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Vapor deposition 방법으로 성장시킨 비정질 $Ge_{1-x}Mn_x$ 박막의 자기적 특성 및 자기수송 특성

Magnetic and Magnetotransport Properties of amorphous $Ge_{1-x}Mn_x$ Thin Films Grown by Vapor Deposition

유상수†, 찬티난안, 김익환, 임영언, 김도진, 김효진, 김창수*, 류현*, 오상준**
충남대학교 공과대학 재료공학과, *한국표준과학연구원, **한국기초과학지원연구원
(ss1453@empal com†)

Magnetic properties of amorphous $Ge_{1-x}Mn_x$ thin films were investigated The semiconductor thin films were grown at 373K on (100)Si wafers by using a thermal evaporator Growth rate was ~40nm/min and average film thickness was around 500nm Thickness and composition were measured by utilizing an alpha-step and an energy dispersive X-ray spectroscopy, respectively X-ray analysis shows that the $Ge_{1-x}Mn_x$ thin films are amorphous when Mn concentration is less than 30 at%, but diffraction peaks appeared when Mn concentration exceeds 30at% The electrical resistivities of $Ge_{1-x}Mn_x$ thin films are 5 0×10-4~1 1Ωcm at room temperature and decrease with increasing Mn concentration. Magnetic properties of amorphous $Ge_{1-x}Mn_x$ thin films were measured by using a VSM and a SQUID The saturation magnetization of amorphous semiconductor thin films vary with Mn concentration, and the largest saturation magnetization is ~100emu/cc for 11 8at% Mn at 5K Low temperature magnetization characteristics and magnetic hysteresis loops measured at various temperatures show that the amorphous $Ge_{1-x}Mn_x$ thin films are ferromagnetic at low temperature but the ferromagnetic magnetization are changing gradually into paramagnetic as increasing temperature The Curie temperature of amorphous $Ge_{1-x}Mn_x$ thin films is considered to be around 150K The in-field electrical resistivity of amorphous $Ge_{1-x}Mn_x$ thin films is lower than the zero-field electrical resistivity when $T<T_C$, but the reverse is true when $T>T_C$ However, the in-field electrical resistivity of amorphous $Ge_{1-x}Mn_x$ thin films is always higher than the zero-field electrical resistivity when Mn concentration is larger than ~12at% In Addition, magnetotransport characteristics of amorphous $Ge_{1-x}Mn_x$ thin films show anomalous Hall phenomenon and negative magnetoresistance when $T<T_C$ The results suggest that the Mn atoms in amorphous $Ge_{1-x}Mn_x$ thin films be related to spin dependent scattering depending on magnetization

Acknowledgement
This work was supported by the Research Center for Advanced Magnetic Materials (RECAMM, Chungnam National University, Korea) and the Brain Korea 21 Program (BK21, the Ministry of Education & Human Resource Development, Korea)