Live Session
Room Live - Session LI-MoM1
Coatings for Flexible Electronics and Bio Applications Live Session

Moderators: Dr. Jean Geringer, Ecole Nationale Superieure des Mines, France, Dr. Grzegorz (Greg) Greczynski, Linköping University, Sweden, Dr. Christopher Muratore, University of Dayton, USA, Dr. Barbara Putz, Empa, Switzerland

10:00am **LI-MoM1-1 ICMCTF Chairs' Welcome Address***, Gregorz (Greg) Greczynski (grzegorz.greczynski@liu.se),* Linköping University, Sweden*; C. Muratore,* University of Dayton, USA

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10:15am **LI-MoM1-2 Plenary Lecture: Organic Bioelectronics – Nature Connected***, Magnus Berggren (magnus.berggren@liu.se),* Linköping University, Norrköping, Sweden **INVITED**

Organic electronic materials are unique as the signal translator across the biology-technology gap. These biocompatible materials are also easily complexed with polyanions, polycations and functional biomaterials and can then be included in various device architectures to form flexible, stretchable and even gelled devices. Such organic bioelectronics can then process electronic, ionic and charged biomolecules in combination. These combined features make organic electronic materials unique in many aspects as the recorder and actuator of various functions and physiology of biological systems. A brief review of some of the recent achievements from the Laboratory of Organic Electronics is here given. In the BioComLab technology platform various organic bioelectronic sensors and actuators are combined with communication technology to form a body area network for future healthcare applications. Various sensors are included within electronic skin patches, then connected to electronic drug delivery components via capacitive body-coupled communication. This system provides sensor-actuator feedback and improves its decision-making performance using deep-learning protocols provided from cloud connectivity. With the BioComLab platform we target an array of neuronal disorders and diseases, such as epilepsy, Parkinson's disease and chronical pain. The BioComLab technology is also explored to regulate functions and physiology of plants, in an effort termed e-Plants. Some of the recent results of using organic bioelectronics to sense and actuate plant physiology is here also presented.

11:15am **LI-MoM1-6 Flexible Printed Sensors for Biomechanical Measurements***, Tse Nga Ng (tnn046@ucsd.edu),* University of California San Diego, USA **INVITED**

Rapid, on-site assessment is highly desirable in the fields of both medical treatment and novel robotics. To achieve this goal, my group's research aims to develop low-cost, flexible, large-area sensor devices for different health and environmental applications. In this presentation, we discuss case studies using similar pressure sensors for two different point-of-use applications:

1) Motor skills characterization. There is no objective metric for evaluating motor skill training progress in autistic children, and current assessments rely on qualitative surveys. We have fabricated an instrumented glove with touch sensors on textile for finger tapping patterns characterization. This glove could find future use for characterizing motor skills of people suffering from autism, Parkinson's disease, epilepsy seizures, and other neurological motor disorders.

2) Robotic sensors for simultaneous pressure and chemical detection. There is an urgent need of sensor technologies to monitor hazardous materials for security and environmental applications. Rapid on-site detection of chemicals through remote robotic sampling is highly desired to avoid placing people at exposure risks. We have combined printed chemical and pressure sensors together on disposable gloves, and demonstrated successive simultaneous tactile sensing and pesticide detection in a point-of-use platform that is scalable and economical.

11:45am **LI-MoM1-8 Flexible Electronics: From Interactive Smart Skins to In vivo Applications***, Denys Makarov (d.makarov@hzdr.de),* Helmholtz-Zentrum Dresden-Rossendorf e. V. (HZDR), Institute of Ion Beam Physics and Materials Research, Germany **INVITED**

Portable consumer electronics necessitates functional elements to be lightweight, flexible, and wearable [1-3]. The unique possibility to adjust the shape of the devices offered by this alternative formulation of the electronics provides vast advantages over the conventional rigid devices particularly in medicine and consumer electronics. There is already a remarkable number of available flexible devices starting from interconnects, sensing elements towards complex platforms consisting of communication and diagnostic components.

We developed shapeable magnetoelectronics [3] – namely, flexible [4,5], printable [6], stretchable [7] and even imperceptible [8-12] magnetosensitive elements, which were completely missing in the family of flexible electronics, e.g. for smart skin applications.

Here, we will review technological platforms allowing to realize not only mechanically imperceptible electronic skins, which enable perception of the geomagnetic field (e-skin compasses) [10], but also enable sensitivities down to ultra-small fields of sub-50 nT [11]. These devices allow humans to orient with respect to earth's magnetic field ubiquitously. Furthermore, biomagnetic orientation enables novel interactive devices for virtual and augmented reality applications. We showcase this by realizing touchless control of virtual units in a game engine using omnidirectional magnetosensitive skins. This concept was further extended by demonstrating a compliant magnetic microelectromechanical platform (m-MEMS), which is able to transduce both tactile (via mechanical pressure) and touchless (via magnetic field) stimulations simultaneously and discriminate them in real time [12]. This is crucial for interactive electronics, human-machine interfaces, but also for the realization of smart soft robotics with highly compliant integrated feedback system as well as in medicine for physicians and surgeons.

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12:15pm **LI-MoM1-10 Biomimetic Extracellular Matrix Coating for Titanium Implant Surfaces to Improve Osteointegration***, Sriram Ravindran (sravin1@uic.edu), P. Gajendrareddy, J. Hassan, C. Huang,* University of Illinois at Chicago, USA **INVITED**

Titanium implants are used widely in orthopedic and dental applications. Their primary function is to integrate with the surrounding bone and provide biomechanical support. Although, several surface modification technologies have been adopted to improve the osteointegration, it remains elusive in normal and more so in diseased individuals. Here, we propose a methodology to apply a biologically active natural extracellular matrix (ECM) coating to implants. Titanium implant surfaces were coated with a natural osteogenic ECM from human bone marrow derived mesenchymal stem cells (HMSCs) using a decellularization technique. The ECM coating was verified quantitatively and qualitatively by immunological characterization. The enhanced ability of coated surfaces to promote attachment, proliferation and osteogenic differentiation of HMSCs was evaluated *in vitro* quantitatively and qualitatively by means of proliferation assays, live cell imaging and qPCR analyses. Osteointegration was evaluated *in vivo* in a rat tibial model. Results indicated that the procedure resulted in an even coating of ECM on the implants. *In vitro* studies indicated that the coated implants promoted enhanced attachment, proliferation and osteogenic differentiation of HMSCs. *In vivo* experiments revealed enhanced bone formation around coated implants as observed by m CT analysis. Overall, these results indicate that coating titanium implant surfaces with a biomimetic ECM can enhance their functionality by generating a bioactive surface and promoting enhanced osteointegration.

12:45pm **LI-MoM1-12 Closing Remarks & Thank You!***, Chris Muratore (cmuratore1@udayton.edu),* University of Dayton, USA*; G. Greczynski,* Linköping University, Sweden, USA

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