11th International Conference
on Advanced Materials

Rio de Janeiro Brazil
September 20 - 25

ICAM2009

Correlation of magnetic properties, morphology and structural parameters in $Mn_{0.5}Zn_{0.5}Fe_2O_4$ nanoparticles

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Abstract – The effect of structural and morphology parameters on the magnetic behavior of $Mn_{0.5}Zn_{0.5}Fe_2O_4$ was discussed. Nanoparticles have been prepared by chemical co-precipitation method. The morphology structure was analyzed via Atomic Force Microscopy (Fig. 1). Zero-field-cooling and field-cooling magnetization measurements were performed using a Physical Property Measurement System (PPMS) to investigate the magnetic properties of nanoparticles (Fig 2). The ZFC magnetization measurements showed a typical superparamagnetic behavior. Considering a log-normal distribution of energy barriers in an assembly of ultrafine magnetic particles blocking temperature, anisotropy energy density, and average magnetization of particle were obtained.

Nanoscale magnetic materials are of interest for applications in ferrofluids, high-density magnetic storage, high-frequency electronics, high performance permanent magnets, and, magnetic refrigerants. Magnetic single-domain nanoparticles ("superspins) are very interesting not only for potential applications, e.g. high density storage devices, but also for fundamental research in magnetism. Ultrafine magnetic particles with different size were sintered. The nanoparticles were deposited on mica substrate; average particle size was obtained using Atomic Force Microscopy. ZFC magnetization measurement can be adjusted for a system of non-interacting nanoparticles with a volume distribution:

$$M(T,H,t) = \frac{{m_o}^2 H}{2T}\int_0^{Vc} dV f(V) V^2$$

Where m_o is magnetization of the particle, V_c is critical volume and *f(V)* is distribution size function. Blocking temperature and average magnetization of the particle were calculated and studied your behavior with the average particle size.

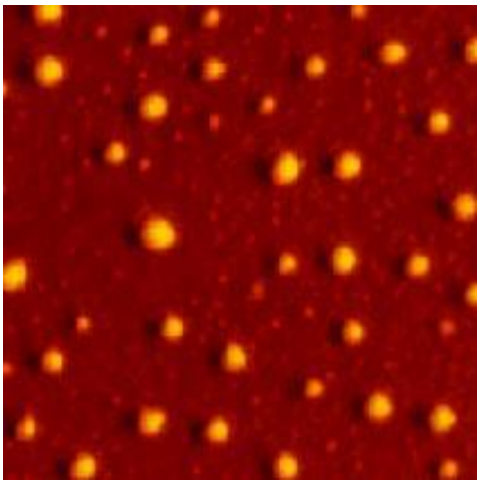

Figure 1. AFM images of nanoparticles of $Mn_{0.5}Zn_{0.5}Fe_2O_4$ on mica, (0.5μm×0.5μm).

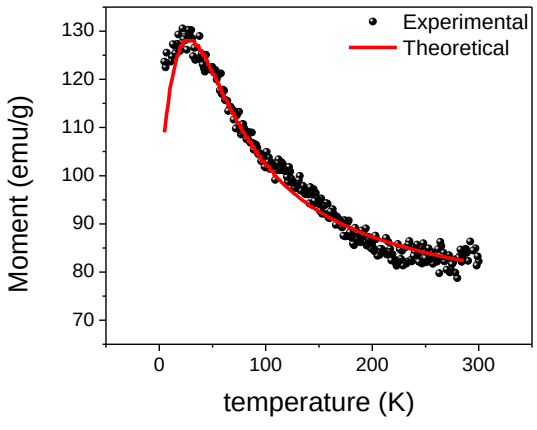

Figure 2. ZFC magnetization measurement, nanoparticles of $Mn_{0.5}Zn_{0.5}Fe_2O_4$

Acknowledgments: This work was partially supported by Excellence Center for Novel Materials, ECNM, under contract No 043-2005.