The temperature dependence of electrical resistivity of the Cd-Sb system of alloys in concentrational interval of 53% Sb ÷ 100% Sb

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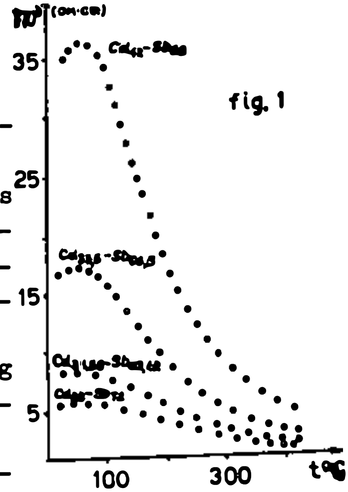
In the presented investigation the variation of the electrical resistivity of the Cd-Sb system of alloys with temperature and composition has been determined by measurements on the spesimens obtained from materials with high purity(Cd -99,9998 and Sb-99,999 percent).The speciments were prepared in evacuated silika tubes.Before the measurement they were annealed at temperature of 180°C ten days.Electrical resistances of speciment were measured by Kelvin bridge method.During the measurement the specimenwas kept in argon atmosphere. The resistivities of the Cd-Sb alloys are shown as a function of temperature in Fig.1. The results for the different specimens of this concentrational interval(53%Sb-100%Sb)have the following features in common.Starting from a room temperature the resistivity increases with the temperature reaching maximum at certain temperature,which depends on the composition.Further increase of the temperature is followed by an exponential decrease of the resistivity (1).Justi and Lautz(2) have observed the same behaviour for alloys in concentrational interval(55,3-55,5%)



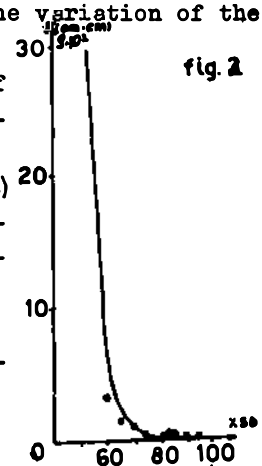
The resistivity ρ of the alloy,which is composed of two phases (3),can be calculated from the resistivity of the components ρ_1 and ρ_2 ,by the relation (1)

$$\rho = \rho_1^{x} \rho_2^{1-x} \qquad (1)$$

where x is part of the component 1 inthe alloy ($0 \le x \le 1$) and $\rho_1 = 300.10^{-3}$om.cm-resistivity of the semiconductor compound CdSb and $\rho_2 = 42.10^{-6}$om.cm-resistivity of pure Sb.

On Fig.2 there are presented calculated values by the relation (1) (solid line),and the measured values are presented by dots.

On the base of relation (1) and the experimental results, we tried to get a relation for the variation of the resistivity with the temperature.



As it is known, the conductivity of semiconductor component-1 with the temperature is given by

$$\sigma = A_1 e^{-\frac{\Delta E}{2kT}} + A_2 e^{-\frac{\Delta E_1}{2kT}} \quad (2)$$

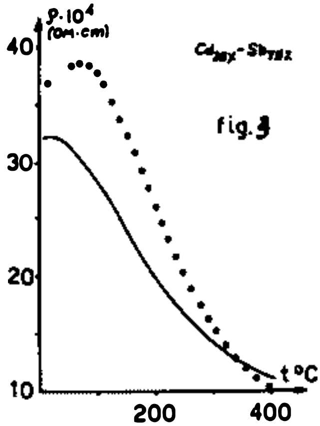
where ΔE and ΔE_1 are activation energies for the intrincic and impurity conduction respectively, and A_1 and A_2 constants, which where experimentaly determined from the diagram $\ln \sigma_I$ v.s. $\frac{1}{T}$.

Resistivity of the component 2 is given by $\rho_2 = \rho_0 [1 + \alpha (T - 273)]$ (3)

By supstitution of (2) and (3) in (1) we get

$$\rho = \left(\frac{1}{A_1 e^{-\frac{\Delta E}{2kT}} + A_2 e^{-\frac{\Delta E_1}{2kT}}} \right)^x \cdot \left\{ \rho_0 [1 + \alpha (T - 273)] \right\}^{1-x} \quad (3)$$

which describes the variation of the resistivity with temperature for any composition of the alloys from 53% Sb to 100% Sb.



On Fig.3 by solid line there are presented calculated value by relation (3) for composition of 25% Cd - 75% Sb, and by dots are present the experimental values, from which it can be seen that the agreament is satisfactory.

REFERENCES:

1. Justi E., Lautz G., Z.Naturforschg, 7a, 191-200, 1952
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3. Livšic B.G., Fizičeskie svojstva metalov i splavov, Mašgiz., Moskva, 1956