Toward an eco-friendly way to produce magnetic nanoarrays for big data

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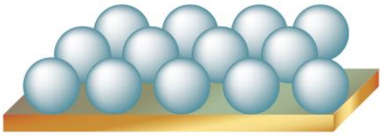


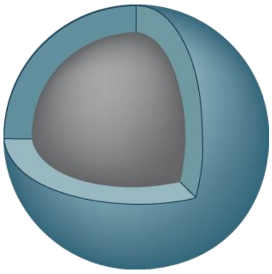
Nanoparticle assemblies directed by a molecular nanopattern

Magnetic nanoparticles are gaining increasing interest for numerous applications.[1] For instance, the next generation of data storage media will be based on smaller bits which are defined by the specific orientation (up or down) of nanoparticle magnetization with high stability at room temperature over 10 years. Such applications require permanent magnets which chemical composition includes rare earth elements. However, the extraction of rare earth elements has a strong ecological impact on the environment. An alternative is nanoparticles based on iron oxide nanoparticles which is abundant and eco-friendly materials. Although iron oxide displays very attractive magnetic properties, nanoparticles have to solve some crucial issues to be suitable for their integration in technological devices:
i) size reduction at the nanoscale usually results in fluctuations of magnetization at room temperature, e.g. superparamagnetism.
ii) the production of highly ordered arrays still remains a great challenge and is highly desirable to master the collective magnetic properties of nanoparticles.

In this context, the objectives of this PhD thesis are:

i) the synthesis of a new class of nanoparticles combining several magnetic phases in order to enhance magnetic anisotropy energy through interfacial exchange couping.[3]

ii) the preparation of highly ordered arrays of nanoparticles directed by molecular patterns through specific chemical interactions. [2]



Onion-type nanoparticle

The candidate will be trained to the thermal decomposition technique in order to synthesized nanoparticles with an onion-type structure, on the basis of our recent results. [3] The characterization of nanoparticles and their assemblies will require a wide panel of techniques (X-Ray diffraction, infrared spectroscopy, transmission electron microscopy, granulometry, scanning electron microscopy, atomic force microscopy). The intrinsic and collective magnetic properties will be investigated by SQUID magnetometry and, also by magnetic force microscopy, prefiguring the integration of nanoparticle arrays in devices for magnetic recording. This research work will give access to the candidate to a wide panel of techniques (synthesis, assembly, structural and magnetic characterization, …) and allow him/her to interact with numerous researchers in Strasbourg.

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[1] Singamanemi *et al. J. Mater. Chem.* **2011**, 21, 16819
[2] Toulemon *et al. Chem. Commun.* **2011**, 47, 11954
[3] Sartori *et al. J. Am. Chem. Soc.* **2019**, 141, 9783