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Lyotropic Liquid Crystal Mesophases as a Platform for Understanding Proton Transfer in Hydrated Polymer Membranes[1] GRAYSON JACKSON, DOMINIC PERRONI, University of Wisconsin-Madison, MAHESH MAHANTHAPPA, University of Minnesota-Twin Cities — Few molecular design rules exist for guiding the development of proton transporting, acidic nanoporous polymer membranes for fuel cell and electrochemical device applications. Lyotropic liquid crystal (LLC) mesophases, which arise from small molecule surfactant self-assembly, comprise a model materials platform for investigating the molecular details of water-mediated proton transfer in monodisperse nanochannels lined with specific chemical functionalities. We describe studies of the aqueous phase behavior and ion conductivities of a new class of non-fluorinated alkylsulfonic acid amphiphile LLCs, which exhibit remarkably high proton conductivities ($\geq$ 150 mS/cm at 25 C and 100 %RH) that rival those of the best polymeric, perfluorosulfonic acid proton conductors. Thus, the acidity of the pore functionality is not the primary determinant of ionic conductivity. Instead, our studies demonstrate that proton conductivity depends on maximizing proton activity within the nanochannels, which sensitively depends on the pore diameter and pore morphology.

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