FERROMAGNETIC NANOPARTICLES EMBEDDED IN SELF-ARRANGED MATRICES

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The investigated nanoscopic system, consisting of a non magnetic host material and precipitated ferromagnetic nanostructures shows a magnetic behavior due to spin magnetism at low magnetic fields and an enhanced magnetism in the high field region. The nanostructures are deposited electrochemically into an etched silicon wafer which offers an array of channels of a few ten nanometers in diameter and a length up to 50 µm. The self-assembled grown templates offer the opportunity of tuning the magnetic properties by varying the geometrical characteristics of the membrane which is loaded with different metals like Ni, Co and NiCo alloy. The deposited metal-structures occur with different shapes between spheres and wires which determine the magnetic behavior too. At low magnetic fields the magnetization can be explained by magnetization reversal of the incorporated metal-particles. They are single domain and the reversal process occurs either by curling or homogeneous rotation depending on the size of the particles [1]. The obtained hysteresis curves are a combination of these processes because of the diversity of the deposited nanostructures. Due to the orientation of the channels perpendicular to the surface the precipitated metal offers shape anisotropy. The tunable coercivity ranges between 200 Oe and 1000 Oe for easy axis magnetization whereas hard axis magnetization exhibits half of these values. At high magnetic fields far above the saturation magnetization of the deposited metals the samples are still not saturated and show a paramagnetic-like enhancement of the magnetization curve. This supplementary magnetic term, additional to the spin magnetism at low fields, seems to be due to an enhanced orbital magnetism [2], generated by the spin polarized electrons of the transition metals which has been reported in literature [3] and is currently under investigation. This ferromagnetic nanocomposite system is not only of interest for basic research but also gives rise to applications in magneto-optics, spintronic and sensor technology.

References:

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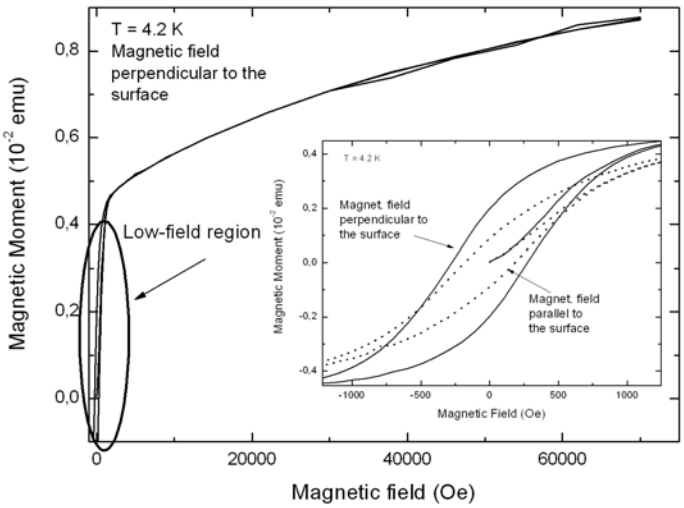
[2] A. Hernando, P. Crespo, M. A. Garcia, Phys. Rev. Lett. **96** (2006) 57206.
[3] A. B. Klautau, S. Frota-Pessoa, Surface Science **579** (2005) 27.

Figures:



Magnetization curves of a Ni-filled sample exhibiting a non-saturating magnetic behavior at high magnetic fields far above the saturation magnetization of Ni (0.62 T). In the inset the hystereis loops for easy axis and hard axis magnetization at low magnetic fields are shown.