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Temperature-Responsive Polyelectrolyte Microtubes and Shells

Hydrated layer-by-layer (LbL) assembles undergo a “glass-melt” transition, which can be leveraged for a variety of applications. Here, these dramatic changes are utilized as a temperature-responsive gate for the delivery of dexamethasone, an anti-inflammatory drug. An LbL nanoshell consisting of poly(diallyldimethylammonium chloride) (PDAC) and poly(styrene sulfonate) (PSS) is deposited onto a dexamethasone nanoparticle. The release of dexamethasone is compared for the number of layer pairs, ionic strength, and temperature. A transition from non-Fickian to Fickian transport is observed as the temperature increases from the glassy to rubbery states. Large changes in hydration also bring about macroscopic changes in shape. This is most readily observed using LbL microtubes formed from sacrificial porous templates. Here, it is demonstrated that free LbL microtubes contract into ellipsoids upon heating through the glass-melt transition. On the other hand, microtubes confined within their original templates undergo Rayleigh instabilities, as they are unable to contract into ellipsoids. In ongoing work, we are comparing this transition to the behavior of analogous polyelectrolyte complexes.