PD04

Electrical Properties and Magnetic Behavior with Mixed Phases in Si:Mn Semiconductor Thin Films

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$Si_{1-x}Mn_x$ magnetic semiconductors were grown on Si(100) substrates by using MBE. Growth temperature was 200℃. Average growth rate was ~15 Å/ min and final film thickness was around 100 nm. Microstructure of $Si_{1-x}Mn_x$ magnetic semiconductors was examined by observing through X-ray diffraction and transmission electron microscope. The electrical resistivities of $Si_{1-x}Mn_x$ thin films are 10^{-3}~1.2×10^{-2} Ωcm at room temperature and decrease with increasing Mn concentration. $Si_{1-x}Mn_x$ thin films have p-type majority charge carriers with hole density is 5.1×10^{19}~5.9×10^{20} cm^{-3}. Hole density increases whereas mobility decreases with Mn concentration. However the predominant increase of hole density is over mobility that results in the overall decrease of electrical resistivity. Temperature dependence of electrical resistivity and Hall analysis show that the $Si_{1-x}Mn_x$ thin films have semiconductor characteristics. Temperature dependence with FC and ZFC and filed dependence of magnetization were measured by using SQUID. We discuss the magnetic behavior of $Si_{1-x}Mn_x$ magnetic semiconductors in which Mn concentration is over 7.5at%. The present of precipitates dominates in the magnetic behavior of thin films.

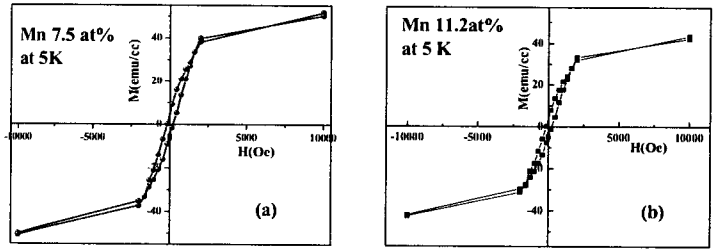

Fig. 1. Magnetization versus applied field for Mn concentrations noted.

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PD05

Formation of Ferromagnetic Ge_3Mn_5 Phase in MBE-grown Polycrystalline $Ge_{1-x}Mn_x$ Thin Films

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Magnetic phases of polycrystalline $Ge_{1-x}Mn_x$ thin films were studied. The $Ge_{1-x}Mn_x$ thin films were grown at various substrate temperatures by using a molecular beam epitaxy. The $Ge_{1-x}Mn_x$ thin films are p-type and electrical resistivities are 4×10^{-2}~5×10^{-4} ohm-cm. Some of $Ge_{1-x}Mn_x$ thin films display anomalous Hall phenomena. Carrier concentration is estimated to be 10^{18}-10^{21}/cm^3 and increases with Mn at% at room temperature. Magnetic hysteresis loops of $Ge_{1-x}Mn_x$ thin films were measured at room temperature using a VSM and saturation magnetizations are plotted in Fig.1. Saturation magnetizations of $Ge_{1-x}Mn_x$ thin films vary with growth temperature and Mn concentration. Magnetization characteristics and X-ray analysis reveal that ferromagnetic Ge_3Mn_5 phase is formed in the MBE-grown polycrystalline $Ge_{1-x}Mn_x$ thin films. We carefully measured the change of resistance that depends on temperature and magnetoresistance for the $Ge_{1-x}Mn_x$ thin film that have Ge_3Mn_5 phase.

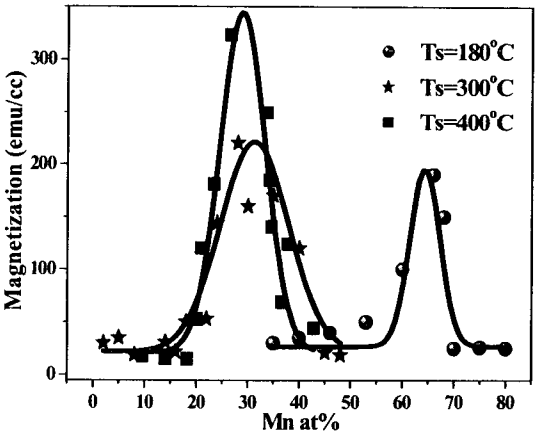

Fig. 1. Saturation magnetizations of $Ge_{1-x}Mn_x$ semiconductors measured at room temperature using VSM. Applied field was 1T. Temperatures are growth temperatures.

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