

物理工学談話会

日時: 2023年12月12日 (火) 15:00ー16:00

場所: 総合研究棟W棟 202(ハイブリッドを予定)

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題目: “Band-Structure Engineering in MBE-grown
Multicomponent Dilute Semiconductors”

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世話人: 物理工学・一柳 (内線4185)

Abstract

Dilute magnetic semiconductors (DMSs) represent a class of alloys which combine semiconductor properties with magnetism integrated into a single material. Their magnetic properties arise from transition metal ions introduced into the semiconductor host lattice. The combination of electronic and magnetic properties results in entirely new physical properties that are of interest in basic science and, importantly, hold promise of a wide range of device application referred to as spintronics.

Impact of P, Bi and Mn incorporation into GaAs layers on their electronic- and band-structures as well as magnetic and structural properties has been studied. A set of the homogenous (Ga,Mn)(P,As) and (Ga,Mn)(Bi,As) layers of high structural perfection have been grown by the low-temperature molecular-beam epitaxy technique. Post-growth annealing treatment of the layers results in an improvement of their structural and magnetic properties and an increase in the free hole concentration in the layers. Hard-X- ray angular-resolved photoemission spectroscopy (HARPES) reveals that a strongly dispersing band crosses the Fermi energy in the highly doped samples. This is a consequence of the high concentration of Mn-induced itinerant holes residing in the valence band of the III-V semiconductor host. The spectroscopic ellipsometry (SE) and photo-reflectance spectroscopy results confirmed the modification of the valence band of the epitaxial layers. This study was supported by the micro-Raman and SQUID magnetometry measurements.