

MBE growth and transport properties of $(\text{Fe}_{1-x}\text{Mn}_x)_2\text{As}$ thin films

Younghun Hwang^{1*}, Jeongyong Choi¹, Sunglae Cho^{1,2}, Sungyoul Choi³, Hyun-Min Park⁴ and
Yongsup Park⁴

¹Department of Physics, University of Ulsan, Ulsan

²Nanodevice Research Center, Korea Institute of Science and Technology, Seoul

³Electronics and Telecommunications Research Institute, Taejeon

⁴Materials Evaluation Center, Korea Research Institute of Standards and Science, Taejeon

Epitaxial ferromagnetic or ferrimagnetic thin films on semiconductor have recently attracted much interests for spintronic devices[1-3]. Arsenide (As) of transition metals with formula M_2As (M= Mn, Fe, Cr) usually crystallize in three different crystal structure types such as hexagonal P-62m, tetragonal P4/nmm or orthorhombic Pnma[4-7]. The most stable crystal structure of M_2As (M= Mn, Fe, Cr) is tetragonal with the lattice constants $a = 3.769 \text{ \AA}/c = 6.278 \text{ \AA}$, $a = 3.627 \text{ \AA}/c = 5.973 \text{ \AA}$, and $a = 3.620 \text{ \AA}/c = 6.330 \text{ \AA}$, respectively[8-10]. The tetragonal M_2As (M= Mn, Fe, Cr) has antiferromagnetic ordering at 573, 325, and 393 K, respectively[11-13]. Note that the magnetic properties strongly depend on the crystal structure. Recently, the tetragonal FeMnAs to have antiferromagnetic ordering at 470 K with the magnetic moments of $3.36 \mu_B$ per Mn [14]. However, the hexagonal FeMnAs alloy showed ferromagnetic ordering at near 190 K with the magnetic moments of 3.14 and $1.54 \mu_B$ per Mn and Fe, respectively[11].

In this talk, we will report on the epitaxial growth of $(\text{Fe}_{1-x}\text{Mn}_x)_2\text{As}$ thin films on Si (001) substrate using MBE (molecular beam epitaxy) and their structural and magnetic properties. The substrate temperature and film thickness were $T_s=300 \text{ }^\circ\text{C}$ and 1000 \AA , respectively. The growth was monitored by RHEED (reflection high energy electron diffraction). We have observed ferrimagnetic ordering in $(\text{Fe}_{0.7}\text{Mn}_{0.3})_2\text{As}$ thin film with $T_C > 400 \text{ K}$.

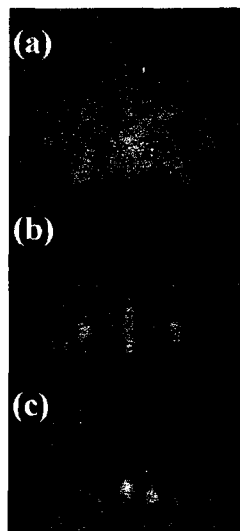


Figure 1. RHEED patterns of $(\text{Fe}_{0.7}\text{Mn}_{0.3})_2\text{As}$ thin films on n -type $\text{Si}(001)$ substrate along the (110) azimuth. $(\text{Fe}_{0.7}\text{Mn}_{0.3})_2\text{As}$ (a) 1000 Å and (b) 300 Å, and (c) $\text{Si}(001)$ substrate along the (110) azimuth.

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