

## **Emergence of new functions in nanostructured materials: engineering colloidal nanocrystals for nanocomposites and assemblies**

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Recently, increasing interest has been devoted to the study of the size dependent properties of inorganic nanocrystals and nanoparticles. Fine tuning of the nanomaterial electronic, optical, magnetic, thermal, mechanical, and chemical properties opens possibilities for their use in a variety of applications. In this perspective the basic nanosized building blocks play a crucial role and the extent to which nanocrystals (NCs) and nanoparticles (NPs) can be fabricated, engineered and their properties tailored is central. Chemical strategies are now able to provide highly processable NCs, possessing an adjustable interface with the external environment, able to tune their specific chemical reactivity towards the surroundings<sup>1</sup>. Equally decisive is the scheme used to convey the instruction for assembly and organization into the inorganic NPs. Assembly can be spontaneous (self assembly), guided by the intrinsic information encoded into the building blocks, and/or driven by external stimuli, templates, chemical and/or physical forces.<sup>2</sup> The complexity of the formed structures depend on a variety of factors, as the type of the single structural component, and the length scale and the mechanism ultimately involved for the creation of the final architectures. Top-down technological methods and techniques, conventional and emerging, can be cleverly and ingeniously combined and matched with dedicated bottom-up approaches, towards the fabrication of materials with unprecedented functionality, thus opening the routes for applications in biomedical, optical, electronic, catalytic and light energy conversion systems.<sup>3</sup> The NC based structures, either hierarchical organized or nanocomposite in nature, can show original emergent properties which cannot be readily envisioned from the building block original properties, while can be observed to arise in the originated mesostructures. The potential of inorganic nano-objects for assembling and patterning will be highlighted and an overview of the inorganic NC functions in the different and complementary strategies will be provided.

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[3] Y.Kim, C. Ingrosso, V. Fakhfour, M. Striccoli, A. Agostiano, M. L. Curri, J. Brugger *Small*, 2009, 5 1051