



Jonathan Rivnay

Assistant Professor

*Department of Biomedical Engineering &
Simpson Querrey Institute*
Northwestern University

October 3, 2017

4:00pm Tech L211

“Organic Mixed Conductors for Applications in Bioelectronics”

Abstract: Direct measurement and stimulation of electrophysiological activity is a staple of neural and cardiac health monitoring, diagnosis and therapy. Such bi-directional interfacing can be enhanced by the attractive properties of organic electronic materials which can favorably bridge the biotic/abiotic interface. These materials are mixed ionic/electronic conductors: they allow for intimate interaction of the electron transporting polymer with the biological environment, including swelling and bulk interaction with ions and biomolecules. This feature improves both electrochemical properties and mechanical matching with surrounding tissue, critical for recording and stimulation in biomedical devices, and can be used to advance the state of the art. Organic electrochemical transistors, for example, have shown considerable promise as amplifying transducers for electrophysiology and biomolecular sensing due to their stability in aqueous conditions and high transconductance. I harness the volumetric gating of these devices to demonstrate human electroencephalography measurements with significant signal enhancement at low frequency. I then demonstrate the use of conducting polymers and polyelectrolytes as active elements in organic electronic ion pumps -- devices which allow for localized electrophoretic delivery, without the adverse effects of fluidic delivery. I show that release of an endogenous inhibitory neurotransmitter can stop seizure-like activity locally in brain tissue. Finally, I demonstrate how the ionic and electronic transport properties of organic mixed conductors can be controlled through synthetic and processing variation. These findings set the stage for a more general fundamental understanding of mixed conduction in organic electronic materials, which is necessary for future materials and device design for far-reaching bioelectronics application.

Biography: Jonathan 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.