

Abstract Submitted
for the MAR14 Meeting of
The American Physical Society

Structure and Water Transport in Nafion Nanocomposite Membranes ERIC DAVIS, KIRT PAGE, Materials Science & Engineering Division, National Institute of Standards and Technology (NIST) — Perfluorinated ionomers, specifically Nafion, are the most widely used ion exchange membranes for vanadium redox flow battery applications, where an understanding of the relationship between membrane structure and transport of water/ions is critical to battery performance. In this study, the structure of Nafion/SiO₂ nanocomposite membranes, synthesized using sol-gel chemistry, as well as cast directly from Nafion/SiO₂ nanoparticle dispersions, was measured using both small-angle neutron scattering (SANS) and ultra-small-angle neutron scattering (USANS). Through contrast match studies of the SiO₂ nanoparticles, direct information on the change in the structure of the Nafion membranes and the ion-transport channels within was obtained, where differences in membrane structure was observed between the solution-cast membranes and the membranes synthesized using sol-gel chemistry. Additionally, water sorption and diffusion in these Nafion/SiO₂ nanocomposite membranes were measured using in situ time-resolved Fourier transform infrared-attenuated total reflectance (FTIR-ATR) spectroscopy and dynamic vapor sorption (DVS).

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Date submitted: 15 Nov 2013

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