Interfacial water inside ionomer membrane pores and channels probed by infrared spectroscopy

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Infrared spectroscopy has long been applied as a simple technique for the study of structure and hydration in polymer electrolyte membrane materials. Typical fuel cell ionomer membranes are high surface area owing to the dense network of pathways that facilitate ion transport. The surface area is such that interfacial water can be detected in straightforward transmission infrared measurements for ionomer membrane in low or intermediate hydration states. This presentation will discuss the properties of interfacial water inside fluorinated ionomer materials. Focus will be on experiments that probe the structure and orientation of interfacial water through the use of H_2O/D_2O mixtures. In Nafion membrane exchanged by sodium ions, a pair of sharp bands near 3700 cm^{-1} characteristic of interfacial H_2O appears as a single feature for interfacial HOD. The results are examined within the context of classical and quantum calculations performed to explain the effect of isotope substitution on water spectra across the O-H stretching mid-infrared region.