Band structure analysis of (Ga,Mn)(Bi,As) and (Ga,Bi)As epitaxial layers

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The GaAs based ferromagnetic semiconductor alloy compounds containing Mn and Bi emerged as potential candidates for novel microelectronic and spintronic application. All the epitaxial layers with the thicknesses up to 100 nm were grown using low temperature (230°C) MBE pseudomorphically on semi-insulating (001) GaAs and InGaAs substrates.

The alloy compositions were determined using high resolution X-ray diffractometry (XRD) followed by the in-situ Reflection High Energy Electron Diffraction (RHEED) [1]. The quality of the epi-layers were estimated using Transmission electron microscopy (TEM). The superconducting quantum interference device (SQUID) magnetometry have been used for the investigation of the magnetic properties of the heterostructures. Photoreflectance (PR) measurements were used the determination of the band gap (E_0) and spin-orbit split-off (E_{SO}) band to conduction band optical transitions. The results presented in the our last publications concerning the ferromagnetic (Ga,Mn)As [2,3,4] and bismuth doped (Ga,Mn)As [5], have shown the merit of the use the PR method for the band structure analysis of the GaAs base epitaxial layers. Besides the PR technique, the samples have been investigated by the μRaman spectroscopy to confirm *p*-type character of some films by the observation of the Coupled Plasmon-LO Phonon Mode (CPPM). The in-situ UV Angle Resolved Photoemission Spectroscopy (ARPES) was used for the band structure analysis of the epitaxial layers.

The low temperature optical-energy-gap measurements supported by complementary characterization, for a series of (Ga,Mn)(BiAs) and Ga(Bi,As) layers show that the deep modification of the GaAs valence band caused by Mn incorporation occurs for a Mn content much lower than that supporting dilute ferromagnetic phase in (Ga,Mn)(Bi,As).

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