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Role of Polymer-Graft Architecture on the Cohesive Interactions, Assembly and Thermo-Mechanical Properties of Particle Brush Materials

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Recent progress in the area of surface-initiated controlled radical polymerization (SI-CRP) has enabled the synthesis of polymer-grafted particulates with precise control over the architecture of grafted chains. The resulting "particle brush materials" are of interest both from a fundamental as well as applied perspective because structural frustrations (that are associated with the tethering of chains to a curved surface) imply a sensitive dependence of the conformation of surface-grafted chains on the architecture of the particle brush. The opportunity to control chain conformation in hierarchically organized hybrid materials with precisely controlled microstructure renders particle brush materials intriguing building blocks for innovative material systems that could have a transformative impact on a range of "soft material" technologies. In the first part, this presentation will discuss experimental results that illustrate the role of polymer graft modification on the interaction between brush particles in solution and the solid state as well as the assembly characteristics of particle brushes in the solid state. The opportunities provided by "merging" of the physical properties of ordered particle superlattice structures with the mechanical properties and processibility of polymer materials will be demonstrated for the example of "plastic colloidal crystal" structures. In the second part, this presentation will showcase results of ongoing experimental studies that aim to harness the distinctively different property characteristics associated with "stretched" and "relaxed" polymer segments to facilitate novel property combinations in particle brush materials that are absent in binary particle/polymer blend systems.