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“Ion-Conducting Polymers for Electrochemical Applications”

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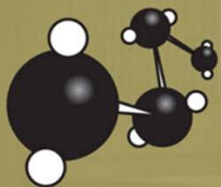
Department of Materials Science and Engineering
The Pennsylvania State University, University Park PA

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Dupuis Hall, Room 215

ABSTRACT

Polymers functionalized with high concentrations of fixed ionic charges are critical components of solid-state electrochemical systems such as fuel cells and electrolyzers. Two important considerations in the design of these materials are: 1) the morphology of their ionic domains, and 2) the motion of the absorbed water in the polymer structure. By manipulating the self-assembly of ion-rich domains in these polymers and by tuning the water-polymer interactions, the properties of these types of materials can be optimized for specific uses. New generations of solid polymer electrolytes are being developed that push the limits of ion conductivity in water-absorbing polymers. Although quantitative design parameters that connect the morphology and water binding to membrane transport properties are still not completely known, fundamental tools and insights gained from both model systems and practical membranes have allowed us to create a framework for understanding these systems and designing next-generation membranes for energy conversion and storage devices.

This talk will discuss the salient features of ion-containing polymers and provide insights into the mechanisms that control their transport properties such as ion conductivity and water permeability. Examples of new polymers targeted towards use in platinum-free fuel cells and redox flow batteries will be highlighted.



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BIO

Michael A. Hickner received a B.S. in Chemical Engineering from Michigan Tech in 1999 and a M. Eng. in 2002 and Ph.D. in Chemical Engineering from Virginia Tech in 2003. In graduate school he worked under the direction of James E. McGrath and also spent time in the fuel cell group at Los Alamos National Laboratory developing novel aromatic proton exchange membranes for both hydrogen and direct methanol fuel cells. Before joining the Department of Materials Science and Engineering at Penn State in July 2007, he was a postdoctoral researcher and subsequently became a staff member at Sandia National Laboratories in Albuquerque, NM where he conducted experimental investigations and modeling studies of liquid water transport in fuel cells and porous media, properties of ion-containing membranes, electrochemical reactors, and nanoporous membranes for water treatment applications. His research group at Penn State is focused on the synthesis and properties of ion-containing polymers, measurement of water-polymer interactions using spectroscopic techniques, and the study of self- and directed assembly of polymeric nanostructures for fast transport. He has ongoing projects in new polymer synthesis, fuel cells, batteries, water treatment membranes, and organic electronic materials. He is currently an Assistant Professor and the Virginia S. and Philip L. Walker, Jr. Faculty Fellow. Hickner's work has been recognized by a Powe Junior Faculty Enhancement Award (2008), Young Investigator Awards from ONR and ARO (2008), a 3M Non-tenured Faculty Grant (2009), and a Presidential Early Career Award for Scientists and Engineers from President Obama in 2009. He has five US and international patents and over 70 peer-reviewed publications since 2001 that have been cited more than 3200 times as of 2011.