Recent Advances in Responsive Polymeric Materials

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We have begun to explore the response of polymers towards nanoparticles as a function of kinetic rates and nanoparticle surface morphology. The kinetic rates of chain exchange between block copolymer micelles varies during in situ sol-gel reactions. Controlling the sol-gel reaction pathway allows for enhanced kinetic control of resulting nanostructured materials. Also, the surface chemistry of nanoparticles determines their interactions with the local environment. Nanoparticles with stripe-patterns of mixed ligands exhibit anomalous interactions with small molecules where designer surface morphologies provide a new path towards regulating nanoparticle-polymer interactions.

Bio-based multi-responsive shape memory polymers have been synthesized via ATRP (atom transfer radical polymerization) techniques and characterized by multiple analytical techniques. Shape memory polymers have the ability to deform and reform shapes in response to different stimuli. In our work, a new bio-based approach is used based on cellulose nanocrystals and soybean oil based polymers. These polymers have so far shown responsiveness to temperature, water, and organic solvents with excellent ability to shape and reform. A general outline of this new approach will be discussed with early results that indicate wide-ranging opportunities and applications.