Microhardness and Young's Modulus of Thin, MBE-Grown, (Sn,Mn)Te Layers Containing up to 8% of MnTe

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In the past few years, the lead and thin chalcogenides as well as various solid solutions containing these compounds have been attracting a lot of attention. There were multiple reasons for this. The lead telluride is one of the chalcogenides, which is considered as extremely useful in the field of thermoelectricity and infrared detection. The lattice dynamics of PbTe and that of SnTe are recently under an extensive debate because of some new physical phenomena that have been observed in these compounds [1, 2]. On the other hand, selected solid solutions obtained on the basis of IV-VI compounds, like, e.g., (Pb,Sn)Se, in some composition range are topological crystalline insulators [3]. Despite a variety of experimental methods being applied in order to study the physical properties of all IV-VI type materials, the mechanical properties of these semiconductors are far from being well known and clearly understood.

The aim of present study is to investigate possible evolution of both microhardness and Young's modulus values in thin (Sn,Mn)Te layers with an increasing MnTe content in the solid solution. A few (Sn,Mn)Te samples with *fcc* crystal structure of NaCl type, thickness close to 1 μm and various chemical compositions containing up to 8% of MnTe were grown by MBE technique on (111)-oriented BaF_2 substrates. The samples were characterized by XRD, SEM and EDX measurements. Morphology of sample surfaces was checked by AFM technique. The room temperature data about microhardness and Young's modulus were determined by the nanoindentation method using an Ultra Nanohardness Tester CSM UNHT/AFM and the Berkovich intender tip. The maximum load equal to 1 mN was applied during 15 s, both the increase of the load during application and the removal of the load were performed in a linear manner with the same upload and download rate 0.033 mN/s. The average values and standard deviations of the microhardness and Young's modulus were extracted from the determined load-displacement results. The comparison of data determined for (Sn,Mn)Te crystals with those corresponding to selected similar solid solutions is given and discussed.

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