Magnetic energy optimization of Cobalt-based nanostructured magnet

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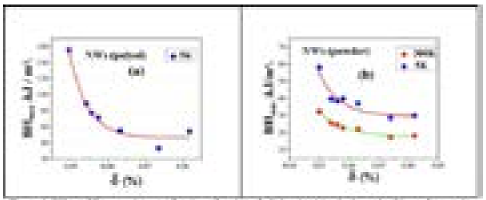
Co-based anisotropic nanowires are attracting scientific interest mainly for their possible applications as nano-magnets in (nano)medicine as well as in recording media and as building blocks in high energy nanostructured bulk permanent magnets. In this latter case, a high magnetocrystalline anisotropy of the ferromagnetic nano-object is essential for high magnetic coercivity which are mandatory for obtaining a high magnetic energy product (namely BH_{max}) and thus a good permanent magnet. In this frame, we studied the magnetic static properties of hcp-cobalt nanowires, which show a high shape anisotropy and magnetocrystalline anisotropy by using a standard Quantum Design MPMS SQUID magnetometer in the temperature range of 5 - 400K and with a magnetic field applied between -7 Tesla and +7 Tesla. The magnetic energy of these nanowires has been studied as a function of the shape as well as of the stacking fault, respectively determined by HRTEM and X-Ray diffraction measurements. The optimum candidates have been sintered by non-conventional SPS technique and cobalt-based nanostructured materials have been studied in view of magnetic energy optimization. A micromagnetic simulation was performed to study the local interactions of nanowires inside the like-bulk nanostructured samples. Our results show that the magnetic energy product of the Co nanowire is strongly affected by the shape ratio (L/d) as well as by the stacking fault density (δ). When the aspect ratio is optimized (L/d>10), the stacking fault density is the key parameter to control the BH_{max} (voir Fig.1). A huge loss in the magnetic energy is discussed as function of the changing interactions between nanowires. We also present the sintering process parameter effects over the BH_{max} product at room temperature, and we discuss future issues and solutions for new nanostructured magnet elaboration.



Biography

Silvana Mercone is an Associate Professor of the LSPM-CNRS laboratory at University of Paris 13th. She obtained the "Italian Laurea" in Solid State Physics at University of Rome "La Sapienza" in 2000 and her PhD sponsored by Marie Curie fellowship (EC) in Material Science in 2003 at the University of Caen (Normandy, France) - Laboratory CRISMAT. She became Assistant professor in 2006 after 3 years of post-graduate fellowships. She has mainly worked on magnetic of complex nanostructures (thin films and devices, nanoparticles and nanowires) focusing on the coupling between the crystallographic properties and their magnetic and transport behavior (magnetic phase separation (AFM-FM), metal-to-insulator transition, magnetoresistance). She has a good experience and knowhow on a broad number of experimental technics allowing the full study of the static and dynamic magnetic behaviour of complex magnetic materials (SANS and Polarized Neutron Reflectivity for magnetic phase homogeneity investigation, Broadband ferromagnetic resonance and electron paramagnetic resonance, SQUID, VSM).

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