Solid State Technology and Devices Seminar

Organic Mixed Ionic/Electronic Conductors for Applications in Bioelectronics

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Abstract: Direct measurement and stimulation of ionic, biomolecular, cellular, and tissue-scale activity is a staple of bioelectronic diagnosis and/or therapy. Bi-directional interfacing can be enhanced by a unique set of properties imparted by organic electronic materials. These materials, based on conjugated polymers, can be adapted for use in biological settings and show significant molecular-level interaction with their local environment, readily swell, and provide soft, seamless mechanical matching with tissue. At the same time, their swelling and mixed ionic/electronic conduction allows for enhanced ionic-electronic coupling for transduction of biosignals. These properties serve to enable new capabilities in bioelectronics. In the first part of my talk, I will focus on the design of polymer bioelectronic materials for enhanced electrophysiological sensors based on electrochemical transistors. Synthetic design and processing can yield high performance mixed conductors with large volumetric capacitance, high transconductance, and steep subthreshold switching characteristics for low power sensing. I will then discuss recent interest in developing devices and simple circuits based on electrochemical transistors that would impart added functionality to sensing sites and ease the burden on back-end electronics for signal processing and analysis. These developments highlight the role of materials design for addressing critical needs in bio-electronic interfacing.

Bio: Dr. Jonathan Rivnay earned his B.Sc. in 2006 from Cornell University (Ithaca, NY). He then moved to Stanford University (Stanford, CA) where he earned a M.Sc. and Ph.D. in Materials Science and Engineering studying the structure and electronic transport properties of organic electronic materials. In 2012, he joined the Department of Bioelectronics at the Ecole des Mines de Saint-Etienne in France as a Marie Curie post-doctoral fellow, working on conducting polymer-based devices for bioelectronics. Jonathan spent 2015-2016 as a member of the research staff in the Printed Electronics group at the Palo Alto Research Center (Palo Alto, CA) before joining the Department of Biomedical Engineering at Northwestern University in 2017. He is a recipient of an NSF CAREER award, ONR Young Investigator award, and has been named an Alfred P. Sloan Research Fellow, and MRS Outstanding Early Career Investigator.