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Substrate temperature dependence of structural and magnetic properties of $Fe_{1-x}Mn_x$ thin films on GaAs(100) using molecular beam epitaxy

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FeMn thin films have been widely used as a pinning layer in a spin-valve type magnetic sensors and magnetic data storage [1]. Fe_xMn_{1-x} alloys have various structural phases such as α, γ, α-Mn, β-Mn, and ε. The crystal structure and lattice constants of Fe_xMn_{1-x} alloys strongly depend on the alloy composition, x [2]. For Fe composition, $x<0.2$, Fe_xMn_{1-x} alloys are the bcc α-phase (a=2.89 Å) which is ferromagnetic at room temperature [3], and for $0.2<x<0.6$ the fcc γ-phase (a=3.63 Å) which is antiferromagnetic with T_N=520~540 K [4]. In this study, we have investigated the structural and magnetic properties of Fe_xMn_{1-x} thin films grown on GaAs(100) substrates by molecular beam epitaxy (MBE). We have obtained the γ- and α-Mn phase Fe_xMn_{1-x} thin films at room temperature and 300 ° C growth temperatures, respectively. The evolution of the crystal structure from the α-phase to the γ-phase characterized by X-ray diffraction patterns (XRD) will be discussed in detail. From the magnetization measurements of the Fe_xMn_{1-x} alloys, the γ- and α-Mn phase Fe_xMn_{1-x} thin films showed antiferromagnetic and ferromagnetic ordering at room temperature, respectively.

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