



UNIVERSITY OF DELAWARE

ENGINEERING

DEPARTMENT OF CHEMICAL &amp; BIOMOLECULAR ENGINEERING

# DEPARTMENTAL SEMINAR



ALLAN P. COLBURN MEMORIAL LECTURE

**MATTHEW PANZER**

Associate Professor

**Tufts University****Friday | April 17, 2020 | 9:00 AM****102 Colburn Lab**

Matthew Panzer is an Associate Professor in the Department of Chemical & Biological Engineering at Tufts University in Medford, MA. He obtained an Honors Bachelor of Chemical Engineering with Distinction degree from the University of Delaware, and earned his Ph.D. in Chemical Engineering at the University of Minnesota under the direction of Prof. C. Daniel Frisbie with a thesis entitled "Polymer Electrolyte-Gated Organic Field-Effect Transistors." Before joining the faculty at Tufts, Dr. Panzer spent two years in the Research Laboratory of Electronics at MIT as a Postdoctoral Associate in the laboratory of Prof. Vladimir Bulović. He has been the recipient of the Massachusetts Clean Energy Center Catalyst Program Award (2017 & 2012), the Recognition of Undergraduate Teaching Excellence (ROUTE) Award from Tufts University (2014), and the Lillian and Joseph Leibner Award for Distinguished Teaching and Advising (2016).

## DESIGN OF POLYMERIC SCAFFOLDS FOR NONAQUEOUS IONOGEL ELECTROLYTES

Ionogel electrolytes are a fascinating class of nonvolatile and nonflammable ion conductors featuring room temperature ionic liquids/molten salts that can enable safer electrochemical energy storage devices, wearable sensors, and many other applications. In first part of this presentation, I will describe the synthesis and characterization of a variety of novel (co)polymer-supported ionogels that can be readily formed, for example, via *in situ* photopolymerization within ionic liquid-based electrolytes, some of which are also facile lithium ion conductors. Varying the chemical nature of the functional groups within the scaffold facilitates the creation of polymer-supported ionogels that exhibit room temperature ionic conductivities as high as 12 mS/cm and compressive elastic modulus values that can be tuned over several orders of magnitude, from ~1 kPa to >10 MPa. Experimental evidence of increased ion pair dissociation, as well as the formation of physical cross-links that enhance gel stiffness due to the presence of zwitterionic groups, has been obtained; in some cases, gel self-healing behavior can also be observed. The second part of this talk will present our recent advances in the design of deep eutectic solvent (DES)-based gel electrolytes. Envisioned to be lower cost, more eco-friendly alternatives to traditional ionic liquids, DESs can be supported using a variety of polymeric scaffolds to create gel composites. Here, I will describe the successful incorporation of a well-studied DES (2:1 molar ratio mixture of ethylene glycol:choline chloride) into gel electrolytes using two distinct approaches. First, a covalently cross-linked scaffold is formed *in situ* via copolymerization of 2-hydroxyethyl methacrylate and poly(ethylene glycol) diacrylate inside the DES. In a second strategy, gelatin has been employed as a biopolymer scaffold to successfully realize highly stretchable, ionically conductive, and nonvolatile DES gel electrolytes. In contrast to the covalent cross-linking approach, the biopolymer scaffold is assembled entirely through noncovalent polymer interactions, which facilitates the formation of dynamic cross-links that enable a high degree of gel stretchability.