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I E C B

Assembles of Magnetic Iron Oxide Nanoparticles with Tuneable Nanostructures and Magnetic properties

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The assembling of magnetic nanoparticles into arrays represents a very exciting and important challenge with regards to their high potential in the development of new nanodevices for spintronic, magnetic and magneto-electronic applications. The physical properties of nanoparticles assemblies being significantly dependent on their spatial arrangement, it is well argued that the key to successful applications of such nanoparticle-based devices is engineering well-defined nanostructures. Magnetic properties are strongly dependent on dipole-dipole interactions and can be finely tuned by controlling the spatial arrangement of nanoparticles in arrays. Therefore, isolated magnetic nanoparticles may be considered as non interacting elemental nano-magnets for high storage applications while tight packed nanoparticles assemblies ruled by collective properties are suitable for sensors.

We will present different assembling strategies which consist in the chemical patterning of magnetic nanoparticles. 2D assembling is addressed by specific interactions between functional groups at both NPs and substrates functionalized by self-assembled monolayers (SAMs) of organic molecules. Two different kinds of interaction have been considered: (i) electrostatic and reversible interactions between polar terminal groups (carboxylic acid or hydroxide) and the nanoparticle surface [1] and (ii) covalent and irreversible triazol linkage resulting from the "click" chemistry reaction between azide terminated nanoparticles and alkyne terminated SAMs.[2],[3] The fine control of the balance between reaction kinetics and dipolar interactions between nanoparticles led to the preparation of 1D assemblies. The uniaxial shape anisotropy of nanoparticle chains enhanced significantly collective magnetic properties. Controlling the density in nanoparticles was also an efficient way to modulate surface plasmon resonance of gold substrate on large range of wavelength by taking advantage of the high refractive index of iron oxide nanoparticles.[5] The integration of nanoparticle assemblies will be also presented in order to explore their magneto resistive properties.[6] Finally, the structuration of nanoparticle arrays will be extended to gold nanoparticles in order to study collective plasmonic properties.[7]

[1] B. P. Pichon et al, *J. Phys. Chem. C*, **114**, 9041 (2010)
[2] D. Toulemon et al, *Chem. Commun.*, **47**, 11954 (2011)
[3] D. Toulemon et al. Chem. Mater., **25**, 2849 (2013)
[4] B. P. Pichon et al, *Langmuir*, **27**, 6235 (2011)
[5] B. P. Pichon et al, *Nanoscale*, **3**, 4696 (2011)
[6] M. Pauly et al. *Small*, **8**, 108 (2012) ; D. Toulemon et al., *Small*, 11, 4638 (2015)
[7] Y. Liu et. *Nanoscale*, 6, 12080 (2014)

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