Design advanced magnetic nano-architecture

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Magnetic Nanoparticles (MNPs) are unique complex objects whose physical properties differ greatly from their parent massive materials. In fact, the magnetic properties are particularly sensitive to the particle size, being determined by finite size effects on the core properties, related to the reduced number of spins cooperatively linked within the particle, and by surface effects, becoming more important as the particle size decreases. MNPs have generated much interest because of their possible applications in high density data storage, ferrofluid technology, catalysis, environmental technology, and biomedicine (e.g., drug delivery, contrast enhanced MRI)[1]. To synthetize Magnetic nanoarchtiecture (MN) represent an additional tool to further tuning physical properties of MNPs, obtaining new multifunctional materials. MN consist in a magnetic core embedded in shell/matrix that may be composed of polymers[2], mesoporous structures (e.g., silica[3], zirconia[4], zeolites[5], metalorganic framework[6]) or even molecules[7]. Shell/matrix can have magnetic properties and in this case properties of MN rely even more strong on the interplay between those of the constituent components. When the individual components themselves, are complex systems belonging for examples to the family of correlated electron oxide with exotic physical properties, it becomes non-trivial and extremely fascinating to customize the properties of these bi-magnetic nanocomposites[8–10]. Based on this framework, this talk will focus on the design of MN that means to control the matter at the nanoscale, correlating magnetic properties, micro- and meso-structure and molecular coating. Some recent results on synthesis of magnetic nanocomposites and their application in energy (e.g., permanent magnets, thermoelectricity), biomedicine, catalysis and other technological field will be discussed.

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