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Mixed phases in MnBi thin film

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The intermetallic MnBi has a NiAs-type crystal structure and exhibits unique properties such as ferromagnetism with T_c = 633 K and large magneto-optic Kerr rotation. Although many efforts such as sintering, arc melting, thermal evaporation and MBE were devoted to produce MnBi thin films, its single phase have not been reported. [1-4]. A typical method for the MnBi thin film growth is to anneal the deposited Mn/Bi multilayers at various temperatures [2,4]. Here we report on the efforts in the growth of MnBi single phase on Si(111) substrate using by MBE. The base pressure of growth chamber was below 3.0×10^{-9} Torr. The growth rate of MnBi was 0.36 Å/s and the substrate temperature was maintained at 300°C. We saw the spotty RHEED pattern during the growth, which indicates the epitaxial growth of MnBi film. But we saw secondary phases in the earthworm-like surface of MnBi film as shown in SEM image (Fig 1). The film showed very interesting temperature dependent resistance data, which had two transition points at 100 and 270 K .We will discuss on magnetoresistance and magnetization data in detail.

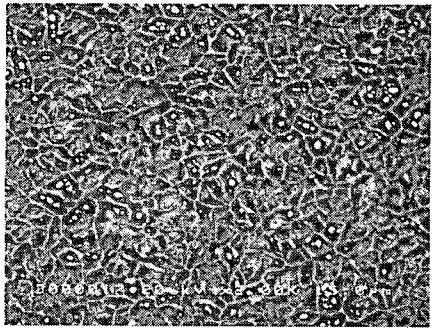

Fig. 1. The SEM image of MnBi thin film.

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Synthesis and quality of Cr-doped thin films grown by RF sputtering

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The AlCrN films were grown by RF reactive sputtering method under the selected conditions. The Cr concentration was varied by the number of Cr pieces placed on the Al target. The sample quality has been studied by XRD, Auger spectroscopy, optical absorption and electrical resistant measurements. The XRD and Auger results show that the samples consist of a major phase with the $Al_{1-x}Cr_xN$ formula, which has hexagonal structure, and a few percent at.of oxygen, which may form Al_2O_3. There exist the Cr clusters in the samples with high concentration of Cr. The optical absorption measurement provides the information about the band gap that relates strongly to the quality of samples. The quality of samples is also clearly reflected in electrical measurement, i.e., the temperature dependence of resistance exhibits a semiconductor characteristic only for the samples that have no Cr cluster. In these cases, the values of ionization energies E_a can be derived from R(T) plots by using the function $R(T) = Ro\ T^{1/2} \exp(E_a/k_BT)$.

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