DP04

Magnetic Properties of Superparamagnets near Curie Point

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The features of the paraprocess in superparamagnetic particles in the Curie point region are discussed [1]. To describe the dependencies of the magnetic properties of superparamagnetic particles on temperature and field, the molecular field theory supplemented with the Langevin Model [2, 3] is applied. It is shown that, as in the case of ordinary ferromagnetic particles, the paraprocess in superparamagnetic particles in the region of small fields is determined by the dominant influence of the exchange field inside the particle. The role of the external filed is, mainly, to change(or even to give rise to) the exchange field. However, the quantitative characteristics describing the paraprocess in a superparamagnet are completely different. The magnetic susceptibility of the paraprocess χ_M (M being the specific magnetization of the particle corresponding to its "relaxation" magnetic moment μ in the field *H*) at the Curie temperature is dependent on the field strength. Under the same conditions, the "experimental measured" magnetization σ is changed with the field in accordance with the H^3 law.

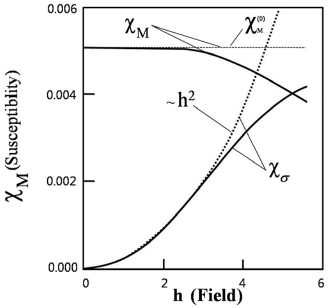

Fig. 1. Field dependence of magnetic susceptibility χ_σ and λ_m for the system of superparamagnetic particle at the Cirie temperature. T_C=3000 K, N=500.

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DP05

Contribution of the Grain Geometry on Magnetic Behavior

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In the previous study [1], we have studied that the convex surface can affect on the magnetic behavior by adjusting the intergranular exchange strength. In this study, the effect of the convex grain geometry is studied in a viewpoint of the contribution of demagnetization field with finite element micromagnetic simulation. A CoCrPt-SiO_2 with crystalline anisotropy K_U=2 x 10^5 J/m^3, saturation polarization J_s = 0.7 T are assumed with 6 nm diameter grains and 1 nm intergranular phase. Two kinds of granular structure are prepared for comparison, one is a convex model which has convex top and concave bottom surfaces, the other is a flat model which has flat top and bottom surfaces as usually used in micromagnetic simulations. The convex surface is generated by surface energy minimization under given wetting angle [2]. The thickness is varied from 1 to 16 nm to investigate the contribution of demagnetization field according to the thickness.

In results, the coercivity of the convex model was always higher than that of the flat model, and their difference was larger in the thinner film. The origin of the different coercivity is seen from the magnetization configurations during reversal. In convex model, domain wall propagation through the grain boundaries is harder because of the stabilized demagnetization field between the adjacent oppositely magnetized grains. In convex model, the demagnetization energy profile during the reversal process was almost same up to the 4 nm thickness, with the maximum fluctuation amplitude 0.01 J/m^3. However, that of the flat model was always as twice as that of convex model, and its shape was getting sharper as the thickness increases. In thicker film, higher contribution of anisotropy energy and intergranular energy reduces the differences in magnetic behaviors.

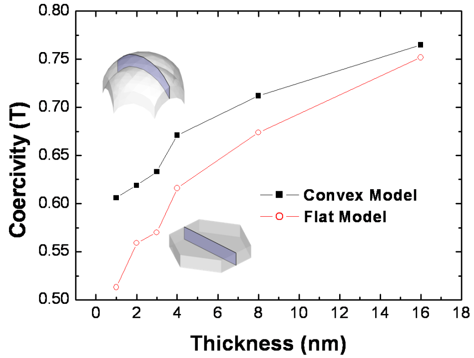

Fig. 1. Effect of thickness on coercivity.

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