SELF-ORGANISED FEPT NANOPARTICLE ARRAYS, COMPACTED POWDERS AND FEPT NANOPARTICLES EMBEDDED ON SIO_2 MATRIX

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Monodispersed magnetic nanoparticles self-organised into superlattices onto a substrate are considered to be of real interest in the development of future magnetic storage systems due to their potential ultra-high storage density, higher than 1 Tbit/cm^2 [1]. These particles are coated by organic acids as oleic acid which act as surfactant layer and avoid coalescence and prevent possible growth of secondary particles [2]. Nevertheless, some technical problems should be overcome before actual use for applications. One of them is that as-prepared samples have a chemically disordered fcc structure, A1 phase, with low anisotropy. To achieve the phase transition from fcc to $L1_0$ in FePt nanoparticles, the samples have to be subjected to thermal treatments [1]. During such annealing, and before the structural transition, different reactions take place in the particle surface, and the surfactant protecting the FePt particles is thermally decomposed. The A1-$L1_0$ phase transformation is accompanied by a sintering process, since the steric barrier between particles is removed [3].

The A1-$L1_0$ transition of FePt nanoparticles 4 nm in size has been investigated in this work. For this propose, we have prepared three different materials from the initial colloidal suspension of $Fe_{50}Pt_{50}$ nanoparticles synthesised by the chemical procedure as described by Sun *et al* [1]: i) Self-organised nanoparticle arrays in superlattices by deposition of the colloidal suspension onto a substrate and slow evaporation of the carrier solvent (hexane), ii) Finely divided powder, constituted by many nanoparticles, and iii) $Fe_{50}Pt_{50}$ nanoparticles embedded in SiO_2 matrix. The evolution of the structural and magnetic properties of these materials with annealing at different temperatures, and the sinterised state have been studied. Whereas for the case of powders annealed at 825 K with sinterised particles, coercivity takes values of several kOe, the un-sinterised particles embedded in SiO_2 matrix and annealed at temperatures up to 1,075 K, exhibit values of coercivity much lower than expected (around several hundreds of Oe), indicating an incomplete $L1_0$-order. The results suggest that $Fe_{50}Pt_{50}$ particles smaller than 4 nm were no completely ordered to $L1_0$ structure by annealing at 1,075 K, whereas bigger particles (sinterised particles of annealed powders and self-organised arrays) at low temperature of annealing (825– 875 K) exhibit higher $L1_0$-order. A compromise between steric stability and structural order is thus analysed in view that nanoparticles larger than 4nm reach the $L1_0$-order at lower annealing temperatures.

References:

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