Strong Enhancement of the Particle Surface Mobility of Polymer Colloids with Shell Architecture

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Nowadays, the application of nanoscaled polymer material is getting widen, but there are still demands for the knowledge of polymer thermal behavior under confinement and near polymer-polymer interface for their applications such as drug delivery, photonic and phononic crystals [1-3].

We previously reported calculated elastic modulus of polymer nanoparticles [4], and dramatic change of surface mobility and thermal behaviour with ultrathin shell in core-shell structured nanoparticles [5]. Here, we studied the effect of a polymer shell layer atop polymer core on modulus and glass transition temperature (T_g) quantitatively via Brillouin light scattering spectroscopy and modulated differential scanning calorimetry. Core-shell nanoparticles consisting polystyrene (PS) as a core, Poly(n-butyl methacrylate) (PBMA) and Poly(methyl methacrylate) (PMMA) as a shell were used. We found that high T_g PS core was not largely affected by the existence of the lower T_g PBMA outer shell, while the lower T_g PBMA shell showed T_g drop with increasing shell thickness. Overall modulus of the core-shell nanoparticles decreased with increasing PBMA shell thickness and slightly increased for PMMA shell. As a result, this research suggests that thermal behavior of nanoparticles such as modulus and T_g can be modified independently by nanoparticle architecture and composition.

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