DTU Library

Theory and simulation of interacting ferro- and antiferromagnetic nano-particles (poster)

Lindgård, Per-Anker

Published in:
Superconductivity and magnetism: Materials properties and developments. Extended abstracts

Publication date:
2003

Document Version
Publisher's PDF, also known as Version of record

THEORY AND SIMULATION OF INTERACTING FERRO- AND ANTIFERROMAGNETIC NANO-PARTICLES

Per-Anker Lindgård (*Materials Research Department, Risø National Laboratory, Denmark)*

The understanding of the interplay between ferro(FM)- and antiferromagnetic (AFM) materials is still incomplete, in spite of the great interest in 'exchange-bias' devices. In order to minimize the problem with domain wall mechanisms we have studied a model system consisting of nano-sized spheres that are half an fcc structured AFM in contact with an F-hemisphere. For the AFM part, parameters corresponding to NiO or CoO are used. It has previously been found[1,2] that fcc AFM nano-particles have a multi-q structure. In the interacting model system the AFM ground state is, however, at low temperatures the simple single-***q*** state with the moments parallel to the ferromagnet at the interface as expected by Miklejohn and Bean[3]. At low temperatures the switching does not follow the rotating uniform mode model. Although the system has different energy barriers for the FM and AFM hemispheres, the switching occurs simultaneously (even for small couplings). Hence no exchange bias effect is observed when the FM and AFM have similar axial anisotropies, even at low temperatures. A small exchange bias effect is observed when the AFM has a large axial anisotropy. However, it is very much reduced due to fluctuations among the various multi-***q*** states, which facilitates the switching of the antiferromagnetic hemisphere. This study was undertaken for the present model system in order to avoid any complications from possible domain switching mechanisms. However, the switching is found to be replaced by the mechanism of transitions between the superposition of various domain states. The possibility of having multi-***q*** structure for AFM's may be a contributing reason (and a new model) for the observed, much reduced, exchange bias also in other more realistic systems.

REFERENCES

1. R.H. Kodoma and A.E. Berkowitz, Phys. Rev. B **59**, 6321 (1999)
2. P.-A. Lindgård, J. Magn. Magn. Mat. (to be published)
3. W.H. Meiklejohn and C.P. Bean, Phys. Rev. **102**, 1413 (1956) and **105**, 904 (1957)