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Morphology and Ionic Conductivity of Humidity-Responsive Polymerized Ionic Liquid Block Copolymers SHARON SHARICK, Department of Materials Science and Engineering, University of Pennsylvania, KELLY MEEK, YUESHENG YE, YOSSEF A. ELABD, Department of Chemical and Biological Engineering, Drexel University, KAREN I. WINEY, Department of Materials Science and Engineering, University of Pennsylvania — We present the ionic conductivity and morphology of humidity-responsive polymerized ionic liquid block copolymers (PIL BCPs), poly(methyl methacrylate-*b*-1-[2-(methacryloyloxy)ethyl]-3-butylimidazolium-X), where X is a bromide (Br) or hydroxide (OH) anion, as a function of relative humidity (RH), temperature, and PIL composition (ϕ_{PIL}). PIL BCPs were characterized by in situ small-angle X-ray scattering and electrochemical impedance spectroscopy. These PIL BCPs have microphase separated morphologies and long-range order increases as ϕ_{PIL} increases. Notably, ionic conductivity increases 3 to 4 orders of magnitude when RH increases from 30 to 90 percent. When ϕ_{PIL} is greater than 0.37, BCP ionic conductivity approaches or exceeds that of the homopolymer, suggesting that the dynamics in PIL microdomains mimic the homopolymer and long-range order aids ion transport. Moreover, over 60 percent of the BCP is nonconductive without a penalty in ion transport. When ϕ_{PIL} is less than 0.37, BCP conductivity is 1 to 2 orders of magnitude less than the homopolymer and non-conductive PMMA segments dominate ion transport, as expected. Ionic conductivities at 80 $^{\circ}$C, 90 percent RH, are 7.6 mS/cm for the Br-containing BCP with $\phi_{PIL} = 0.53$ and 25.0 mS/cm for the OH-containing BCP with $\phi_{PIL} = 0.50$.

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