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Spin Configuration of Ferromagnetic/Antiferromagnetic Nano-Composite Particles

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Among many studies on nano-particles [1], exchange coupling in ferromagnetic/antiferromagnetic nano-composite particles is an appealing subject but there is still very little work on this theme. The present paper therefore focuses on the study of the exchange coupling in FePt(core)/FeMn(shell) nano-composite particles by two approaches: micromagnetic and atomistic simulations [2]. The sizes of the core and the shell are 4.8 nm and 9.6 nm, respectively. The core parameters are $K_U = 7\times10^7$ erg/cc, $M_S = 1100$ emu/cc, JFM $= 4\times10^{-14}$ erg and the shell ones are $K_{AF} = 1.3\times10^5$ erg/cc, $M_S = 800$ emu/cc, $J_{AF} = -1.2\times10^{-14}$ erg. The exchange coupling constant is varied from 10^{-16} to 10^{-14} erg. It is interesting to note that micromagnetic simulations predict that the spin configuration of the core breaks up into domains when the exchange coupling is weak while it is single domain for the strong exchange coupling case as in Fig. 1. Such complex domain structures, however, cannot be observed using atomistic simulation [2]. This is interpreted in terms of the under-estimation of the exchange energy for rapid spatial fluctuations of the magnetization by the (continuum) exchange formalism. The atomistic simulations show a variety of spin states of the AF shell as a function of the interlayer exchange and the anisotropy of the AF layer.

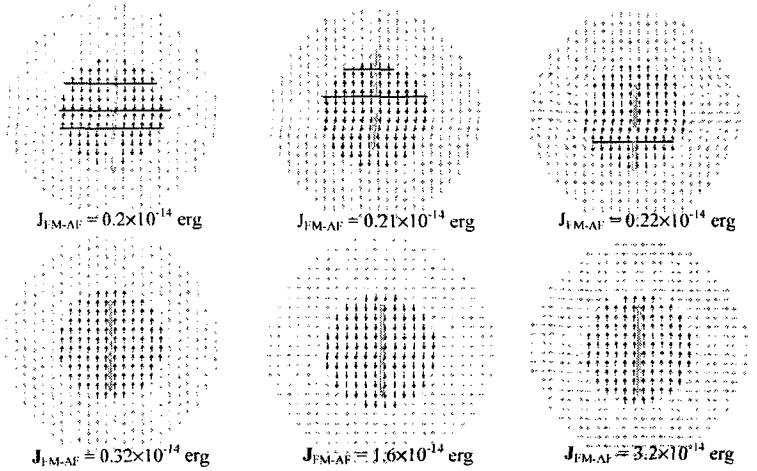

Fig. 1. Spin configuration in demagnetization state of the FM/AF nano-composite particles

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Size Control Synthesis of Iron Oxide Nanospheres using solution chemistry

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A facile solution chemistry approach to the batch synthesis of iron oxide nanocrystals is developed. By adjusting the synthetic parameters (reaction time, reaction temperature and starting materials), the size control of nearly monodispersive sphere-like iron oxide can be achieved. Detailed investigations on the effect of the experimental parameters on the morphology and size distribution of the final products were carried out with the aid of field emission scanning electronic microscopy (FESEM). The crystal structure was studied by powder X ray diffraction (XRD). Vibrating sample magnetometer (VSM) was used to study the magnetic properties of these sphere-like products.

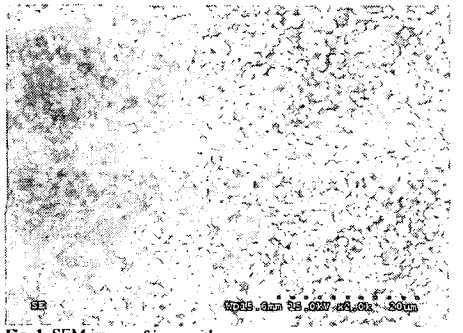

Fig. 1. SEM image of iron oxide.