences in the treatment outcomes. Animal models have been extensively used in the pre-clinical research, however these models fail to demonstrate the anatomical features and the individual variability of human cochlea. In an effort to reduce *in vivo* approaches and to develop a personalised model for cochlear implant testing, this work aims to develop a 3D printed cochlea model for cochlear implant research. Here, we demonstrate a novel strategy to fabricate a cochlea model by embedded 3D printing. Our 3D model was designed to replicate the key anatomical features of the human cochlea; the composition of the gel matrix was tuned to match the impedance properties of temporal bone. We showed that the Electric Field Imaging (EFI) profiles obtained from the 3D printed models are highly similar to the clinical patients' profiles. These 3D cochlear models see the potential to be used as a tool to understanding the clinical outcome of existing cochlear implantation; or as a pre-clinical model for testing new cochlear implants.

SB04.08.24

Scaffold Pattern Optimization for Esophageal Tissue Repair Kai Ren, Bin Wu and Yinghsi Jerry Fuh; National University of Singapore, Singapore

Esophageal tissue engineering is an emerging solution to treat esophageal carcinoma. It utilizes a combination of cells, materials, suitable biochemical and physio-chemical factors to repair or replace biological tissue or organ functions. Scaffold pattern is critical in the tissue engineering as it influences the scaffold's ultimate tensile strength and tissue's cellular infiltration, while existing scaffold pattern design relies on empirical experience. This paper proposed a scaffold pattern optimization frame to design the scaffold structure. In the frame, a finite element (FE) model was developed to describe the physical constitution of the scaffold, together with an optimization algorithm to adjust scaffold structure. A hydrophilic additive, Pluronic F127 (F127), blended with polycaprolactone (PCL) was used as the scaffold with satisfying wettability and cell adhesion. The optimized pattern was tested to mechanically and biologically mimic the native esophageal tissue structure, facilitating the tissue regeneration.

SB04.08.25

White Light Emitting Graphene Quantum Dot Hydrogels for Bioimaging and Biosensing Applications Ankarao Kalluri¹, Bilal Cakir^{2,2}, Prabir Patra^{3,3}, In-Hyun Park² and Challa V. Kumar^{1,1}; ¹University of Connecticut, United States; ²Yale University, United States; ³University of Bridgeport, United States

A new facile synthesis of white light-emitting, multifunctional, water-soluble, metal-free, non-toxic, highly photostable, bio-active Protein Quantum dot (ProQDot) hydrogels is reported here. These advanced functional nanoparticles consist of cross-linked bovine serum albumin (BSA) and graphene quantum dots (GQDs). The ProQDots contain blue, green and red dye conjugated GQDs, which are intern crosslinked with BSA to form white emitting hydrogels. These are bio-degradable and highly photostable when compared to organic and inorganic dyes. This bio-hydrogels are further characterized by XRD, CD, FT-IR, DLS, Raman, UV-Visible, TEM, SEM, confocal laser microscopy, photoluminescence spectroscopy, and gel electrophoresis techniques. This robust ProQDots with a variety of surface-functionalities with unique optical properties has led to promising applications in bioimaging, cellular biology, and drug delivery studies. Furthermore, as prepared ProQDot hydrogels can be used to study neuronal intracellular processes for *in vivo* observation of cell trafficking, tumor targeting, bio-sensing, CRISPR-Cas, and immunohistochemistry (IHC) applications.

SB04.08.26

Bioprinting Autologous Dermal Equivalent Organotypics Juyi Li¹, Michael Cottone¹, Philip Cottone¹, Olias Christie¹, Vivian Su¹, Zahin Huq¹, Michael Gozelski¹, Sampson Berlinski¹, Kimberly Lu¹, Adeel Azim¹, Christopher Chan², Teresa Duong³, Saba Gulzar⁴, Clara Dokyung Lee⁵, Stella

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