Multi-Nanoparticle Assemblies for Tailoring Optical, Magnetic and Magneto-Plasmonic Properties of Thin Film Devices

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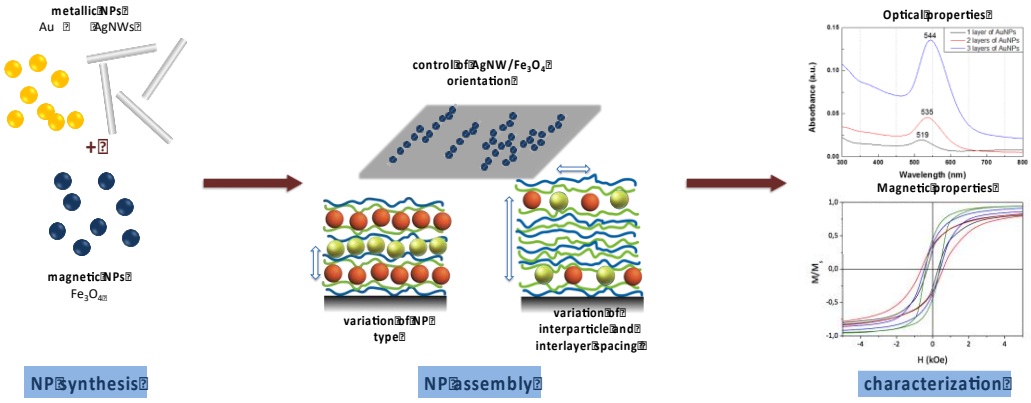
The hierarchical organization of nanoscale building blocks into functional assemblies with well-controlled location, orientation, and spacing across multiple length scales is a major challenge, in particular for building complex thin films that comprise more than one functional material in which the coupling between different nanomaterials affects the physical properties. For instance, plasmon-enhanced magneto-optical effects have been shown to occur when iron oxide nanoparticles are very close to a plasmonic nanostructure. In this context, the goal of this thesis is to build controlled assemblies of magnetic and plasmonic nanoparticles in thin films and study the resulting magnetic and optical properties.



The thesis will take place in the framework of a collaboration between IPCMS (B. Pichon) and ICS (M. Pauly and G. Decher), two teams that have a recognized expertise in the synthesis and assembly of functional nanoparticles in thin films [1]. Iron oxide nanoparticles, metallic spherical nanoparticles and silver nanowires will be synthesized and assembled in thin films using the Layer-by-Layer approach [2] with a specific care on the control of the superstructure (number of layers, density and composition of each layer, spacing between the layers) in order to probe its influence on the resulting properties. A novel technique that has been recently developed at ICS and that allows forming oriented thin films of nanowires will be used to induce an anisotropy in the sample [3]. The optical, magnetic and magneto-optical (MO) properties of such systems will be studied in order to evidence novel combined or synergetic effects.

This multidisciplinary thesis, at the frontier between nano-chemistry, materials science and solid-state physics will involve both synthesis and physicochemical characterization. We are looking for a highly motivated student with a master in physical chemistry, nanoscience and/or materials science.

[1] Schmitt et al. *Adv. Mater*. **1997**, 9, 61-65; Pichon et al. *Chem. Mater.* **2011**, 23, 3668-3675; Pauly et al. *J. Mater. Chem*. **2012**, 22, 6343-6350; Dolci et al. *Adv. Funct. Mater*. **2018**, 28, 1706957
[2] Decher, *Science* **1997**, 277, 1232-1237
[3] Sekar et al. *Faraday Discuss.* **2016**, 191, 373-389; Blell et al. *ACS Nano* **2017**, 11, 84-94; Hu et al. *Nanoscale* **2017**, 9, 1307-1314; Probst et al. *ACS Appl. Mater. Interfaces* **2018**, 10, 3046-3057