Building colloidal architectures with nanoparticles.

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We will report on the preparation of binary colloidal composites made from organic and inorganic nanoparticles and their use as complex templates for the fabrication of hollow inorganic nanostructures. Control over the assembly of nanoscale functional building units is of great significance to practical applications, but is also interesting from a more fundamental point of view of understanding the self-assembly of nanostructured materials. Joining together different spherical nanoparticles in a defined manner allows control over the shape, composition and surface roughness of the nanocomposites [1]. If the constituents consist of different materials, the resulting heteroaggregates feature both compositional and interfacial anisotropy, offering unprecedented perspectives for rationally designed functional colloids, which are of fundamental importance to a broad range of applications including sensing, photonic, and electronic devices.

Colloidal binary aggregates obtained by joining organic and inorganic particles.

The preparation of the clusters is based on the agglomeration of particles that are dispersed in an emulsion [2]. The droplet size distribution in the emulsion is controlled by ultrasound. The particles adsorb on the surface of the emulsion droplets (Pickering effect) and coagulate in a well-defined way during the evaporation of the (dispersed) oil phase. Using one can produce clusters with colloidal dimensions (<400nm) [3]. Further functionalization can be accomplished by deposition of functional nanoparticles onto the surface of the assemblies. [1] Removal of the colloidal support opens opportunities for submicron-sized nanoparticle shells with complex yet defined shapes.

The configurations and yields of the nanostructures were studied by electron microscopy, computer simulation, scattering methods, and differential centrifugal sedimentation.
