PHASE INTERACTIONS IN CuGaSe$_2$-Bi AND CuGaSe$_2$-Bi$_2$Se$_3$ SYSTEMS

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Employment of the monocrystals growing out method from solution in the melt is quite perspective for CuGaSe$_2$ fusing at the high temperature (1040°C). This method allows to grow out the crystals at the temperature lower than the own melting point of the compound. Investigation of state diagrams of CuGaSe$_2$-Bi and CuGaSe$_2$-Bi$_2$Se$_3$ systems was made with the aim of studying the possibility of bismuth and Bi$_2$Se$_3$ use as a solvent for the synthesis of monocrystals CuGaSe$_2$ by above mentioned method.

The alloys were synthesized by direct melting of components in the pumped out up to 0.133 Pa quartz ampoules in the vertical kiln at 1000-1100°C with the further cooling in the regime of cut out kiln. In order to achieve the equilibrium the alloys of CuGaSe$_2$-Bi system were sustained at 200°C and samples of CuGaSe$_2$-Bi$_2$Se$_3$ system were sustained at 550°C during 300 hours. Investigation of alloys was made by the method of differential-thermal, microstructural analysis and microhardness measurement. On the basis of obtained results there have been drawn up diagrams of state CuGaSe$_2$-Bi and CuGaSe$_2$-Bi$_2$Se$_3$ systems.

CuGaSe$_2$-Bi is a quasi-binary system of eutectic type. Two effects have been obtained on thermograms of all alloys. Effect at 270°C corresponds to eutectic crystallization. Eutectic content is 4 mol % CuGaSe$_2$.

CuGaSe$_2$-Bi$_2$Se$_3$ system is also quasi-binary of eutectic type. Eutectic of 60 mol% Bi$_2$Se$_3$ composition is melting at 650°C. On the basis of CuGaSe$_2$ we have found out small region of solid solutions, which becomes narrow while cooling from 1,5 mol % at 500°C up to 0,7 mol % Bi$_2$Se$_3$ at the room temperature.

Thus, it has been established, that both CuGaSe$_2$-Bi and CuGaSe$_2$-Bi$_2$Se$_3$ systems are quasi-binary of eutectic type. In both systems the region of primary crystallization of CuGaSe$_2$ is rather wide. The use of solution-melt of these systems for monocrystals growing of CuGaSe$_2$ is possible.