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Mechanics of Polymer Thin Films: What Can We Learn from the Glass Transition?

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Mechanical properties of polymeric materials are critical to their utility in many applications. However, little is known regarding the mechanical properties of polymers when confined to dimensions approaching their intrinsic molecular size (R_g). Thermal properties, in particular the glass transition temperature (T_g), of nanoconfined polymers have been studied extensively over the past two decades due to the relative ease of measurements. Correlations between T_g and modulus are well established for bulk polymers, but it is unclear if these hold at the nanoscale. Here, I will present direct comparisons of the thickness dependent T_g and elastic moduli behavior to address this question. Additionally, correlations between bulk T_g and the thickness dependent behavior will be explored by using a homologous series of poly(n-alkyl methacrylate)s and a series of widely varying molecular mass polystyrene films.