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Multifunctional Block Polymer Thin Films for Templating and Separations

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Self-assembled block polymer thin films are useful for applications that rely on coatings or freestanding structures that are compositionally heterogeneous on a nanometer length scale. For example, AB diblock copolymers such as poly(styrene)-poly(methyl methacrylate) have been broadly utilized as thin film templates for various nanopattern transfer processes that are attractive for microelectronics applications. In addition, self-assembled block polymer films have garnered interest in the area of gas and liquid separations based their inherent ability to simultaneously incorporate both selective domains and mechanically robust domains needed for practical membrane applications. Motivated by the tremendous technological potential of block polymer thin films, we have explored the incorporation of multiple functional blocks into these hybrid macromolecules that (i) expand the range of accessible nanostructures and (ii) contain the chemical functionality essential for a particular targeted application. These efforts often require the controlled synthesis of multiblock polymers from monomers with chemical features that are well suited to the ultimate intended use. For example, we have incorporated selectively crosslinkable, hydrolytically degradable, proton conducting, and/or reactive ion etch resistant materials into a variety of di-, tri- and multiblock structures using combinations of controlled polymerization techniques. We have used thin films of these block polymers for the preparation of nanostructured magnetic materials in addition to ultrafiltration, gas separation, and fuel cell membranes. In this presentation I will discuss our recent efforts in the synthesis, self-assembly, and implementation of multifunctional block polymer thin films for applications in templating and separations.