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INVESTIGATION ON PHASE-DIAGRAM OF THE Ag_2Te - $CdTe$ SYSTEM

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The phase diagram of the Ag_2Te-$CdTe$ system in determined by the data from differential thermal and X-ray analysis, microstructure and microhardness. A characteristic feature of this diagram is the presence of solid solution regions on the basis of α-Ag_2Te, β-Ag_2Te, γ-Ag_2Te and $CdTe$. Solid solutions on the basis of α-Ag_2Te have semiconductor properties.

The semiconductor compounds Ag_2Te and $CdTe$ and their solid-state solutions are relatively new materials and are very interesting because of the great variety of their physical, physico-chemical and optical properties, which could be fluently changed in dependence of the composition.

The system Ag_2Te - $CdTe$ represents a polythermal section of the ternary system Ag-Cd-Te. Data about that system are not available. The state-diagram of Ag-Te system is constructed using the results of refs. [1-3]. The state-diagram of Cd-Te is studied in refs. [4-6].

There exist four compounds in the Ag-Te system: Ag_2Te, which melts congruently at 959^oC and $Ag_{1,88}Te$, Ag_5Te_3 and $AgTe$ which are formed by peritectic reactions at 465^o, 460^o and 210^oC respectively.

The Ag_2Te compound exibits three polymorphic forms: monoclinic [7] - α-Ag_2Te (20-145^oC); cubic close-packing [8] - β-Ag_2Te (145-802^oC) and cubic body-centred [3] - γ-Ag_2Te (802-959^oC). The compound $CdTe$ is melting congruently at 1092^oC and forms degenerated eutectics with its components [5, 9].

The aim of the paper is to study the state-diagram of the Ag_2Te-$CdTe$ system. The samples with $CdTe$ content 0-100 *mol.%*, were obtained by direct one-temperature synthesis at 1050^o-1130^oC and vibrational stirring the melt for three hours. After 4000 hours homogeneous annealing the samples were studied by X-ray diffraction powder patterns, differential thermal analysis and metallographic analysis [10].

The X-ray diagrams showed shifting of Ag_2Te reflections towards increasing of Breg's angle. (from 100 to 90 *mol.%* Ag_2Te). The same tendency is observed when Ag_2Te is added to $CdTe$ (from 95 to

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100 mol.% CdTe). The diffraction reflections of the solid solutions, based on Ag_2Te and *CdTe*, are observed in the concentration range *10-95 mol.% CdTe*.

To determine the microstructure of the samples we grinded and polished them. We used the mixture: *10 ml HF + 10 ml* HNO_3 *+ 5 ml* H_2O *+ 1 ml* CH_3COOH to develop the microstructure (temperature 20^oC and *20 ÷ 30 sec.* time for developing).

The samples with Ag_2Te content from *90* to *100 mol.%* and *CdTe* content from *95* to *100 mol.%* are monophase. All the other compositions are diphase.

More of the diphase samples are characterized by small size of the phases and to determine the microhardness of the phases we constructed the probability ranges of empirical distribution of microhardness. We calculated $\bar{H}_\mu$ (the average value of microhardness from *200* measurements) for every composition and where it was possible - for every phase (fig. 1). There is a linear dependence of $\bar{H}_\mu$ in the concentration ranges *0-10 mol.-%* and *95-100 mol.-% CdTe*, which indicates the existance of solid solutions based on Ag_2Te and *CdTe* respectively.

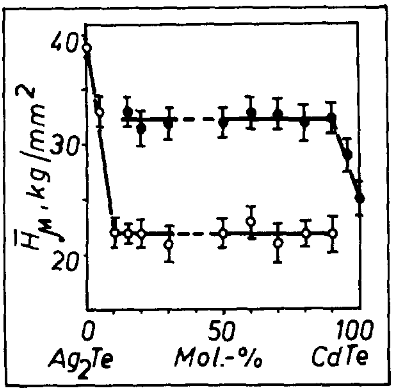

Fig. 1. Microhardness of the samples of the Ag_2Te-*CdTe* system

We constructed the Ag_2Te-*CdTe* phase-diagram using the *X*-ray diffraction analysis, thermal analysis and metallographic analysis data. This phase-diagram is quasi-binary section of the ternary system *Ag-Cd-Te* (fig. 2).

The state diagram is charaterized by *12* phase fields, eutectic reaction at $(900\pm10)^oC$ with eutectic point at *50 mol.-% CdTe* and two eutectic decompositions at $(500\pm10)^oC$ and $(140\pm10)^oC$ with eutectic points at about *80* and *85 mol.-%* respectively.

It is observed that the temperature of phase transition from cubic body-centred lattice (region IV) to cubic close-packing lattice (region III) as well as from cubic close-packing lattice (region VIII) to monoclinic lattice (region IX) decreases with increasing the content of *CdTe* from the side of Ag_2Te. That structu-

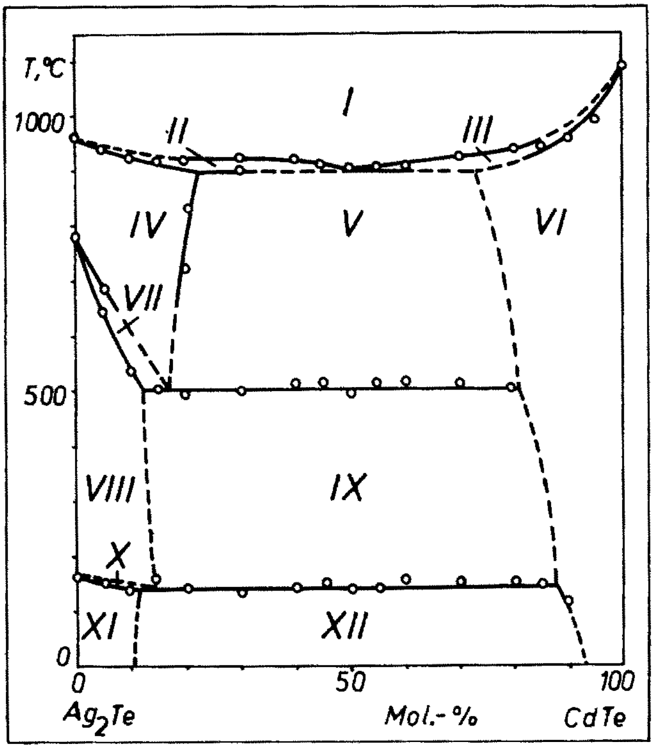

Fig. 2. State-diagram of the Ag_2Te-$CdTe$ system; I - Liquid; II - Liquid + γ-Ag_2Te; III - Liquid + $CdTe$; IV - γ-Ag_2Te; V - γ-Ag_2Te + $CdTe$; VI - $CdTe$; VII - γ-Ag_2Te+β-Ag_2Te; VIII - β-Ag_2Te; IX - β-Ag_2Te+$CdTe$; X - β-Ag_2Te+α-Ag_2Te; XI - Ag_2Te; XII - α-Ag_2Te+$CdTe$

ral difference predetermines the existance of diphase regions VII and X.

Increasing the temperature from 20^oC to 140^oC and from 500^oC to 900^oC the solubility of $CdTe$ in α-Ag_2Te and γ-Ag_2Te respectively increases too. The solubility of $CdTe$ in β-Ag_2Te decreases with increasing the temperature in the whole temperature range of β-phase existing.

The boundaries of regions XI and XII and regions VI, VIII and IX below 200^oC are confirmed by differential thermal analysis, X - ray diffraction and metallographic analysis, by investigating the microstructure and measuring the microhardness. The boundaries of the other phase-fields are established by DTA. The regions I, IV, VI, VIII and IX are monophase and the others are diphase.

Conclusions

The state-diagram of the Ag_2Te-$CdTe$ system resembles the eutectic type; it is characterized by two eutectic decompositions at 500^oC and 140^oC; 12 phase fields are observed, three of which represent restricted solid solutions based on Ag_2Te and one - solid solution based on *CdTe*.

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