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Interaction of Cd(Zn)Te components with carbon, oxygen, and hydrogen at crystal growing by Bridgeman method

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Chemical reactions of Cd(Zn)Te components with construction materials, gas medium, and atmosphere possible during crystal growth from melt using the Bridgeman method are considered. Thermodynamic parameters are calculated for carbide and oxycarbide formation in the system under consideration in the growth conditions. The raw material purification of oxygen-containing impurities has been shown to result in a substantial reduction of carbon-containing ones.

Рассмотрены возможные химические реакции компонентов Cd(Zn)Te с конструкционными материалами, газовой средой и атмосферой в процессе выращивания кристаллов из расплава методом Бриджмена. Рассчитаны термодинамические параметры образования карбидов и оксикарбидов в исследуемой системе в условиях выращивания. Показано, что очистка сырья от кислородных примесей приводит к существенному снижению концентрации углеродных примесей.

$A^{II}B^{VI}$ compounds and solid solution based thereon are materials of good prospects in the modern semiconductor engineering. Those materials make it possible to vary gradually their physical properties by changing the composition, thus obtaining semiconductors with controllable pre-specified characteristics. Of great interest are crystals of CdTe–ZnTe solid solutions being a material of promise for semiconductor-based detectors operated at room temperatures.

CdTe–ZnTe solid solution crystals transcend cadmium telluride ones in electrophysical properties due to a larger gap width. To realize these advantages, however, the high-perfection crystals of homogeneous composition with a low chemical impurity content are to be manufactured in reproducible manner.

It is clear that, when operating with even high purity initial blend components, the purity cannot be maintained always in the grown crystal. Carbon-containing impurities were revealed before [1] in zinc selenide crystals grown in graphite crucibles. The main impurities in those crystals, as detected by mass spectrometry, were carbon oxide and dioxide.

This work is aimed at the study of possible chemical reactions of Cd(Zn)Te (both in solid state and in melt) involving construction materials and gas media at the stages of blend synthesis and crystal growing.

Elementary cadmium, zinc, and tellurium of 6N purity grade were used as initial materials. The solid solution was synthesized in sealed quartz ampoules and in graphite crucibles under argon pressure of about 3 MPa. $Cd_{1-x}Zn_xTe$ ($x = 0.1$ to 0.2 %) were grown by vertical Bridgeman technique under argon pressure of 5 MPa. Carbon material with thermal expansion coefficient less than $5 \cdot 10^{-6}$ K^{-1} was used for crucibles. The crucible with blend charge