NEUTRON DIFFRACTION STUDY OF MAGNETIC TRANSFORMATIONS IN InSe ⟨Mn⟩ LAYERED SEMICONDUCTOR

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S u m m a r y

The analysis of magnetic properties and neutron diffraction spectra for an InSe layered semiconductor doped with Mn has been carried out. The neutron diffraction structural studies show that the InSe⟨Mn⟩ semiconductor is a multiphase material consisting of several phases, namely InSe, MnSe, and In_4Se_3, which is a result of a poor solubility of manganese in InSe. A nonmonotonic temperature dependence of magnetic susceptibility (MS) for the InSe⟨Mn⟩ specimen within a temperature range of 2.4–270 K is due to the antiferromagnetic properties of the MnSe cubic phase. A quantitative agreement between the experimental and simulated data is achieved when the MnSe phase content is about 0.15 mass percent in InSe. The observations of the neutron reflections from the MnSe phase indicate that the typical sizes of its inclusions exceed the coherence area size for neutron radiation. It is revealed that the magnetic lattice period for the MnSe cubic phase is doubled in comparison with that for a crystal lattice. For the first time, the decrease in the magnetic lattice parameter was observed with the temperature reduction below 70 K, where MnSe is in the antiferromagnetic state. It is concluded that this effect leads to an enhancement of the interaction between magnetic moments in the magnetic sublattice and probably to the appearance of a new ferromagnetic state. This is believed to lead to a drastic increase in MS of MnSe with decrease in the temperature from 70 to 2.4 K, whose nature remained unknown till now.