Mössbauer spectroscopy and X-ray diffraction studies of VMnSn solid solutions

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Recently performed theoretical studies indicate on the possibility of appearance of half-metallicity in the full-Heusler compounds like Mn_2VZ (Z = Al, Ga, In, Sn) [1]. These compounds show ferrimagnetism with the V and Z spin moments being antiparallel to the Mn ones. The interest for such compounds is mostly due to the fact that the small value of the total magnetic moment in these system gives additional possibility for stabilization of spin electronics devices. However only the Mn_2VAl compound has been grown experimentally [2] and the ferromagnetic ordering as well as nearly half-metallic character was revealed.

Searching a possibility for preparation of the Mn_2VSn compound, we have carried out a study of the VMnSn alloys with the atomic concentration (V-25%, Mn-25.%, Sn-50%), (V-50%, Mn-25%, Sn-25%) and (V-25%. Mn-50%. Sn-25%). The polycrystalline samples were arc melted on the water-cooled copper hearth in a high-purity argon atmosphere. The samples quenched from elevated temperatures as well as annealed at 873 K for 1 month and slowly cooled were investigated. The X-ray-diffraction and scanning electron microscopy was applied to the phase analysis. The ^{119}Sn-Mössbauer spectra were recorded from 80 to 300 K in a liquid nitrogen cryostat using a constant-acceleration spectrometer. The magnetization measurements (magnetic balance technique) were carried out in the range (80 K – 1073 K).

No ternary compounds were found in investigated V-Mn-Sn system. The existence of solid solutions based on the binary compounds, namely V_2Sn_3, V_3Sn and Mn_3Sn was detected, with different extension in Mn and V atomic concentration, respectively. Combining an independent information about atomic structure from X-ray-diffraction and Mössbauer spectroscopy it was possible to identify main chemical environments responsible for the magnetic ordering observed in this compounds.

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[1] K. Özdoğan *et al.* J. Phys : Condens. Matter. **18** (2006) 2905.
[2] C. Jiang, M. Venkatesan, J.M.D. Coey, Solid State Commun. **118** (2001) 518.

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