

Thickness-dependent magnetic properties in MnAs thin films grown at relatively high temperature

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A NiAs-type MnAs is a ferromagnetic metal with 318 K Curie temperature and $3.6 \mu_B$ magnetic moment per Mn. Recently, epitaxial MnAs thin films grown on semiconductors have considerable interests for semiconductor/ferromagnet spintronic applications. It was reported that MnAs films can be grown on zinc-blende GaAs substrate despite of the different crystal structure. On the other hand, several theoretical studies predicted the half-metallic properties in zinc-blende MnAs and a monolayer zinc-blende growths of MnAs and CrSb were reported.[1-5]

While the growth of MnAs thin films using molecular beam epitaxy (MBE), it showed various electrical property as function of thickness of MnAs thin films. Here, we will report on the thickness-dependent structural, electrical and magnetic properties of MnAs thin films grown on GaAs(100) substrate using solid-source MBE. We have grown 200, 500, 1000, 1500, and 5000 Å MnAs thin films on GaAs(100) substrates at the same growth temperature 600 °C by MBE. The base pressure of growth chamber was an order of 10^{-10} Torr. The evaporation ratio of As/Mn was about 100. Reflection high-energy electron diffraction (RHEED) was used to examine the specific surface reconstruction, the growth mode, and the growth orientation of the deposited layers. Interestingly, the films grown at 600 °C showed semiconducting behaviors for the less than 1000 Å in thickness and metallic for the thicker ones.

Reference

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