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ELECTRICAL PROPERTIES OF THE ALLOYS OF THE SYSTEM Cd-Sb WITH THE COMPOSITION NEAR TO THE INTERMETALLIC COMPOUND CdSb

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The results of the measurement of the resistivity and the Hall coefficient are presented in this work, for the alloys of the system Cd-Sb with the composition near to the intermetallic compound CdSb. The samples are prepared by components with the purity of 99.9998% for Cd and 99.999 for Sb, melted in evacuated silica tubes. In order to get the samples with high homogeneity the alloys were subjected to additional thermal treatment. For the resistance measurements the samples had the cylindrical form with the dimensions 3x0.5 cm and for the Hall-voltage measurement the plates had the dimensions of 2.5x0.4x0.2 cm.

The resistance of the samples was measured with respect to the temperature in the interval from 90 to 700 K by means of the Kelvin bridge. The measurements of the resistance was performed for two directions of the current in order to eliminate thermoelectrical effects. The temperature of the samples was measured by Fe-constantan thermocouple. The measurements in the high temperature range were performed in argon atmosphere. The Hall-voltage measurements were carried out by a compensating method, with the current of 10-20 mA. The result of the Hall-voltage measurement was a linear function of the field strenght.

The results of the resistivity with respect to the temperature, are presented on Figs 1 and 2. The room temperature resistivity from 0.15 to 0.35 ohm.cm decreases exponentially by the increase of the temperature. However, the low temperature measurements have shown the existance of temperature interval /183-240 K/ in which there exists an increase of the resistivity with temperature /samples No 1 and 2, Fig.1/. This is probably due to a surplus of one component with stoichiometry of the compound, which leads to the degeneration of the electron gas, so that in the low temperature interval the metal type conductivity appears. Similar behaviour of the resistivity has been described for germanium and silicium with high impurity concentration /1,2/.

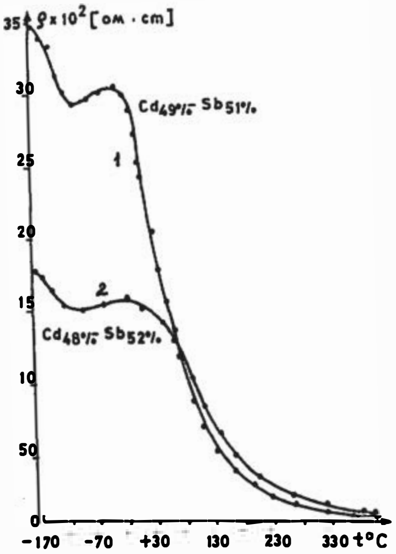

Fig.1

Fig.2

The resistivity of the sample No3 Fig.2, shows the decrease of the resistivity in the whole temperature interval from 90 to 700 K. Such a behaviour of the resistivity is similar to that of the dopped semiconductor. The role of doppants in this case can play a surplus of both components with respect to stoichiometry of the compound.

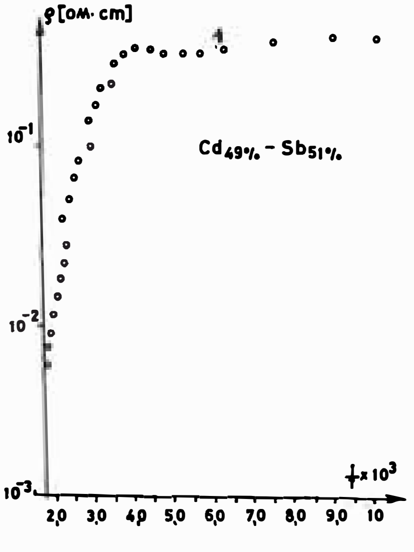

Fig.3

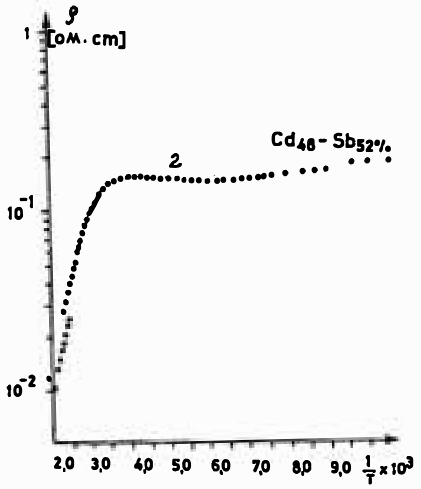

Fig.4

The intrinsic conductivity of the alloys begins from 340 K. For these samples there appears histeresical loop behaviour on the resistivity- temperature curves, if they are warmed over 570 K, which has been previosly reported by some authors /3,4,5/. The logarithmic plot of the resistivity with respect to the reciprocal temperature is presented on Fig.3,4,5 for which the results from Figs 1 and 2 have been used. The results of different samples

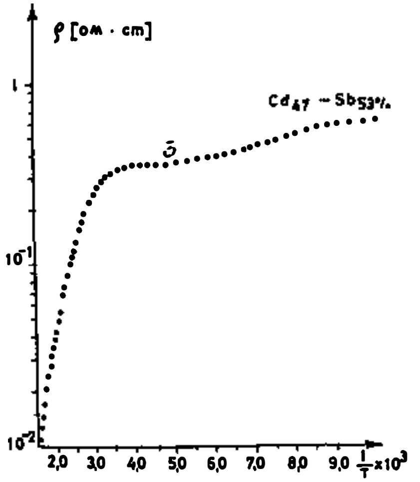

Fig.5

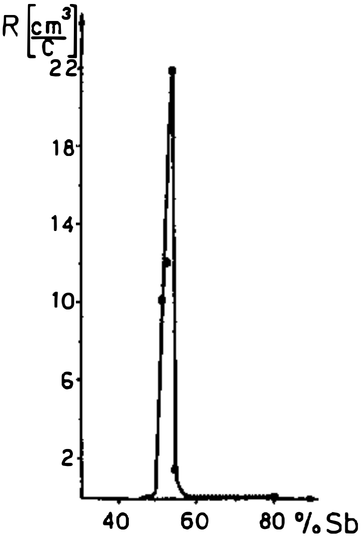

Fig.6

/No 1,2/ Figs 3,4 have the following features in common. Starting from the liquid nitrogen temperature, logρ decreases with 1/T up to a temperature around 200 K. Logρ passing through a minimum and then increases to a maximum value. Thereafter logρ decreases very rapidly along a straight line /intrinsic range/. For sample No 3 presented on Fig.5, logρ does not possess the minimum, but it monotonically decreases in the whole temperature interval. The energy of activation of the value of 0.40-0.47 eV has been found from the plot of logρ with 1/T. In the low temperature range was found the activation energy of 0.029 eV.

From the Hall-vol tage measurement, the Hall coefficient has been evaluated /Fig.6/, which has been positive for all the samples, which shows that the alloys have P-type conductivity. The sign of the Hall-coefficient coudn't be changed by a surplus of any component /Cd or Sb/.

The concentrations and mobilities of the carriers in impurity range, calculated from the resistivity and the Hall-coefficient are given on Table I.

Table I

Sample No	n /cm^{-3}/	μ_H /cm^2/V.s/
1	7.33×10^{17}	35.0
2	6.10×10^{17}	67.0
3	3.35×10^{17}	62.1

The alloys of the system Cd-Sb, very close to the compound CdSb, have a semiconductive character with respect to the resistivity with temperature. The existence of a temperature interval /at low temperatures/ with a positive temperature coefficient of the resistivity can be explained in the same way as in the case for Ge and Si with high impurities concentration /1,2,3/. However, for high concentrations of Sb, when another phase appears/ the phase of Sb in a semiconductive matrix/, this explanation cannot be used. In that case, resistivity of the alloys can be derived by the formula based on the law of mixtures mentioned before /6,7/.

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