Functional Soft Interfaces Based on Reactive Polymer Scaffolds

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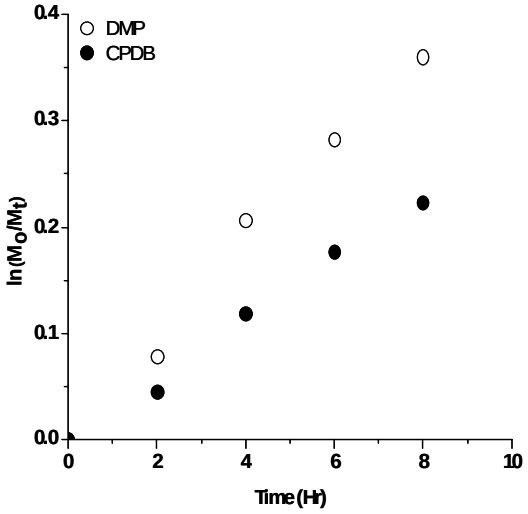
Scientific Thrust Area: Polymer science, thin films

Research Achievements

Materials interact with their environment via their interfaces, and as the volume of materials decreases to the nanoscale, surface-to-volume ratios increase dramatically. For these reasons, modification of surfaces with thin polymer films is commonly used to tailor a range of properties, including wettability and antifouling characteristics, adhesion and lubricious behavior, and abrasion and corrosion resistance. The ability to alter interfacial structure and confer desirable properties to the substrate enables application across a broad array of technologies. Underlying such applications is the need to understand the interconnected assembly-structure-property relationships.

In this regard we have been studying polymers based on the reactive monomer, 2-vinyl-4,4-dimethylazlactone (VDMA), which offers compelling potential for creating functional polymers due to its ability to readily react with nucleophiles, such as alcohols and primary amines, as well as its intrinsic hydrolytic stability. The robustness of these transformations provides a convenient way to alter polymer structure and properties. A series of well-defined polymers based on VDMA were synthesized using reversible addition fragmentation-chain transfer (RAFT) polymerization. Linear pseudo first order kinetics are observed for the RAFT polymerization of VDMA in benzene at 65 °C, with differences in polymerization rate most likely due to the higher rate of fragmentation of the two chain transfer agents (CTAs) used to mediate the polymerization.



The ability to modify the chemical structure and properties of these polymers has been demonstrated using a variety of nucleophiles that transform these polymers into weak polyelectrolytes, decorate the chains with pendant biomolecules or fluorescent tags, or provide specific motifs used for site-specific immobilization of tagged proteins. An example of such a transformation is shown below, where gel permeation chromatography (GPC) is used to confirm