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Ferromagnetic Semiconductor Properties of Cr Doped MnTe Thin Film

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Ferromagnetic semiconductor had been reported in Mn-GaN, Co-TiO_2, and Co-ZnO. The ferromagnetism in those materials is interested for diluted magnetic semiconductors (DMS), and many kind of discussion are still open whether the ferromagnetism observed is originated from intrinsic properties of DMS or cluster of magnetic materials. Therefore sigle phase of crystallographic structure is essential condition to ensure ferromagnetic semiconductor. Recently, ferromagnetic semiconductor properties on Cr-doped MnTe powder compunds has been reported and interested for enhancement of ferromagnetism, which is not from the secondary phase [1]. In this report, we present ferromagnetic properties of Cr doped MnTe thin film.

Single phase of high crystalline quality of $Mn_{1-x}Cr_xTe$ (x = 0.05, 0.1, 0.15) were successfully grown on Si(100):B substrates by molecular beam epitaxy (MBE). Under tellurium-rich condition and the substrate temperature around 400℃, a layer thickness 700 Å with the growth rate of 1.1 Å/s could be easily obtained. We have investigated the structure, magnetic and transport properties of MnTe layers by using x-ray diffraction (XRD), superconducting quantum interference device (SQUID) magnetometer, Investigation of magnetic and transport properties of MnTe films showed ferromagnetic properties unlike antiferromagnetic bulk MnTe materials. The temperature dependence of the magnetic susceptibility exhibits a sharp ferromagnetic transitions at around 250 K in the film of x = 0.5, as shown in Fig. 1. The valence band of X-ray photoemission spectroscopy(XPS) shows a shift toward to the lower binding energy, denoting enhancement of half metallic properties.

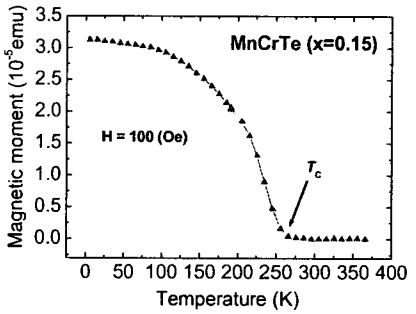

Fig. 1. Temperature dependence of magnetization for $Mn_{1-x}Cr_xTe$ (x= 0.15).

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Spin Polarization of a Non-magnetic High G-factor Semiconductor at Low Magnetic Field

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We have studied the spin polarization of bulk Hg_(1-x)Cd_(x)Te (x=0.21) at 2K by measuring Shubnikov-de Haas oscillations. The magnetic field have been applied in parallel and perpendicular to the current, and the obtained transport properties show the spin-related selection rules near the fully polarized magnetic field regime. The electronic Fermi level is located at 6.5 meV above the conduction band, and the carrier electrons are completely polarized when the applied magnetic field is more than 0.5 Tesla.

This magnitude of the magnetic field can be generated and controlled by ferromagnetic materials deposited on the surface of the specimen [1], which means the spin-manipulation such as spin up/down junction [2] can be realized with this material.

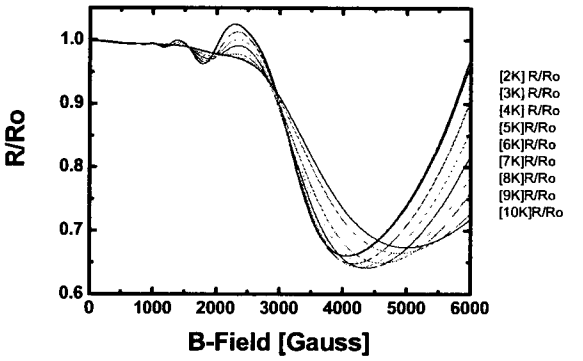

Fig. 1. Temperature dependence of the Shubnikov-de Haas oscillations in HgCdTe. The magnetic field have been applied magnetic field in parallel.

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