Colloidal Nanoparticles: Novel Perspective For Nanopatterning

E. Fanizza[1], N. Depalo[1], M. Tamborra[1,2], R. Comparelli[2], M. Striccoli[2],A. Agostiano[1,2],
M. L. Curri[2]*
[1] Dipartimento di Chimica, Universita` di Bari, via Orabona 4, I-70126, Bari, Italy
[2] CNR-IPCF sez. Bari, c/o Dip. di Chimica, Universita` di Bari, via Orabona 4, I-70126, Bari
* lucia.curri@ba.ipcf.cnr.it

The unique size- and shape-dependent optoelectronic and magnetic properties of semiconductor and metal nanoparticles (NPs) make them extremely attractive as novel structural building blocks for constructing a new generation of innovative materials and solid-state devices.

Recent advance in chemical synthesis allows to synthesize colloidal nanoparticles in a wide range of composition with an excellent control on size, shape and uniformity. In addition, the nanoparticle surface can be properly engineered by ligand exchange and surface functionalization, and can be placed in almost any chemical environment. In this perspective, the colloidal nano-objects can be really considered a new class of chemical macromolecules, which can be organised using the well-assessed principles and techniques of (bio)organic chemistry. The rational assembly of structures from nanometer scale building blocks can be achieved by choosing NPs differing in size and/or composition. Also the interaction between NPs by means of the length and chemical functionality of the organic interlayer play a distinctive role in the assembly mechanisms. A wide range of molecules can be linked to the nanoparticle surface, which can be thus embedded in polymers or deposited on substrates and assembled in organized 2D and 3D structures.

In this contribution two approaches will be presented as distinctive opportunities of exploitation of the nanoparticle properties in patterning procedures. On one side, examples of chemically-directed assembly of NPs onto substrates by means of the introduction of functionalities onto the NC surface will be reported. The possibility to improve the processability and/or tune the reactivity of the particles without altering their original structural and chemical-physical properties will be demonstrated. On the other side the unique characteristics of hybrid materials based on polymers and semiconducting luminescent colloidal nanoparticles, and thus able to combine the optoelectronic and chemical properties of the inorganic moiety, and the processability and structural characteristic of the polymer will be discussed. The potential use of such functional polymer nanocomposites for pattern fabrication by means of nanoimprinting lithography techniques will be highlighted.