Functional Nanomaterials from the Bottom-up Assembly of Solution-Processed Nanoparticles

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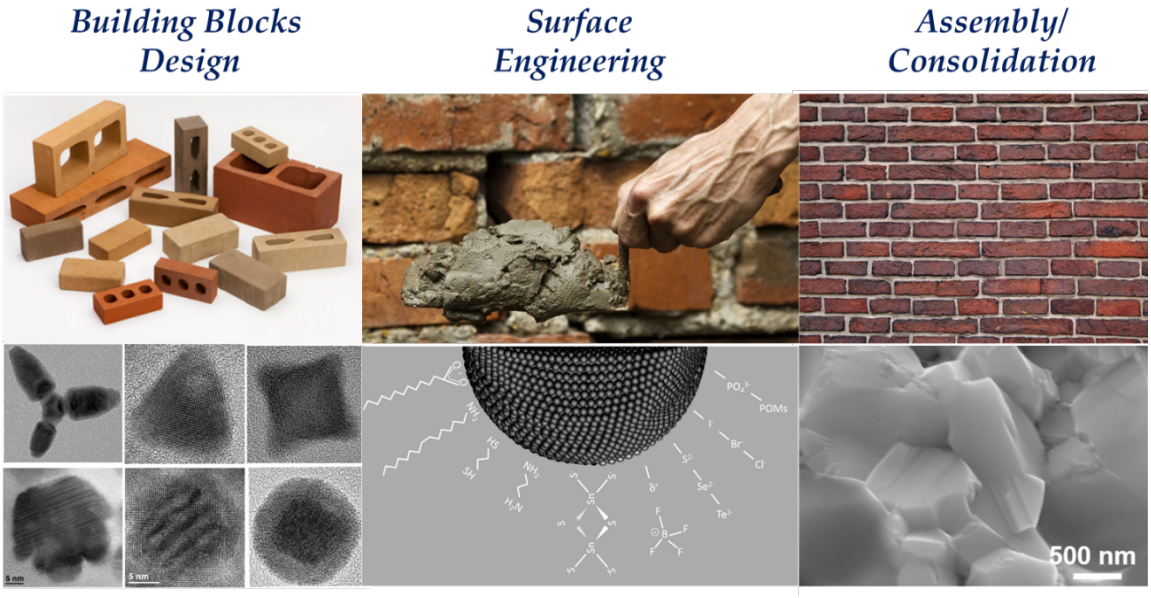

Nanocrystals can be envisioned as artificial atoms to build-up materials from. Colloidal synthetic routes are capable to yield nanocrystals with precise control of size, shape, crystalline phase and composition, thus allowing to accurately engineer such artificial atoms. Therefore, a new generation of complex materials with nanoscale control can be created in which components and functionalities can be defined in a predictable manner. Beyond nanocrystal design, another key player on the building-up process is the nanocrystal surface. Most synthetic strategies developed render nanocrystal with organic molecules coordinated at their surfaces (ligands). By locally controlling surface energy and charge is possible to exchange native ligands by other organic or inorganic molecules that may incorporate foreign atom/ions at each surface site. The possibility to modify nanocrystal surface chemistry opens a new degree of freedom to tune final nanomaterial properties, defining the surface ligand as a building block on its own. Last but not least, the functional properties are as well determined by the nanocrystals organization, interconnection, packing density and relative crystal orientation in the final nanomaterial. Herein, we will focus on the synthesis of nanoparticles with precisely engineered composition and surface chemistry, and their combination and consolidation into nanostructured materials to target the needs of thermoelectricity.