Anisotropy of Young's Modulus and Microhardness of PbTe

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The mechanical properties of such materials as Si, GaAs and few other semiconductor crystals of III-V type serving as a basis of several devices have been determined long time ago and they are relatively well-known today. On the contrary, similar properties of IV-VI compounds and solid solutions obtained on the basis of these semiconductors have not yet been a topic for systematic studies and these properties are much less explored.

Among the group of IV-VI semiconductors those which have served for thermoelectric applications or infrared detection are considered particularly interesting. In the last few years one may easily observed a 'renaissance' of topics of studies devoted to the lattice dynamics in these compounds [1, 2]. Recently, it was discovered that some from these materials can also serve as a basis of solid solutions which under well selected conditions exhibit the properties of topological crystalline insulators [3]. All studies devoted to new topological states of matter attract a lot of attention. Taking into account all circumstances mentioned above we decided to investigate the anisotropy of Young's modulus and microhardness for single PbTe crystal. The bulk sample was grown at the Institute of Physics PAS by the self-selecting vapor growth (SSVG) method [4], the microhardness and Young's modulus for (001), (011) and (111) planes of crystal were determined by the nanoindentation method. The values of microhardness and Young's modulus for a thick, MBE-grown, (111)-oriented PbTe layer deposited onto BaF_2 substrate were found for the comparison. The values resulting from all measurements were compared with those given by theoretical predictions and a few existing experimental data taken for other compounds or solid solutions exhibiting the same type of crystal structure (see, e.g., [5]).

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