STRUCTURAL AND MAGNETIC PROPERTIES OF GaSb:MnSb GRANULAR LAYERS

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The $Ga_{1-x}Mn_xSb$ layers were grown by molecular beam epitaxy method on two kinds of substrates: GaSb(100) and GaAs(111)A covered by thin GaSb buffer layer. The growth temperature of all layers was kept at 450°C. The nominal Mn contents (x = 0.01, 0.03, 0.07 and 0.08) were defined as a ratio of Mn to Ga flux during growth.

The structure of the layers was investigated by X-ray diffraction with the use of synchrotron radiation (XRD), scanning electron microscopy (SEM), as well as by atomic and magnetic force microscopy (AFM, MFM).

The results of XRD studies showed the presence of the hexagonal MnSb clusters embedded in a GaSb matrix formed during growth**.** The lattice parameters of these inclusions were determined on the base of 2θ-ω scans in the vicinity of 20.2 and 30.0 hexagonal reflections for the layers grown on (100)-oriented substrates and for 00.4 and 10.5 reflections in the case of layers grown on (111)-oriented ones. The different results were obtained for these two kinds of samples. For the first kind the lattice parameters of the inclusions, within the range of experimental errors, were the same as those for bulk MnSb, it means: a = 4.128 Å, c = 5.789 Å. On the other hand, the lattice parameters of the inclusions created in the layers grown on (111)-oriented substrates were significantly different from those for bulk MnSb. This result suggests that the MnSb clusters in these samples are strained on the contrary to the first kind of samples where the inclusions are relaxed. The spatial distribution of the clusters inside GaSb matrix depends also on the substrate orientation. In the case of GaSb:MnSb layers on GaSb/GaAs(111) substrates all clusters grow with their c-axis parallel to the <111> directions of the matrix, while in the case of layers grown on (100)-oriented substrates the MnSb clusters contain differently oriented blocks (see Fig. 1). According to the SEM studies (Fig. 2) the sizes of these clusters were ranging from ~50 nm to ~600 nm.

The AFM studies revealed the grains on the surfaces which were sources of strong magnetic contrasts. It suggests that the grains are ferromagnetic at room temperature.

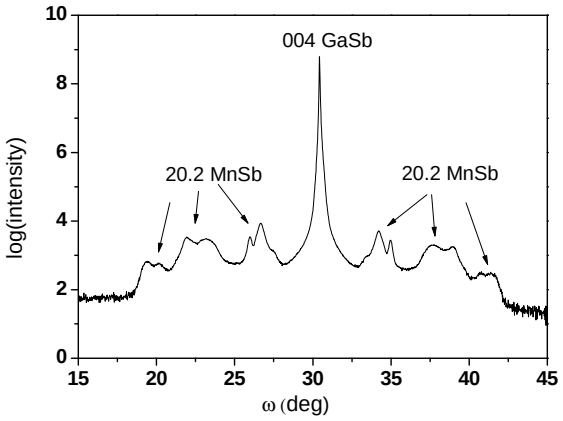

Figure 1. The 004 GaSb rocking curve in the wide range of ω angles – the small peaks on both sides of central peak are related to 20.2 peaks of different blocks of hexagonal MnSb clusters.

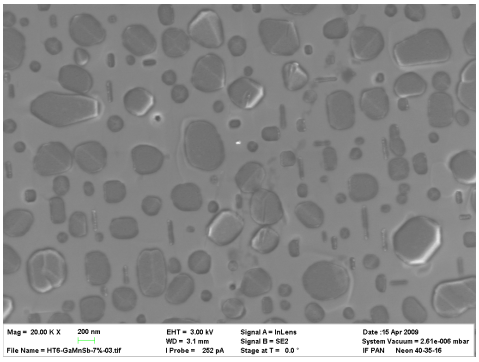

Figure 2. An example of the SEM picture of GaSb:MnSb granular layer grown on GaSb(100) substrate. The sizes of the clusters ranged from ~50 nm to ~600 nm.

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