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New structure of ferromagnetic $Fe_{1-x}Mn_x$ thin films on GaAs(100) using molecular beam epitaxy

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$Fe_{1-x}Mn_x$ alloys have third phases with α, γ, and ε. For x<0.2 the alloys form the bcc α-phase which is ferromagnetic at room temperature, 0.2<x<0.6 the alloys from the fcc γ-phase which is antiferromagnetic at T_N= 520~540 K. Antiferromagnetic materials have attracted great attention in technological applications such as spin-valve and MTJ (magnetic tunnel junction) since the discovery of the exchange bias associated with the interface between ferromagnetic and antiferromagnetic materials. Here, we report the new structure of ferromagnetic $Fe_{1-x}Mn_x$ thin films on GaAs(100) substrate by using molecular beam epitaxy (MBE). The base pressure of the chamber was 1×10^{-9} Torr. The growth rate of $Fe_{1-x}Mn_x$ and substrate temperature were 0.4 Å/s and T_S=300 ℃, respectively. The growth was monitored with RHEED (reflection high-energy electron diffraction). We have observed streaky RHEED patterns, indicating the layer-by-layer growth of $Fe_{1-x}Mn_x$ thin films. In fig 1, we observed that the lattice constants were 10.80~10.86 Å with x=0.2, 0.25, 0.3, 0.4, and 0.5. $Fe_{1-x}Mn_x$ thin films showed ferromagnetic ordering at high temperature (T_C> 300 K). Also, coercivity field were increased according to Mn concentrations (fig 2.).

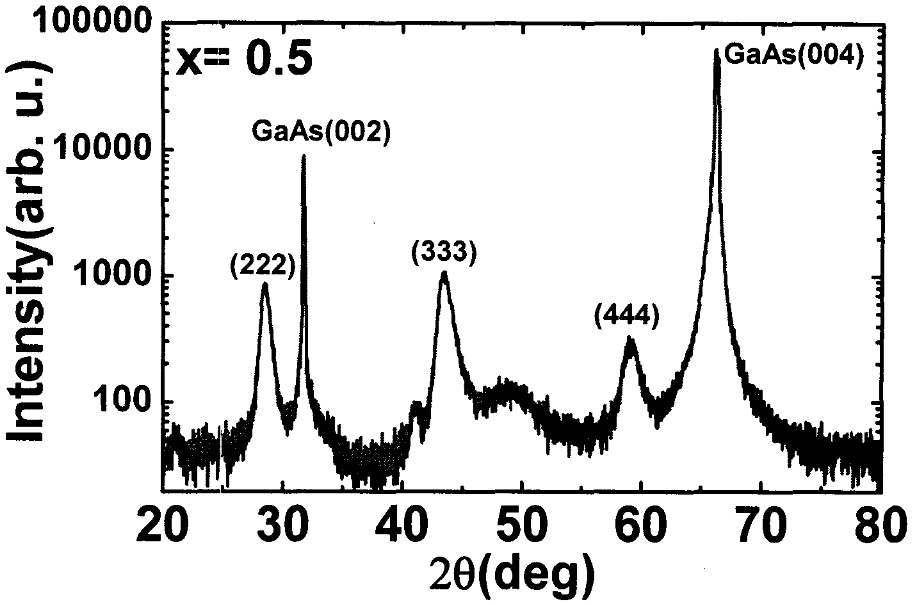

Fig 1. X-ray diffraction of $Fe_{1-x}Mn_x$ (x=0.5) thin film.

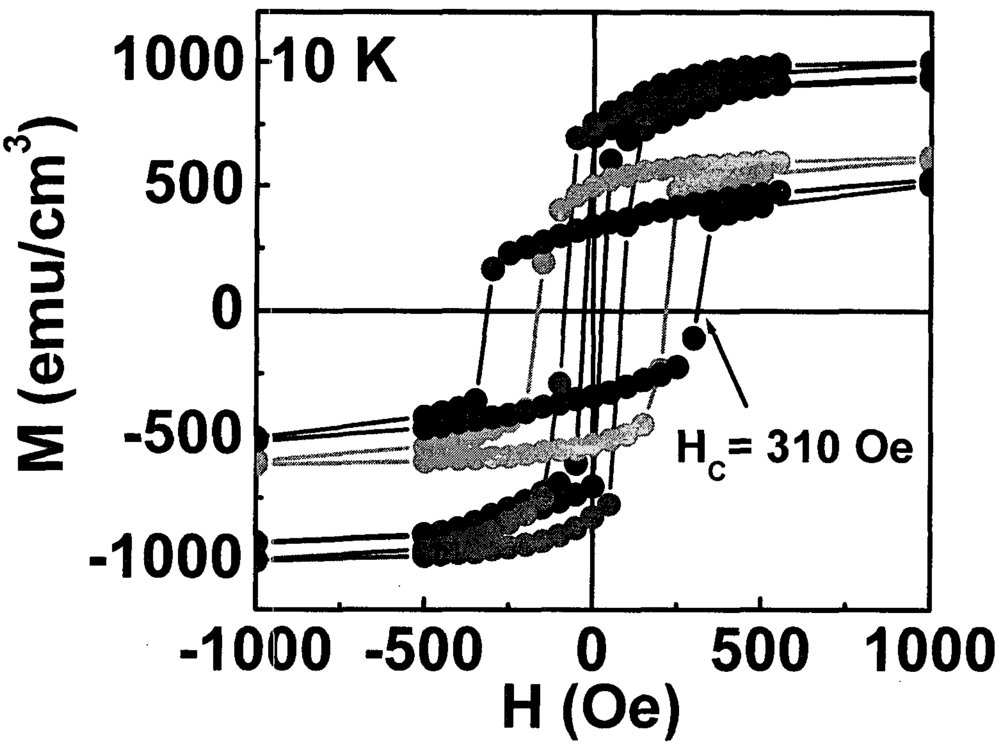

Fig 2. Hysteresis of $Fe_{1-x}Mn_x$ (x=0.2, 0.3, 0.4 0.5) thin films.