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Structure and magnetic properties of C-type doped rare earth oxides $Er_{2-x}Mn_xO_3$ and $Er_{2-x}Ni_xO_3$

Zein K Heiba[a], M.Bakr Mohamed[b], Mouner A. Abdelslam[b] and H. Fuess[b], [a]*Taif University, faculty of Science, physics department, Saudi Arabia,* [b]*Materials Science, Darmstadt University of Technology, D - 64289 Darmstadt, Germany.*
E-mail: zein_kh@yahoo.com

Doped rare earth oxides are potential materials not only due to expected applications taking advantages of their properties, but also because of the interesting physics in this class of materials. The structure and magnetic properties of the two systems $Er_{2-x}Mn_xO_3$ and $Er_{2-x}Ni_xO_3$ have been investigated. The two systems with the composition x=0.0, 0.05, 0.10 and 0.15 were prepared with the sol gel technique. Single phase solid solution is formed up to x=0.2 for $Er_{2-x}Mn_xO_3$, while for $Er_{2-x}Ni_xO_3$ single phase is obtained only for x=0.05. All structural parameters including the cation distribution between the non-equivalent sites 8b and 24d have been determined applying Rietveld method. Inspite of the smaller ionic radii of Mn^{+3} and Ni^{+3} than that of Er^{+3}, substituting the later by one of the formers is found to increase the lattice parameter (a) of the cubic bixbyite structure. For the system $Er_{2-x}Mn_xO_3$, preferential cationic distribution is found for x=0.05 & 0.15 with different preferred site, and random for x=0.1. For $Er_{2-x}Ni_xO_3$, slight preferential distribution is found for x=0.05 and 0.1 and random for 0.15. Magnetic susceptibility measurements were done in the temperature range 5-300 K and a behavior in accordance with Curie-Weiss law was found. The Curie's constants, the Curie-Weiss paramagnetic temperature and effective magnetic moments μ_{eff} were determined for all samples. For the system $Er_{2-x}Ni_xO_3$, μ_{eff} is found to decrease linearly with composition parameter x. For $Er_{2-x}Mn_xO_3$, interesting behavior is obtained where μ_{eff} increases for x=0.05 and decreases for x=0.1 & 0.15 with a bigger value for the later. The Curie-Weiss paramagnetic temperatures indicated antiferromagnetic interaction. These magnetic results are discussed in view of the cationic distribution and magnetic ions clusterisation.

Keywords: Magnetic measurements, Cation distribution, rare earth sesquioxides

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Mossbauer and neutron diffraction study of polycrystalline $GaFeO_3$

M.Bakr[a], K.Szymańsk i[c],_A. Senyshyn[a] ,_G.Parzych[b], L.Dobrzynski [b,c] , and H. Fuess[a], [a]*Institut for Materials Science, Darmstadt University of Technology, D - 64289 Darmstadt, Germany .*[b] *The Soltan Institute for Nuclear Studies, Poland,* [c] *Faculty of Physics,University of Bialystok, Poland.*
E-mail: mbm1977@yahoo.com.

Gallium iron oxide ($GaFeO_3$) is a member of a multiferroic family which exhibits ferrimagnetic and piezoelectric properties below room temperature [1-2].This material has orthorhombic crystal structure with space group P c 2_1 n with four different cation sites labeled Ga1, Ga2 (mostly occupied by gallium) and Fe1, Fe2 (mostly occupied by iron) [3-5]. Polycrystalline $GaFeO_3$ materials have been prepared by a traditional solid state reaction (SR) and sol-gel (SG) methods. The Curie temperature (T_C) for $GaFeO_3$ (SR) is about 190K and increases or reaches room temperature when the temperature of preparation is decreased from 1400°C to 900°C. The dielectric constant and dielectric loss are temperature and frequency independent for both samples. Mossbauer analysis shows that at least two different assignment of the EFG and IS for the main Fe1 and Fe2 sites are possible. Both assignments results in similar site occupancies. It follows from the neutron powder diffraction that $GaFeO_3$ exhibits a ferrimagnetic order with spins parallel to c-axis. Also Mossbauer indicates for higher temperature of magnetic order in SG sample, in agreement with magnetization and neutron data.

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Keywords: Multiferroics, Mossbauer, Neutron diffraction.

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Magnetic and nuclear structure of orthorhombic and monoclinic polymorphs of $CoGeO_3$ pyroxene.

Georg Amthauer[a], Günther J. Redhammer[a], Anatoliy Senyshyn[b], Gerold Tippelt[a], Clemens Pietzonka[c], Georg Roth[d], [a]*Department of Material Engineering & Physics, University of Salzburg, Austria,* [b]*Materials Science, Technical University Darmstadt,; c/o Forschungs-neutronenquelle Heinz Maier-Leibnitz FRM II Garching, Germany,* [c]*Department of Chemisty, Philipps-University Marburg, Germany,* [d]*Institute of Crystallography, RWTH Aachen University, Germany*
E-mail: georg.amthauer@sbg.ac.at

Pyroxenes have gained vivid interest in solid state science due to their low temperature magnetic properties and the discovery of multiferroic behaviour in some members of this well known mineral group [1]. As a continuation of our ongoing research in crystal-chemistry and crystal-physics of pyroxenes [2-4 and references therein] we here report on the synthetic pyroxene-type material $CoGeO_3$. The title compound was synthesized at 1273K and 1448 K using ceramic sintering techniques in the monoclinic and orthorhombic modification respectively. The two compounds were analysed by magnetic susceptibility measurements and neutron diffraction in order to study magnetic ordering and spin structures at low temperature. The monoclinic form of $CoGeO_3$ has *C*2/*c* symmetry and orders magnetically below 36 K with a small negative paramagnetic Curie temperature θ_P = -4.6(2) K. The magnetic structure can be described with k = (1, 0, 0) in the magnetic space group *C*2'/*c*' having a ferromagnetic spin arrangement within the chains of M1 sites, but a dominating antiferromagnetic coupling between the chains. At the M1 sites the magnetic spins are aligned within the *a*-*c* plane forming an angle of 120° with the +a-axis and they are not parallel to the spins at M2. Here spins are also ferromagnetically coupled within, but anti-ferromagnetically coupled between the M1/M2 site bands. The orthorhombic phase of $CoGeO_3$ displays *Pbca* symmetry