

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°C. 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 10³ ~ 1.2 × 10³ Ω·cm 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 × 10¹⁷ ~ 5.9 × 10¹⁸ 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 field 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.

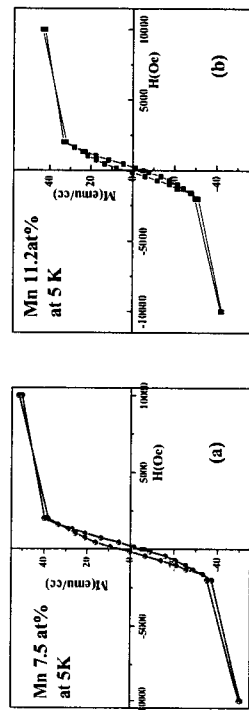


Fig. 1. Magnetization versus applied field for Mn concentrations noted.

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PD05

Formation of Ferromagnetic Ge₃Mn₅ 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 × 10² ~ 5 × 10⁴ ohm-cm. Some of Ge_{1-x}Mn_x thin films display anomalous Hall phenomena. Carrier concentration is estimated to be 10¹⁸ - 10²¹/cm³ 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 Ge₃Mn₅ 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 Ge₃Mn₅ phase.

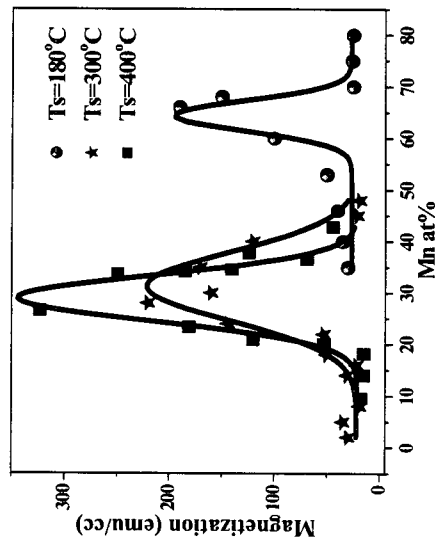


Fig. 1. Saturation magnetizations of Ge_{1-x}Mn_x semiconductors measured at room temperature using VSM. Applied field was 1T. Temperatures are growth temperatures.

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