Structure and Magnetic Properties of FeGa Thin Film on GaSb (100)

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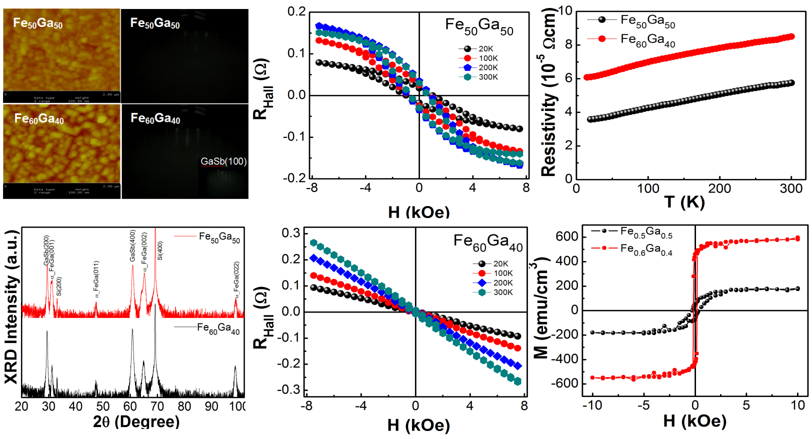
The Fe-Ga alloys have recently attracted great interests because they exhibited ferromagnetic properties with high Curie temperature (T_C), high saturation magnetization (M_S) and unique magnetostriction properties which are promising to real applications such actuators, acoustic sensors, torque sensors, and positioning devices in particular for micro and nano-electromechanical systems (MEMS and NEMS) and the integrated magnetostrictive devices (MagMEMS) [1-4]. Clark *et al.* reported that in the bulk $Fe_{1-x}Ga_x$ (4<x<27) alloy, the magnetostriction constant (●$_{100}$) has two maximum values; 265 ppm at x = 19 and 235 ppm at x=27[1]. Similar results are reported by Kellogg *et al.* that single crystal $Fe_{0.81}Ga_{0.19}$ has the saturation magnetostriction and magnetization of 298 ppm and 1265 emu/cm^3 at 80 ^{o}C, respectively, and by Cullen *et al.* that $Fe_{0.82}Ga_{0.18}$ has ~300 ppm [5, 6]. In addition, there is less information about transport and magnetism properties of the epitaxial Fe-Ga thin film which grown on semiconductor substrates. Expitaxial $Fe_{1-x}Ga_x$ (x = 40; 50) thin film has been grown on GaSb (100) substrate by molecular beam epitaxy. The bcc α-Fe crystal structure (A2) with the lattice parameter as 2.967Å was observed by X-ray diffraction. The saturation magnetization and coercivity at room temperature of $Fe_{60}Ga_{40}$ and $Fe_{50}Ga_{50}$ are 570 emu/cm^3; 170 (Oe) and 180 emu/cm^3; 364 (Oe), respectively. The temperature dependent resistivity of both samples showed metallic behavior. The Hall resistance, R_{Hall}, is given by the sum of the ordinary Hall effect (OHE) due to the Lorentz force and the anomalous Hall effect (AHE) originating from asymmetric scattering in the presence of magnetization. The carrier densites of sample increased from 1.71x10^{20} (cm^{-3}) to 10.38x10^{20} (cm^{-3}) with increasing the Ga concentration from 40 to 50% at room temperature which are calculated from Hall measurement results.



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