**Towards a new generation of ultra-dense magnetic memories: Organization, detection and manipulation of magnetic nanoparticles.**

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One of the last challenges in nanotechnology is to be able to organize, detect and manipulate individual nanometric magnetic units in order to prepare very high-density magnetic memory devices. These units can be, for example, magnetic nanoparticles (NPs) based on coordination chemistry compounds. The possibility of synthesizing a large family of NPs with different properties, based on one coordination compound, makes them really interesting.[1]

At present we are working with NPs of a family of bimetallic cyanide-bridged coordination compounds known as Prussian blue analogues (PBA). PBA are molecule-based magnetic compounds of general formula $A_xM_y[M'(CN_6)]_z$ (where A is an alkali-metal cation and M and M' are transition metal ions) whose magnetism can be modified with an external perturbation.[2] In order to organize these anionic NPs, we take advantage of the electrostatic interactions with patterned silicon surfaces. We have used two different approaches: (i) Very local and precise nanolithography based on local oxidation by means of an atomic force microscope (LON-AFM), combined with the formation of self-assembled monolayers of different molecules on specific regions of the surface;[3] and (ii) Long range organization based on soft lithography with polydimethylsiloxane (PDMS) stamps. In this scenario we are able to attach PBA-NPs on the surface, as randomly disperse particles, at high accurate position on a specific point (few micrometers area), or in long periodic lines in square millimeters areas.

The PBA-NPs have been magnetically characterized by low temperature magnetic force microscopy (LT-MFM). With this technique we obtain 3D topographic images and the magnetic image of the same region, measuring the interaction between a magnetic coated tip and each individual NP. Due to the possibilities of our setup, we can apply an external magnetic field with different magnitude and direction at different temperatures. This allows us to modify the magnetic orientation of the resultant magnetic moment of the NP and to detect it with nanometric resolution. The reversibility of NP magnetization with the external field proves that the signal that we are recording is purely magnetic and it is not masked by other long range interactions (for example electrostatic). [4]

**References**

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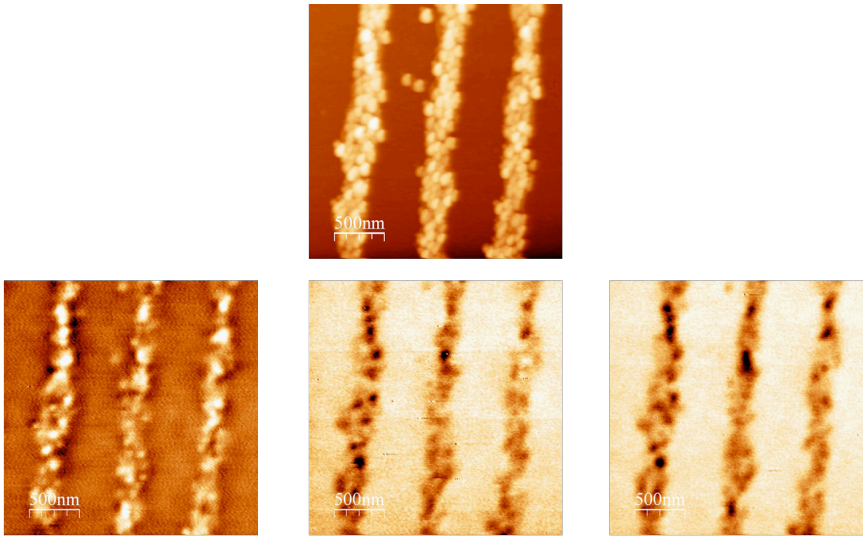


**Figure 1: Top:** AFM topographic image of $K_xNi[Cr(CN)_6]_y$ NPs organized on a silicon surface with a soft-lithography method. **Bottom:** Magnetic images of the same region with different external magnetic field at -500 G, 0 G and +500 G (Color contrast indicates different magnetic interaction between tip and sample: Dark stands for attraction and bright for repulsion).