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Phase transition of nanostructured zinc ferrite spinel at high pressure

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The study of ferrites of spinel type is of great importance due to the wide variety of their structural and magnetic properties, which are of interest from the point of view of fundamental and applied research. In particular, canted states of an antiferromagnet, ferrimagnet, and spin glass can be realized in these compounds [1].
Significant saturation magnetization, relatively high electrical resistance, low electrical losses and good chemical stability make spinel-type ferrites are important for a wide range of technological applications as transformer cores, rod antennas, storage devices [2,3]. Moreover, such ferrites can be useful in biomedicine: as an effective heating agent for the treatment of cancer tissues through magnetic hyperthermia, as biomarkers for MRI diagnostics and magnetic drug delivery systems [3].
A wide range of magnetic properties of spinel ferrites is determined by the features of the distribution of iron ions between different crystallographic positions in crystal structures of the spinel type [2]. One of the important parts of the prospective research of spinel-type ferrites is the synthesis of complex ferrites with a controlled redistribution of iron ions between positions A and B, leading to a change in the magnetic properties of ferrites [3]. In addition, understanding of the relationship between the structural properties and the magnetic order of spinel ferrites can be given by high pressure exposure.
In the present work, ferrite with the spinel structure Zn0.34Fe2.53O4 was chosen for X-ray and neutron diffraction studies at high pressure and in a wide temperature range. Experiments on neutron diffraction in a wide temperature range were carried out on a DN-12 diffractometer with a pulse high-flux reactor IBR-2 [FLNP, JINR]. X-ray diffraction data were obtained on a specialized Xeuss 3.0 diffractometer (Xenocs SAS, France) using a high-pressure cell with diamond anvils.

The distribution of magnetic moments of iron ions in the crystallographic positions A and B using temperature have been studied. Calculated lattice parameters, interatomic distances and angles, magnetic moments as functions of temperature and pressure were presented. The structural mechanisms of phase transition in ferrites with spinel structure are discussed.

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References

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