ThPO10.190

Magnetic properties of Co and CoO_x nanoparticles produced by pulsed laser deposition

J. Margueritat*, J. Gonzalo, and C. N. Afonso
Laser Processing Group, Instituto de Optica, CSIC, Serrano 121, 28006, Madrid, Spain

A.N. Dobrynin, D.N. Ievlev, K. Temst, P. Lievens
Laboratorium voor Vaste-Stoffysica en Magnetisme, KULeuven, B-3001 Leuven, Belgium

E. Piscopiello, G. Van Tendeloo
Universiteit Antwerpen, EMAT RUCA, B-2020 Antwerp, Belgium

Magnetic properties of ferromagnetic nanoparticles (NPs) embedded into a non-magnetic host are known to be different from those of the bulk. Assemblies of NPs show interesting effects such as quantum tunneling of magnetization or giant magnetoresistance. Hybrid ferromagnetic-antiferromagnetic structures have further interest for the study of the exchange anisotropy at the nanoscale, since it may increase the superparamagnetic blocking temperature [1] and therefore make possible the design of ultrahigh density magnetic data storage systems. Moreover exchange biased NPs may be used as spin valves in spintronics. The aim of this work is to produce such hybrid ferromagnetic-antiferromagnetic nanostructures embedded in a dielectric host by pulsed laser deposition.

Nanocomposite films formed by Co-core / CoO shell NPs embedded in amorphous Al_2O_3 were produced by alternate pulsed laser ablation of the matrix (Al_2O_3) and the metallic (Co) targets using an ArF excimer laser. The films were deposited at room temperature on Si or carbon-coated substrates. They consist of 5 layers of NPs equally spaced by Al_2O_3 layers at a background pressure $< 10^{-7}$ mbar. In order to produce the core-shell structures, oxygen is injected in the chamber after production of the Co NPs layers. Similar samples without oxygen exposure were produced for comparison. The dimensions of the NPs were selected to be small enough in order to eliminate magnetic domain related effects when studying the exchange anisotropy. Specimens were characterized with transmission electron microscopy and Rutherford backscattering spectroscopy. Pure Co NPs are round and have a mean diameter smaller than 3 nm with a very sharp, diameter distribution. Oxidized NPs look very similar to the pure ones, their mean diameter being slightly smaller. In both cases, the NPs are well separated from each other and homogenously distributed along the film plane. The magnetic response of the two types of nanocomposites is essentially different thus proving the successful formation of ferromagnetic Co-core /CoO-shell structures. Also, the results evidence the existence of a critical NPs size for exchange bias to occur.

[1]"Beating the superparamagnetic limit with exchange bias", V. Skumryev, S. Stoyanov, Y. Zhang, G. Hadjipanalys, D. Givord, J. Nogués, Nature **423**, 850 (2003).

*Presenting Author: j.margueritat@io.cfmac.csic.es; Telephone: (+34) 915 61 68 00 ext: 23 28; Fax: (+34) 915 64 55 57

Acknowledgments: this work has partially supported by the EU NanoCluster Network (HPRN-CT-2002-00328).