INTERNATIONAL CONFERENCE ON MAGNETISM

ICM 2009

July 26 - 31 2009 Karlsruhe Germany

PROGRAM AND ABSTRACTS

Congress Center Stadthalle Karlsruhe

Th-B-7.9-21

Ferromagnetic ordering on superparamagnetic iron oxide nanoparticles with proton irradiation

Sung Wook Hyun, Sam Jin Kim, Chul Sung Kim
Kookmin University, Seoul 136-702, Korea

We have investigated the changes of magnetic properties on iron oxide nanoparticles with proton irradiation. Iron oxide, Fe_3O_4, nanoparticle, which has the average size of 8 nm, has been fabricated by the high temperature thermal decomposition method and proton-irradiated with 0, 10 and 20 pC/μm^2. Analysis of XRD patterns shows that the crystal structure is cubic spinel with space group of Fd3m. Compared to non-irradiated sample, which has the saturation magnetization (M_s) of 57.2 emu/g and the coercivity (H_c) of 1.4 Oe at room temperature, the values of magnetization and coercivity at room temperature are 56.5, and 53.7 emu/g, and 1.7, and 1.8 Oe, respectively, for 10 and 20 pC/μm^2 irradiated nanoparticles. The Mössbauer spectra taken at room temperature show 6 absorption lines of ferromagnetic behavior and the values of isomer shift (δ) for the tetrahedral (A) and octahedral (B) sites are consistent with the Fe^{3+} valence state. The results suggest that the proton irradiation induces the ferromagnetic ordering on Fe_3O_4 nanoparticles.

Th-B-7.9-22

Hexaferrite submicron and nanoparticles with variable size and shape via glass-ceramics route*

Pavel Kazin[1], Lev Trusov[2], Natalia Yaroshinskaya[2], Yuri Tretyakov[1], Martin Jansen[3]

[1] *Moscow State University, Department of Chemistry, Moscow, Russia*
[2] *Moscow State University, Department of Materials Science, Moscow, Russia*
[3] *Max-Planck-Institut fur Festkorperforshung, Stuttgart, Germany*

This work has been devoted to the investigation of glass crystallization in the SrO-Fe2O3-B2O3-Al2O3 system and the formation of ultrafine monodomain particles of strontium hexaferrite during this process. By modifying the initial glass composition and thermal treatment conditions particles of various sizes and shapes have been obtained. The particle size could be widely varied. Our method allows to synthesize thin platelets only a few nanometers thick and several tens nanometers in diameter as well as large half-micron sized truncated bipiramids and all shapes and sizes in between. The magnetic properties of the material cover the interval between superparamagnetic nanoparticles and samples with record-high coercivity of over 10 kOe.

*This work was partially supported by Grants RFBR No. 07-03-00569, No. 08-03-91950 and DFG 436 RUS 113/933/0-1

Th-B-7.9-23

Influence of heat treatment on magnetic properties of ϵ-Fe_2O_3/SiO_2 nanocomposites*

A. Mantlikova[1], J. Poltierova Vejpravova[1], P. Brazda[2], S. Danis[1], D. Niznansky[2]

[1] *Department of Condensed Matter Physics, Faculty of Mathematics and Physics, Charles University, Prague, Czech Republic.*
[2] *Department of Inorganic Chemistry, Faculty of Natural Sciences, Charles University, Prague, Czech Republic.*

ϵ-Fe_2O_3 is a metastable phase of iron tri-oxide with enormous room-temperature coercivity of ~2 T, and potential multiferroic properties. We have studied influence of the heat treatment on magnetic properties of ϵ-Fe_2O_3/SiO_2 nanocomposites obtained by a novel sol-gel based method. The powder X-ray diffraction revealed, that the particle size and content of particular iron oxide phases, respectively, varies with the annealing temperature, T_{an}. Detailed measurements of magnetization, a.c. susceptibility and hysteresis loops, respectively, performed by a commercial SQUID magnetometer up to 7 T, demonstrate a significant change of magnetic properties with respect to the T_{an}. The most dramatic effect is a sharp decay of the room-temperature coercivity from ~ 2 T to ~ 0.1 T with the T_{an}, decreasing from 1100 °C to 900 °C, respectively.

*The work is a part of the research plan MSM 0021620834 that is financed by the Ministry of Education of the Czech Republic and was also supported by the grants 202/08/P006 and 106/07/0949 provided by GACR.

Th-B-7.9-24

Magnetic properties of $Fe_{2-x}Al_xCoO_4$ $(0 \leq x \leq 1)$ nanoparticles

Nikolina Novosel[1], Damir Pajić[1], A. T. Raghavender[2], Krešo Zadro[1], K. M. Jadhav[2]

[1] *Department of Physics, Faculty of Science, University of Zagreb, Bijenička c. 32, HR–10000 Zagreb, Croatia*
[2] *Department of Physics, Swami Ramanand Treeth Maratwada University, Nanded, Maharastra 431606, India*

Nanocrystalline particles of the $Fe_{2-x}Al_xCoO_4$ ferrites with cubic spinel structure have been synthesized by the sol-gel method*. Size of the particles decreases from 39 nm to 6 nm as the Al content x increases. In the present work magnetic hysteresis curves and ZFC-FC curves have been studied. The magnetization of the Fe_2CoO_4 nanoparticles is lower than the magnetization of the bulk sample due to the surface and finite size effects. Saturation magnetization and remanent magnetization decrease as the x increases because of substitution of magnetic Fe ions with non-magnetic Al ions and possibly due to the spin canting and changes in ferrimagnetic structure. Coercive field changes with x in a complex way. Anisotropy barrier is lowered by reducing the size of the particle, but it can be increased by changing the distribution of Fe and Al ions in the spinel structure. The observed splitting between ZFC-FC curves in a rather high field indicates the presence of particles with the large anisotropy barrier.

*A. T. Raghavender, K. M. Jadhav, *Int. J. Mod. Phys. B* Vol. 23, No. 2 (2009) 223-234

Th-B-7.9-25

Magnetic properties of Fe_3O_4 nanoparticles embedded in polypropylene

Marco Coïsson[1], Alberto Fina[2], Federico Carosio[2], Federica Celegato[1], Paola Tiberto[1], Franco Vinai[1], Rodica Turcu[3]

[1] *INRIM, Electromagnetism Division, 10135 Torino (TO), Italy*
[2] *Politecnico di Torino, Sede di Alessandria, 15100 Alessandria (AL), Italy*
[3] *National Institute R&D for Isotopic and Molecular Technologies, 400293 Cluj-Napoca, Romania*

Nanocomposite materials were obtained by embedding Fe_3O_4 nanopowders in polypropylene. Dispersion was achieved by means of organic functionalization of particles surface. The magnetic properties were measured as a function of temperature (5 – 300 K) with a vibrating sample magnetometer (VSM, maximum field 7 T). Field-cooled and zero-field-cooled measurements reveal an irreversibility temperature of $\approx$ 150 K, below which the particles behave as Stoner and Wohlfarth systems. Above this temperature, a superparamagnetic law is followed, with a small hysteresis which can be attributed to dipolar interactions among the nanoparticles. Conversely, nanocomposites prepared with powders which were not surface functionalized showed tendency to form aggregates, which strongly affect their temperature dependent magnetic properties.

Th-B-7.9-26

The magnetic properties of nanocrystalline particles of Co(1-x)Bi(x)Fe2O4

Adolfo Franco Jr[1], Frederik Wolff-Fabris*[2], Vivien Zapf[3]

[1] *Instituto de Física, Universidade Federal de Goiás, Caixa Postal 131, 74001-970 Goiânia-GO, Brazil*
[2] *Hochfeld-Magnetlabor Dresden (HLD), Forschungszentrum Dresden-Rossendorf, 01314 Dresden, Germany*
[3] *National High Magnetic Field Laboratory, MS E536, Los Alamos National Laboratory, Los Alamos, NM 87545, USA*

We have studied the magnetic properties of polycrystalline Co(1-x)Bi(x)Fe2O4 where x = 0, 0.05, 0.08, 0.1 e 0.15. Recently metal-oxide nanoparticles have been attracted interest because of their unusual optical, electronic and magnetic properties, which often differ from the bulk. Cobalt ferrite is a well-known hard magnetic material with high coercivity and moderate magnetization. Nanocrystalline magnetic particles have been synthesized by a combustion reaction method without intermediate decomposition and/or calcining steps. We have performed DC magnetization in function of temperature between 4 and 340 K and in function of applied magnetic fields up to 14 T. Our magnetization measurements reveal the saturation magnetization decreases from 80 to 60 emu/g as increasing the Bi concentration. These values are relatively higher as compared to nanocrystalline magnetic particles of MgFe2O4 specimens. Doping with Bi has increased the coercivity of the nanoparticles in this ferrite.

*corresponding author, also at NHMFL - Los Alamos National Laboratory, USA