Polymers are one of the most common glass-forming materials and they are ubiquitous in many industries. Thin polymer films, that have properties that significantly deviate from those of the bulk polymer, have attracted much attention from numerous researchers in the past two decades. A fundamental challenge in characterizing the materials is to understand how competing interfacial and confinement effects influence the apparent glass transition temperature $T_g$ and the dynamics of these films.

In particular, there is a significant variation in the reported magnitude, and even the sign of glass transition temperature $T_g$ shifts in thin polymer films with the same chemistry, film thickness, and supporting substrate. Specifically, $T_g$ estimates based on thermodynamic properties of these thin polymer films have often been found to be inequivalent to $T_g$ estimates based on a dynamical criterion. We use molecular simulations to show that these $T_g$ variations, reflecting different $T_g$ measurements, have differing sensitivities to the mobility gradient across the film. Our results emphasize the limitations of using $T_g$ to infer changes in the dynamics of polymer thin films. However, we show that the thermodynamic and dynamic estimates of $T_g$ can be combined to predict local changes in $T_g$, providing a simple method to infer properties of the mobility gradient.

**BIO**
Wengang Zhang is a postdoctoral researcher at NIST and Wesleyan University. He received his Ph.D. in physics from Wesleyan University in January 2018. His research focuses on the use of theoretical and computational approaches to understand soft materials including polymers, dense liquids, and glasses. He is currently developing metrologies for characterizing emergent spatial patterns in disordered materials at NIST.