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Ionic Conductivity and Gas Permeability of Polymerized Ionic Liquid Block Copolymer Membranes CHRISTOPHER EVANS, Lawrence Berkeley Lab, GABRIEL SANOJA, University of California-Berkeley, YANIKA SCHNEIDER, Lawrence Berkeley Lab, MIGUEL MODESTINO, University of California-Berkeley, RACHEL SEGALMAN, University of California-Berkeley, Lawrence Berkeley Lab, JOINT CENTER FOR ARTIFICIAL PHOTOSYNTHESIS TEAM — Polymer membranes for many energy applications, such as solar-to-hydrogen fuel production, require ionic conductivity while acting as gas diffusion barriers. We have synthesized a diblock copolymer consisting of poly(styrene-block-(4-(2-methacrylamidoethyl)-imidazolium trifluoroacetate) by treating poly(styrene-block-histamine methacrylamide) (PS-*b*-PHMA) with trifluoroacetic acid. The PS block serves as the structural support while the imidazolium derivative is an ion conducting polymerized ionic liquid (PIL). Small angle X-ray scattering and transmission electron microscopy demonstrate that the block copolymer self-assembles into well-ordered nanostructures, with lamellae and hexagonally packed cylindrical morphologies. The ionic conductivities of the PS-b-PHMA materials were as high as 2 x 10^{-4} S/cm while an order of magnitude increase in conductivity was observed upon conversion to PS-b-PIL. The ionic conductivity of the PS-b-PIL increased by a factor of $\sim$ 4 up to 1.2 x 10^{-3} S/cm as the PIL domain size increased from 20 to 40 nm. These insights allow for the rational design of high performance ion conducting membranes with even greater conductivities via precise morphological control. Additionally, the role of thermal annealing on the ionic conductivity and gas permeability of copolymer membranes was investigated.

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