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Elucidating the Role of Confinement on Structure and Water Transport in Nafion Thin Films ERIC DAVIS, NICHOLE NADERMANN, EDWIN CHAN, CHRISTOPHER STAFFORD, KIRT PAGE, Materials Science and Engineering Division, National Institute of Standards and Technology, Gaithersburg, MD 20899 — Perfluorinated ionomers, specifically Nafion, are the most widely used polymer membranes for fuel cell applications. For these devices, Nafion is utilized in both a bulk (hundreds of microns) and confined (tens of nanometers) state. Therefore, a more complete understanding of the structure-processing-property relationships of these thin ionomer films, compared to the bulk membranes, is needed. In this study, water transport and structure of a series of Nafion thin film thicknesses were measured using a variety of experimental techniques. Water diffusion was measured via time-resolved in situ polarization modulation infrared reflection absorption spectroscopy (PM-IRRAS) and poroelastic relaxation indentation (PRI). The former probes through-thickness diffusion (direction of confinement), while the latter probes in-plane diffusion in the Nafion thin films. Suppressed water diffusion relative to the bulk was observed in both the through-thickness and in-plane directions of the thin film Nafion. Additionally, the structure of hydrated Nafion thin films was captured using small-angle neutron scattering (SANS). These results suggest that the nanostructure of the Nafion changes as the thickness of the film is decreased, resulting in a decrease in the effective water diffusivity of these thin ionomer films compared to the bulk membranes.

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