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Special aspects of structure of complex nanostructured oxides of iron and manganese under high pressure

Manganites of perovskite type La1-xSrxMnO3 and spinel Cu0.7Zn0.3 Fe1.5Ga0.5O4 exhibit great variety of properties depending on the doping level and particle size.
Such compounds are widely used in the manufacture of magnetic media for storing information, supersensitive magnetic field and temperature sensors. But apart from potential application, the complex manganites and spinel are attractive for great number of scientific research. The knowledge of relationship between magnetic and crystal structure of such compounds, which can be obtained from high-pressure investigations, is very essential for understanding the nature and mechanism of physical phenomena observed in it.

In present work, well-studied compound Zn0.3Cu0.7Fe1.5Ga0.5O4 was chosen at ambient condition, and performed neutron diffraction studies at high pressure. Neutron powder diffraction measurements at ambient and high pressures up to 4.7 GPa were performed at room temperatures with the DN-6 diffractometer at the IBR-2 high-flux pulsed reactor [FLNP, JINR, Dubna, Russia] using the sapphire anvil high-pressure cell. In additional, for studies the role of structural parameters across the paramagnetic-ferrimagnetic phase transition we had investigate structure and magnetic moments evolution in temperature range 300 - 425 K.
The crystal and magnetic structure of nanostructured manganites La1-xSrxMnO3 with doping level x= 0.28 и 0.37 also has been studied by means of a neutron diffraction method on a new diffractometer DN-6 of reactor IBR-2 under pressure up to 5.7 GPa.

With increasing temperature and pressure, a gradual decreasing of the magnetic moments of iron ions in the A and B crystallographic sites of spinel Zn0.3Cu0.7Fe1.5Ga0.5O4 were observed. This effect corresponds to magnetic phase transition from ferrimagnetic state to paramagnetic one. The lattice parameters, interatomic bond lengths and angles, magnetic moments of iron as functions of temperature and pressure were calculated. The structural mechanisms of the magnetic transition in spinel ferrite compounds are discussed.
We found that in both manganite La1-xSrxMnO3 samples the FM ordering is formed close the room temperature and at cooling below T<270 K the ferromagnetic FM phase coexists with an A-type antiferromagnetic AFM phase. At high pressure the volume fraction of AFM phase increases while FM is gradually suppressed. The structural aspects of the magnetic phase separation and pressure effects on the studied nanostructured manganites are discussed.
Pressure dependences of unit cell parameters and volume, magnetic moments of ferromagnetic (FM) phase and antiferromagnetic (AFM) phase, Curie and Neel temperature were also calculated.

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