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TEMPERATURE DEPENDENCE ANOMALY OF THE THERMAL CONDUCTIVITY OF BRASSES

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The existence of a point inflexion for temperature dependence curves of thermal conductivity for the investigated brass samples is noted. Heating curve and heat capacity measurements did not confirm the existence of a phase transition.

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Temperature dependence anomalies of thermal conductivity were observed in many cases for the solid state. Though, analysis indicated that these anomalies were caused by phase transitions.

As it was earlier mentioned in [1] for the brass samples M86*, M85, M70, M65* investigated by us; inflexion points on the thermal conductivity temperature dependence $\lambda(T)$ curves in the temperature range 70–120 K were obtained.

In Fig. 1 the dependence $\lambda(T)$ for sample M86* (curve *1*) and $d\lambda/dT$ dependence for the same sample is presented. A detailed analysis of the measurement error and control measurements repeated many times enable the statement that the measurement error limits do not confirm this anomaly. The possibility of appearance of this anomaly in connection with the change arrangement degree of crystal structure of alloy was suggested.

The change of settlement degree of crystal structure has been obtained by authors [2] in Cu_3Zn alloys at the temperatures 233°C and 452°C. The point inflexions on the curve

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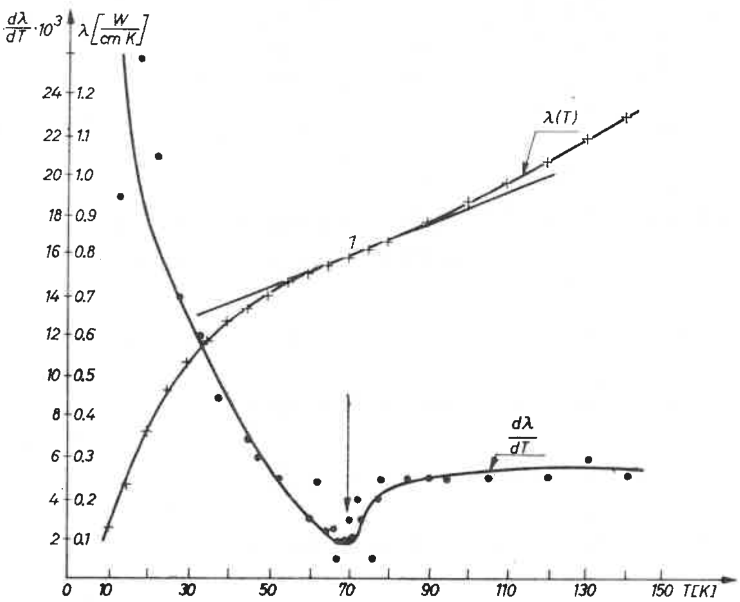

Fig. 1. The plot of the temperature dependence of $\lambda(T)$ thermal conductivity and the derivative $d\lambda/dT$ for brass M86* sample

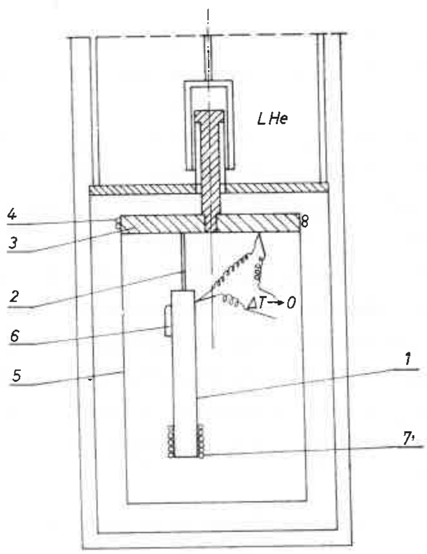

Fig. 2. Scheme of measurement chamber for sample heating curve determination *1* — sample, *2* — steel rod, *3* — cold block, *4* — upper heater, *5* — screen, *6* — thermometer, *7* — lower heater

showing the dependence of thermal conductivity on temperature for the Cu_3Au alloy in the temperature range 70–100 K have been obtained by authors [3]. They did not try to explain the observed effect, however. The appearance of the anomaly of heat capacity of the investigated material proves that there is a change of arrangement degree of crystal structure.

Therefore, for the M86* sample the curve of measurement of sample heating for time dependence was done additionally. A similar experiment has been done by authors [2].

The sample was suspended in a measurement chamber under quasistationary conditions — Fig. 2. The temperature change of the sample was measured by a precise thermo-

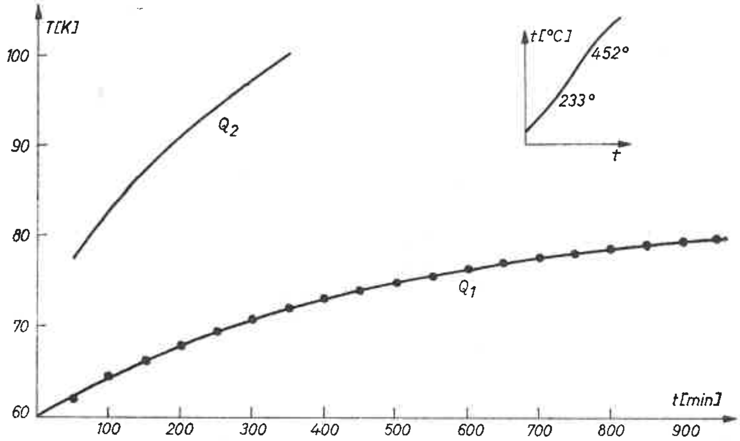

Fig. 3. The heating curves of the brass M86* sample with different powers Q_1 and Q_2 and heating curve for the CuZn alloy according to [2]

meter. The sample was heated by constant electric power which is dissipated through heater (7 in Fig. 2) wound about the sample.

The obtained $T(\tau)$ dependence is presented in Fig. 3. The curve obtained by authors [2] has also been marked on Fig. 3 for comparison reasons. Fig. 3, however, does not confirme the anomaly.

Because of the small sensitivity of the heating method curve with respect to time, heat capacity measurements for the M86* sample were made additionally. The cryostat for thermal conductivity measurements was adopted for heat capacity measurements by the introduction of a heat key shown in Fig. 2. The above mentioned heat key operates by means of the temperature stabilization set; it is thoroughly discussed in [4].

The basic problem was the difficulty of maintaining the temperature difference of the cold block — the sample was investigated down to zero despite the use of temperature stabilization sets. The existence of temperature drift causes the experimental error of heat capacity to be on the level of 2–3%. The lack of heat capacity anomaly of brasses measured in the discussed set was not recognized as sufficient proof of phase transition absence.

For the next heat capacity measurements, the experimental chamber with mechanical heat key was used. During the measurements of heat capacity, the sample practically did not exchange heat with the surroundings along the nylon mechanical suspension.

The component of heat transfer by heat radiation was minimalized by holding the temperature difference between screen and sample below 0.1 K. The temperature drift 10^{-1} K/min made possible the measurement of heat capacity with average difference of sample tem-

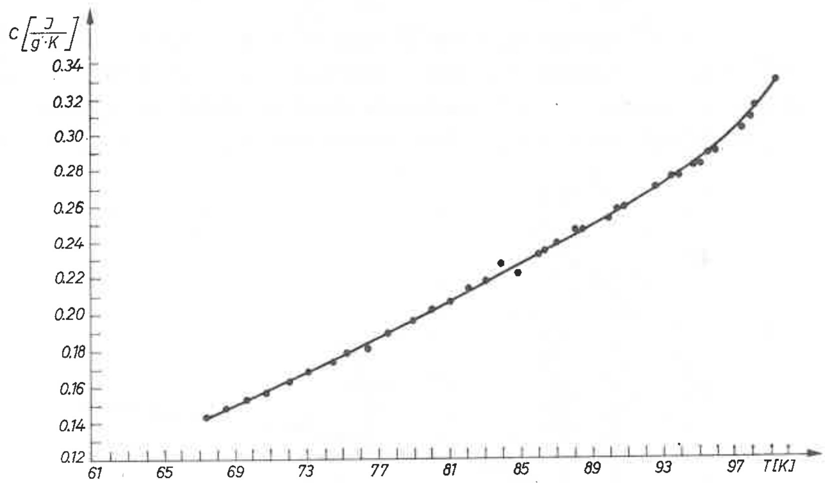

Fig. 4. The graph of heat capacity dependence on temperature for the M86* brass sample

perature $\Delta T = 0.3$–0.5 K. The whole measurement error was not larger than 2–3%. The results of these measurements were recognized as the most reliable. The results of heat capacity measurements are presented in Fig. 4. The monotonic plot of heat capacity dependence on temperature suggests the lack of phase transition in a M86* sample in the temperature range 70–100 K.

The explanation of point inflexion in the $\lambda(T)$ dependence in M86*, M85, M70, M65* brass samples still remains an open problem.

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