Colloidosomes as Polymerization Vessels

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Advances in controlled/living radical polymerization and (mini)emulsion polymerization techniques have created great opportunities in the syntheses of polymer molecules and particles. We synthesize a variety of polymeric molecules and particles and investigate their use as building blocks for the design of more complex colloidal structures. When particles, instead of surfactant molecules, are used to stabilize an emulsion one speaks of a Pickering emulsion. Important applications can be found for example in the food, cosmetics and oil recovery industries. Pickering stabilized colloidal systems are currently going through a renaissance.

One of the drives behind this is that vast arrays of supracolloidal self-assembled structures can be build. Pioneering work by Velev showed that latex particles could be used to self-assemble into supracolloidal structures at the liquid-liquid interface of emulsion droplets. Weitz reported the fabrication of similar structures, naming them colloidosomes.

Our general interest lies in the use of colloidosomes as polymerization vessels as a versatile strategy towards novel supracolloidal structures. In this work we report the preparation of submicron clay armored latex particles made via a Pickering stabilized miniemulsion polymerization of monomer filled Laponite colloidosomes of submicron dimensions. We will discuss the versatility of the polymerization process, look at the film formation properties of these armored latexes and their application in polymer clay nanocomposites.

Moreover, we will address the Pickering suspension polymerization of micron sized colloidosomes. One of the key problems is the mechanical robustness and stability of colloidosomes, especially when they are taken out of the environment in which they were formed. Scaffolding of these supracolloidal structures by linking the individual building blocks together has been carried out via autohesion, chemical crosslinking of the individual building blocks, jamming, 2D colloidal crystal formation, or physi/chemisorption of macromolecules. Our suspension polymerization is a conceptually different approach which addresses scaffolding. We show the unprecedented example of preparing an interpenetrating polymer network as a scaffold to produce hollow supracolloidal structures, build from colloidosomes of crosslinked latex particles. We will show that the mechanical properties of these novel capsules can be tailored readily by varying the chemical composition of the interpenetrating polymer network.