Nanoscale physics

Ferromagnetism and band structure engineering in the (Ga,Mn)As, Ga(Bi,As) and (Ga,Mn)(Bi,As) nanolayers

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The GaAs based ferromagnetic semiconductor alloy compounds containing Mn and Bi emerged as potential candidates for novel nanoelectronic and spintronic application. The (Ga,Mn)As, Ga(Bi,As) and (Ga,Mn)(Bi,As) nanolayers are grown using low temperature (230°C) molecular beam epitaxy (MBE). The alloy compositions are determined with high resolution X-ray diffractometry (XRD) followed by the in-situ Reflection High Energy Electron Diffraction (RHEED). The superconducting quantum interference device (SQUID) magnetometry is used for the investigation of the magnetic properties of the heterostructures.

Photoreflectance (PR) measurements are used for the determination of the band gap (E0) and spin-orbit split-off (E_{SO}) band to conduction band optical transitions. 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) is 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)As, Ga(Bi,As) and (Ga,Mn)(Bi,As) nanolayers, 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 the investigated nanofilms.