SYNTHESIS AND STUDY OF HIGHLY INTERCALATED $Fe_xTi_2S_4$ COMPOUNDS

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Compounds $Fe_xTi_2S_4$ ($1 \leq x \leq 1.5$) were obtained and studied by means of X-ray diffraction, magnetization and magnetoresistance measurements. The results are discussed under the assumption that the mixing of Fe and Ti plays a significant role in changing the properties with increasing iron content.

Transition metal chalcogenides with metal deficiency and substitution $(M,M')_xCh$ (Ch = S, Se, Te) form a wide range of layered solid solutions ($0.5 \leq x < 1$) with vacancies in each second layer of cations (Fig. 1). The structure of $(M,M')_xCh$ is a derivative of NiAs structure type. Such compounds are very interesting due to the possibility of varying their chemical composition in wide ranges. Moreover, their magnetic properties are very sensitive to structural features [1].

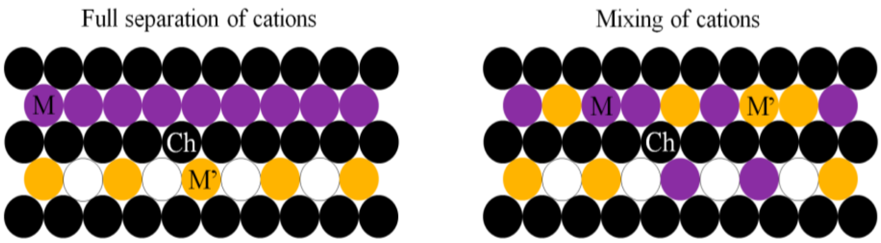

Fig. 1. Simplified representation of layered structure of $(M,M')_xCh$.

Polycrystalline compounds $Fe_xTi_2S_4$ (x = 1, 1.32, 1.5) were obtained by solid state reactions. The samples were examined by powder X-ray diffraction on a Bruker D8 ADVANCE. The resulting patterns were analyzed by using the FullProf program. The temperature and field dependences of magnetization were obtained by a SQUID magnetometer MPMS. The electrical resistivity and magnetoresistance were measured by a four-probe method in magnetic fields up to 12 T using the DMS-1000 system.

The compounds are single-phase and have the same structure but the behavior of magnetization and resistivity of samples with x = 1 and x > 1 is qualitatively different. The sample with x = 1 is antiferromagnetic and the resistivity decreases with cooling. Samples with x > 1 are ferrimagnetic and the resistivity increases with cooling below magnetic ordering temperature. This difference in the behavior of the electrical resistivity can be explained by the assumption, that in compounds with x > 1 there is mixing of the Fe and Ti cations (Fig. 1).

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1. N. V. Baranov et al., J. Phys.: Condens. Matter, Vol. 27, 286003 (2015)