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PROGRAM AND ABSTRACTS

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### Mo-C-8.2-05

## Crystallographic and Mössbauer studies of the spinel $FeCr_{1.9}Al_{0.1}S_4$

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The polycrystalline sample of Al-doped $FeCr_{1.9}Al_{0.1}S_4$ has been studied by x-ray, Mössbauer spectroscopy, and superconducting quantum-interference device (SQUID) magnetometry. The crystal structure is determined to be a cubic spinel with space group Fd-3m, and the lattice constant is found to be $a_0$ = 9.998 Å. Mössbauer spectra of $FeCr_{1.9}Al_{0.1}S_4$ have been taken at various temperatures ranging from 4.2 to 300 K. The Néel temperature $T_N$ is found to be 163 K. Magnetic hyperfine field and electric quadrupole interactions for the sample at 4.2 K have been fitted, yielding the following results; $H_{hf} = 150$ kOe, $1/2e^2qQ(1+1/3\eta^2)^{1/2} = 2.3$ mm/s, $\theta = 29.9°$, $\varphi = 0.0°$, $\eta = 0.9$, and $R = 2.3$. Magentic susceptibility measurements by dc SQUID magnetometry show that superexchange interaction between $Fe^{2+}$ ions are ferrimagnetic.

### Mo-C-8.2-06

## Effect of synthesis route on the magnetic properties of $(Cd, Cu)_{0.5}Ni_{0.5}Fe_2O_4$ ferrites

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Single-phase $(Cd, Cu)_{0.5}Ni_{0.5}Fe_2O_4$ fine particles (grain size about 10 nm) have been prepared by hydrothermal and high energy ball milling to investigate the effect of synthesis route on the magnetic properties. XRD, TEM, magnetization and Mössbauer spectroscopy investigations are used to discuss the phase formation during different preparation stages. The ease of phase formation appears to be affected by reaction temperature and pressure during hydrothermal process. The Mössbauer spectra indicate ferrimagnetic behaviour of samples. Low values coercive fields (about 5.5 Oe) of samples prepared by hydrothermal process are observed. The coercive fields of nanosize samples prepared by high energy milling are significantly high (about 490 Oe). This is explained on the bases of particle size distribution.

### Mo-C-8.2-07

## Mössbauer studies for $Ni_{0.7}Fe_{0.3}Ga_2S_4$

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$NiGa_2S_4$ has been studied by x-ray, Mössbauer spectroscopy, and superconducting quantum-interference device (SQUID) magnetometry. The crystal structure of $Ni_{0.7}Fe_{0.3}Ga_2S_4$ has a trigonal structure with space group P-3m1. The lattice constants are $a_0$ = 3.640 and $c_0$ = 12.021 Å. Mössbauer spectra of $Ni_{0.7}Fe_{0.3}Ga_2S_4$ have been taken at various temperatures ranging from 4.2 to 295 K. Magnetic hyperfine and quadrupole interactions in $Ni_{0.7}Fe_{0.3}Ga_2S_4$ at 4.2 K have been studied, yielding the following results; $H_{hf} = 124.2$ kOe, $1/2e^2qQ(1+1/3\eta^2)^{1/2} = 2.10$ mm/s, $\theta = 40°$, $\varphi = 0°$, $\eta = 0.1$, and $R = 2.5$. The Néel temperature $T_N$ is found to be 19 K. The electronic structure of ferrous Fe ions in $Ni_{0.7}Fe_{0.3}Ga_2S_4$ was calculated with the Hamiltonian incorporating free-ion term, axial and rhombic crystal field, spin-orbital couplings, and exchange interactions.

### Mo-C-8.2-08

## Enhanced Magnetization in Nanometric Ferrimagnetic Epitaxial Thin Films

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Ferrimagnetic insulating spinels such as $NiFe_2O_4$, $CoFe_2O_4$ are being considered for spin-filtering and injection in a number of spintronic applications. However, fabrication of nanometric films of these compounds with properties similar to bulk, have been proven to be challenging. Most commonly, nanometric thin films of magnetic materials display depressed properties; however, it turns out than thin films of these oxides display an opposite trend. We have observed that the measured saturation magnetization of $NiFe_2O_4$ and $CoFe_2O_4$ films grown on $SrTiO_3$ and $MgAl_2O_4$ substrates approach the bulk values only for thickness above $\approx$ 20 nm. By combining magnetizations and neutron reflectivity measurements we show here, that the enhanced magnetization can be described by the presence of partially inverted cationic distribution in the spinel structure and we are able to exclude that partially invention takes place at the film/substrate interface. Implications for functional properties are discussed.

### Mo-C-8.2-09

## Experimental end theoretical study of the MI effect in NiFe/Ag multilayers

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The magnetoimpedance (MI) effect is a classic phenomenon that depends on the transverse differential magnetic permeability and geometry of a sample. In particular, for nanostructured samples it is possible to tailor the Z vs. H curves and the MI ratios by changing geometric parameters such as spacer layer, nature of the inner layer, etc. In this work, we investigate the dependence of the MI effect with the frequency and magnetic field in a multilayer sample, structured by a $[Ni_{81}Fe_{19}(10nm)/Ag\ (1nm)] \times 50$ multilayers grown by magnetron sputtering. The MI measurements were performed using an impedance analyzer working with probe currents in the frequency range 10 MHz -1.4 GHz. A high MI ratio (90%) was obtained at 1.2 GHz. The experimental Z vs. H curves were successfully simulated for the whole frequency range by using a simple model based on electrodynamics and a transverse susceptibility calculation in a cubic anisotropy system.

### Mo-C-8.2-10

## Formation mechanism of $\beta - Fe_2O_3$ with bixbyite structure and its magnetic properties

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Iron oxides are widely used in ceramic applications, electronic and magnetic materials, and so on. Among iron oxides, $\beta - Fe_2O_3$ has been known much less than other iron oxides such as $\alpha$- and $\gamma - Fe_2O_3$. This oxide has the bixbyite structure and is produced when the mixtures of $Fe_2(SO_4)_3$ and NaCl are heated about 500 °C*. However, the formation mechanism and physical and chemical properties of $\beta - Fe_2O_3$ have been unrevealed. If we could control the particle size and shape of $\beta - Fe_2O_3$ and reveal its formation mechanism and properties, it is used for various applications. We succeeded to prepare the single phase of $\beta - Fe_2O_3$ from the mixture of $NaFe(SO_4)_2$ and NaCl. In the present study we investigate the formation mechanism of $\beta - Fe_2O_3$ by controlling the mixing ratio of $NaFe(SO_4)_2$ and NaCl, and heating conditions as well. The obtained products were characterized by using TG/DTA, XRD, SQUID, Mössbauer spectroscopy, SEM and TEM.

*Y.Ikeda, M.Takano, Y.Bando, Bull. Inst. Chem. Res., Kyoto Univ. 64, 249 (1986).