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Investigating Block-Copolymer Micelle Dynamics for Tunable Cargo Delivery XIULI LI, BRYCE KIDD, Virginia Tech, TYLER COOKSEY, MEGAN ROBERTSON, University of Houston, LOUIS MADSEN, Virginia Tech
— Block-copolymer micelles (BCPMs) can carry molecular cargo in a nanoscopic package that is tunable using polymer structure in combination with cargo properties, as well as with external stimuli such as temperature or pH. For example, BCPMs can be used in targeted anticancer drug delivery due to their biocompatibility, in vivo degradability and prolonged circulation time. We are using NMR spectroscopy and diffusometry as well as SANS to investigate BCPMs. Here we study a diblock poly(ethylene oxide)-b-(caprolactone) (PEO-PCL) that forms spherical micelles at 1% (w/v) in the mixed solvent D_2O/THF-d8. We quantify the populations and diffusion coefficients of coexisting micelles and free unimers over a range of temperatures and solvent compositions. We use temperature as a stimulus to enhance unimer exchange and hence trigger cargo release, in some cases at a few degrees above body temperature. We present evidence for dominance of the insertion-expulsion mechanism of unimer exchange in these systems, and we map phase diagrams versus temperature and solvent composition. This study sheds light on how intermolecular interactions fundamentally affect cargo release, unimer exchange, and overall micelle tunability.

Xiuli Li
Virginia Tech

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