Mössbauer investigations of a magnetic structure of γ-Fe-Mn

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Magnetic structure of chemically disordered alloys in which atoms occupy fcc lattice positions is still a subject of intensive investigations. Symmetry of cubic structure allows for at least three different antiferromagnetic structures with wave vectors q_1=(1,0,0), q_2=(1,1,0) and q_3=(1,1,1), respectively. Experimental determination which of these possibilities is realized in a given system is difficult. Because of formation of antiferromagnetic domains, all the magnetic structures result in the same neutron diffraction pattern. Mössbauer experiments performed so far seem to disprove the q_1 structure [1, 2].

Huge progress in computational physics allows one for calculation of magnetic structures including noncollinear magnetic order. In case of gamma Fe-Mn strong influence of chemical disorder on the collinearity was reported [3]. The calculations [3] were performed within the framework of self –consisted tight-binding linearized muffin tin orbital approach. The ground state of ordered FeMn is predicted to consist of ferromagnetic Fe spins and canted Mn magnetic moments, while in disordered alloy a collinear antiferromagnetic order builds up. In another first principle calculations, KKR multiple scattering approach [4], q_2 and q_3 structures are stable solutions with lowest energies.

Mössbauer polarimetry was used for investigations of Fe magnetic moments orientations in γ-Fe-Mn system. External magnetic field was applied to single crystal samples. Since the hyperfine field is a vector quantity, it forms a vector sum with the external magnetic field, and this quantity obviously depends on the magnetic structure realized in the system. Investigations with different orientations of external magnetic field with respect to the crystalline directions were performed. There is a clear experimental evidence that distribution of Fe moments is present, which is interpreted as result of different chemical environments. Orientation of Fe magnetic moments does not depend on the chemical environment. Shapes of the spectra are best explained under assumption of a coexistence of q_2 and q_3 structures, while presence of q_1 structure could be hardly reconciled with the results of measurements.

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