Young's Modulus and Microhardness of (Pb,Cd)Te Solid Solution Grown by SSVG and MBE Method

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The PbTe, both alone or as a constituent of several systems (solid solutions, low-dimensional structures, composites etc.), attracts an increasing interest. The reasons are related to the new physical findings e.g., such as topological crystal insulators or dynamic local symmetry breaking and important applications, mostly in the harvesting energy area. The solids containing PbTe and CdTe, intensively investigated the last dozen years are one of the systems of today's active research. In particular, a significant hardening of the (Pb,Cd)Te solid solution with an increasing CdTe content could be an attractive property for selected applications of such crystals (see, e.g. [1]).

Recently, it was suggested that selected mechanical property, the microhardness, of PbTe bulk crystals and MBE-grown layers differ substantially [1]. On the other hand, analogous difference seems to be much smaller in case of GaAs [2] and not observed in (Cd,Hg)Te [3]. Therefore the question arises whether this effect exist also in (Pb,Cd)Te solid solution crystals.

All presently investigated samples were obtained at the Institute of Physics PAS. The bulk, single (Pb,Cd)Te solid solution crystals containing a few percent of CdTe were grown by the SSVG method. The samples oriented along three principal crystal directions by the X-ray diffraction were selected for further studies in order to check the microhardness anisotropy. In case of (001) orientation, sample with a natural surface was used, while the (011)- and (111)-oriented samples were etched in a bromine methanol solution. A few micrometers thick, (001)-oriented MBE layers with an analogous chemical composition were grown on GaAs substrates for the comparison. The samples characterized by XRD and AFM were investigated by the nanoindentation method at the University of Rzeszów. The applied load varied from 0.2 mN to 10 mN. The microhardness and Young's modulus, presently determined and compared with our previous results [1,2] and available literature data are given and discussed.

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