THE PRINCIPLES OF CORRESPONDING STATES FOR THE THERMAL CONDUCTIVITY LATTICE COMPONENT OF BRASSES

By D. Włosewicz, K. Bartkowski and J. Rafałowicz

Institute of Low Temperature and Structure Research, Polish Academy of Sciences, Wrocław*

(Received February 5, 1980)

The principle of corresponding states gives common universal dependence for all metals of different purity. This principle is confirmed in lattice thermal conductivity of brasses of different purity. The investigated brass samples presented in reduced lattice thermal conductivity coordinates versus reduced temperature lie about a common curve for samples of different zinc concentration.

PACS numbers: 72.15.Eb

Although the theory of solid state thermal conductivity gives qualitatively good results, there exists a lack of dependences allowing one to predict the thermal conductivity with good accuracy. This is caused by the following reasons:

1. the thermal conductivity equations are formulated on the basis of certain simplified assumptions,
2. these equations include quantities which are difficult to estimate for the given substances,
3. it is very difficult to solve the Boltzmann transport equation for the given substances [1].

The reduced thermal conductivity values λ/λ_{max} of different metals of different purity vs reduced temperatures T/T_{max} lie about the mutual dependences [2]

$$\lambda^* = \frac{1}{\frac{1}{3}T^{*2} + \frac{2}{3T^*}}. \tag{1}$$

* Address: Instytut Niskich Temperatur i Badań Strukturalnych PAN, Próchnika 95, 53-529 Wrocław, Poland.

Eq. (1) is valid for the temperature interval $0 < T < 1.5\,T_{max}$. Eq. (1) does not contain any material characteristics and it explains the fact that data concerning the thermal conductivity of all metals of different purity degree lie along a mutual dependence (1).

The reduced thermal conductivity values of non-metals and semimetals (they dominate the lattice component of thermal conductivity) for the range $0 < T < 1.5\,T_{max}$ vs reduced temperature lie on one common curve independent of the degree of purity of the investigated material.

Because the nature of lattice conductivity is more complicated than the electronic thermal conductivity, it is impossible to obtain the simple reduced universal relation for all substances.

For the CuZn alloys investigated by the present authors the thermal conductivity lattice component in reduced coordinates is presented. Experimental points collect about

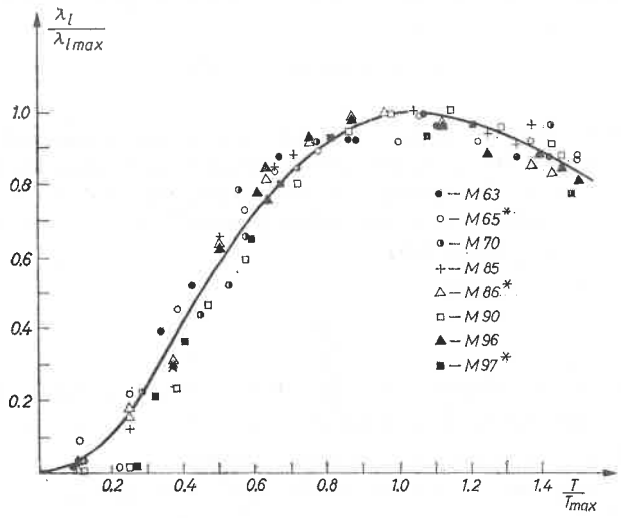

Fig. 1. The reduced lattice thermal conductivity of brass samples vs reduced temperature

some single curve running as in Fig. 1. Essential percentage deviation from this curve may be explained by different percentage participation of different kind of scatterings (different for different samples) in a total thermal resistivity.

REFERENCES

[1] A. Cezairliyan, N. Nalbantyan, *Phys. Status Solidi* (a) **4**, 555 (1971).
[2] A. Cezairliyan, Ph. D. Thesis, School of Mechanical Engineering, Purdue University 1963.