Characterization of Zn(Mn)Se/GaAs(001) Layers by Multi-Beam X-Ray Diffraction

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X-ray multi-beam diffraction (MBD) is not often used for characterization of complicated multilayered semiconductor systems due to complexity of diffraction pattern governed by both multi-beam effects and complex real structure influence. However X-ray MBD is a high-precision tool for determination of lattice parameters, chemical composition and strain distribution in crystalline materials [1-2].

The technique of high-resolution X-ray MBD with the using of coincidental coplanar / non-coplanar diffraction [2] was developed for multilayered systems comprising $ZnMn_xSe$ (x=0.05÷0.15) layers on GaAs (001) substrate. Experimental approbation of this technique was carried out on the 1-μm-thick ZnMnSe layers grown by molecular beam epitaxy (MBE) pseudomorphically on GaAs (001) substrate via a GaAs buffer epilayer at a temperature of T_S= 280°C by using a double-chamber MBE setup (Semiteq, Russia). X-ray MBD measurements were performed using the high resolution x-ray diffractometer (Bruker D8 Discover) equipped with an Eulerian quarter circle, a graded parabolic mirror and a double-crystal symmetric Ge (220) monochromator. CuKa1 radiation from a 6 kW rotating anode x-ray source was used.

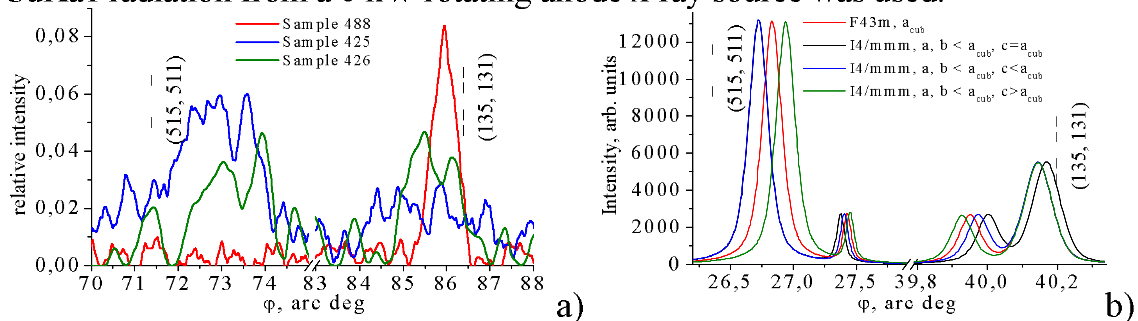

Fig. 1. Fragment of multi-beam X-ray diffraction scan for $Zn_{1-x}Mn_xSe$ layer.
a) experiment; b) calculations, the cubic-to-tetragonal transition in layer is taken in account. φ is a scanning angle, primary reflection is (006), CuKα-radiation.

Application of the developed X-ray MBD technique enables one to study the structural disordering near the II-VI/III-V heterovalent interface, the degree of interdiffusion of chemical elements between ZnMnSe and GaAs layers and to determine the depth of heterovalent interface mixing for the multilayered structures based on Zn(Mn)Se (Fig. 1).

1. Chang S-L, *Journal of Physics and Chemistry of Solids,* **62**, (2001), 1765.
2. Borcha M *et al.* (2009). Physica status solidi A **206**, N 8, 1699.