IMPACT OF NANOPARTICLES ON TRANSPORT AND SEGMENTAL DYNAMICS IN IONOMER NANOCOMPOSITE MEMBRANES

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September 7th, 12:00 p.m.,
Jack E. Brown Building Room 256

Improvements in the ion selectivity of ionomer nanocomposites remain insufficient for the wide-scale implementation of needed energy-storage technologies such as vanadium redox flow batteries. To address this issue, we are investigating how the incorporation of nanoparticles (NPs) alters the conductive network formed in hydrated ionomer membranes and improves selectivity against vanadium ions. By tuning the surface chemistry of silica NPs, we examine how interactions between the NPs and the ionomer matrix modulates their spatial organization in the ionomer membrane (i.e., the NP 'dispersion state'), which we find significantly impacts vanadium ion permeability and segmental dynamics of the ionomer. A systematic study reveals anomalous water transport behavior, which is evidenced by water diffusion and water-induced polymer relaxation occurring on similar time scales. Results from this work indicate that both the dispersion state and surface chemistry of the incorporated NPs play a critical role in governing the vanadium ion transport as they act to slow down the segmental dynamics in these ionomer nanocomposite membranes.

About Dr. Eric M. Davis

Davis is an Assistant Professor in the Department of Chemical and Biomolecular Engineering. Before joining Clemson in 2015, Prof. Davis was a National Research Council postdoctoral fellow in the Materials Science and Engineering Division at the National Institute of Standards and Technology. He earned his B.S. in Chemical Engineering from Clemson University in 2008 and his PhD in Chemical Engineering from Drexel University in 2013 under Dr. Yossef Elabd.

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