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| הפקולטה להנדסה כימית  ע"ש וולפסון |  |  |
| The Wolfson Department of Chemical Engineering |  |  |

**Wolfson Department of Chemical Engineering Seminar**

**Tuesday, November 23th, 2021 at 15:30**

**Via zoom** [**https://technion.zoom.us/j/97577956516**](https://technion.zoom.us/j/97577956516)

**Self-Assembly of Thermoresponsive Polymers in Solutions and Melts**

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Thermoresponsive polymers belong to the class of stimuli-responsive polymers that show a significant and abrupt change in physical properties upon a temperature change. My research focuses on the self-assembly of two thermoresponsive polymer systems: bulk diblock copolymers consisting of a linear block attached to bottlebrush block, and methylcellulose in aqueous solutions.

For the first system, I studied the phase behavior of nine sets of norbornene-based coil-*block*-bottlebrush copolymers to determine the effect of architectural asymmetry and the interaction parameter on self-assembly into network and other structures. Block copolymer (BCP) networks consist of reoccurring interpenetrating nanodomains, providing the opportunity to design materials with several orthogonal properties, *e.g*., mechanical strength and ion conductivity, through manipulation of the constituent blocks. However, access to potential applications has been limited because network formation with linear BCPs tends to occur only over narrow compositional windows. Moreover, slow self-assembly kinetics at high molecular weight places limits on the tractable molecular size, hence on the accessible pore size of the network structures and the resulting properties of the matrix. Polymers with a bottlebrush architecture provide access to larger length scales due to an extended backbone chain conformation, and faster ordering kinetics as a result of greatly reduced entanglement density. I have combined the coil and the brush architectures into hybrid diblock copolymers, and explored the consequences on the formation of network phases. Through a combination of molecular and structural characterization techniques, I demonstrate that the shape of the polymer and the identity of the coil block provide significant control over the molecular factors that dictate network formation.

In a separate investigation, I examined the effect of added salt on the structure, fibril formation, and gelation of methylcellulose (MC) in water. MC is a commercially important water-soluble polysaccharide derivative, which gels thermoreversibly upon heating. Although MC has been studied and exploited in applications for many decades, it has only recently been discovered that gelation occurs via self-assembly of the polymer chains into *ca*. 15 nm diameter fibrils, which percolate into a network. The fibrillar and network structures dictate the mechanical properties of the resulting hydrogel. Addition of various types of salt to MC gels has been an area of academic and commercial interest, where MC solutions exhibit both increases or reductions in the gelation temperature, generally consistent with predictions based on the Hofmeister series. I have explored the effect of salt on MC fibril structure, and probed the effects of different salts on the gelation and dissolution temperatures using rheological and cloud point measurements. Small angle X-ray scattering (SAXS) and cryogenic transmission electron microscopy experiments have revealed that nanoscale fibrils also characterize salty MC gels. Fitting the SAXS curves to a semiflexible cylinder model demonstrates that the fibril diameter decreases monotonically with increasing salt molarity, largely independent of the salt anion or cation type.