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DEPARTMENT OF MATERIALS SCIENCE AND ENGINEERING
COLLEGE OF EARTH AND MINERAL SCIENCES

~~~~ Polymer Physics Seminar ~~~~

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301 Steidle Bldg.

Ion-Containing Block Copolymers for Fuel Cell Membranes

The ability to control the ionic domain structure of fuel cell membranes is a critical aspect of optimizing their properties and boosting their performance.[1] Ion-containing block copolymers are of interest for fuel cell membranes due to their high degrees of phase separation that promote formation of a connected ionic nanophase, which can be controlled by tuning the block copolymer composition and membrane processing. Poly(hexyl methacrylate-b-styrene-b-hexyl methacrylate) [PHMA-*b*-PS-*b*-PHMA] triblock copolymer was synthesized via atom transfer radical polymerization (ATRP) for this purpose (Figure 1).[2] The PS block of the PHMA-*b*-PS-*b*-PHMA triblock was post-functionalized with either sulfonate or quaternary ammonium ions, the latter of which required an intermediate chloromethylation step. Chloromethylation using paraformaldyhyde and chlorotrimethylsilane in the presence of a Lewis acid catalyst was used because other routes involving in-situ formation of chloromethyl methylether led to no reaction, likely due to complexation of a zinc-based Lewis acid catalyst with the methacrylate blocks.

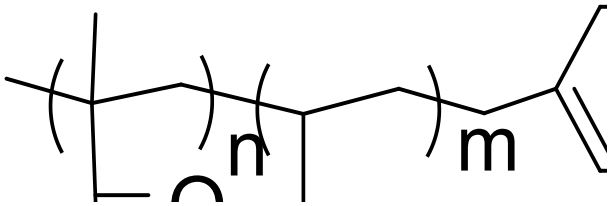

Figure 1. Synthesis routes for sulfonation (left) and quaternization (right) of poly(hexyl methacrylate)-*b*-poly(styrene)-*b*-poly(hexyl methacrylate) triblock copolymer

Morphological changes in films of these PHMA triblocks were observed using small angle x-ray scattering (SAXS),[3] and the domain spacings were calculated. Ion conductivity, hydration number, and water uptake for the functionalized PHMA triblock copolymers were measured to evaluate how the ionic phase ordering influenced the properties of these materials. In addition, we are interested in how the behavior of the polymer in solution affects the final membrane properties. Small angle neutron scattering (SANS) has been used to perform preliminary studies of the aggregation of triblock copolymers in solution.

1 Elabd, Y. A.; Hickner, M. A. *Macromolecules*. **2011**, *44*, 1-11.
2 Saito, T.; Moore, H. D.; Hickner, M. A. *Macromolecules*. **2010**, *43*, 599-601.
3 Moore, H. D.; Saito, T.; Hickner, M. A. *Journal of Materials Chemistry* **2010**, *20*, 6316-6321.