SHORT COMMUNICATIONS

THE ELECTRONIC HEAT CAPACITY OF A COPPER–3 PER CENT. ZINC ALLOY*

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Recent measurements on a copper–1 per cent. cadmium alloy (Rayne 1956) have shown that its electronic heat capacity differs considerably from that of pure copper. For the alloy

$$\gamma = 0 \cdot 799 \pm 0 \cdot 005 \times 10^{-3} \text{ J mole}^{-1} \text{ deg}^{-2},$$

while for the pure metal

$$\gamma = 0 \cdot 686 \pm 0 \cdot 005 \times 10^{-3} \text{ J mole}^{-1} \text{ deg}^{-2}.$$

This difference could be due either to a valence electron effect arising from a steep slope in the density-of-states curve for copper or to the severe lattice distortion produced by the cadmium atoms. To distinguish between these possibilities, the low temperature heat capacity of a copper–3 per cent. zinc

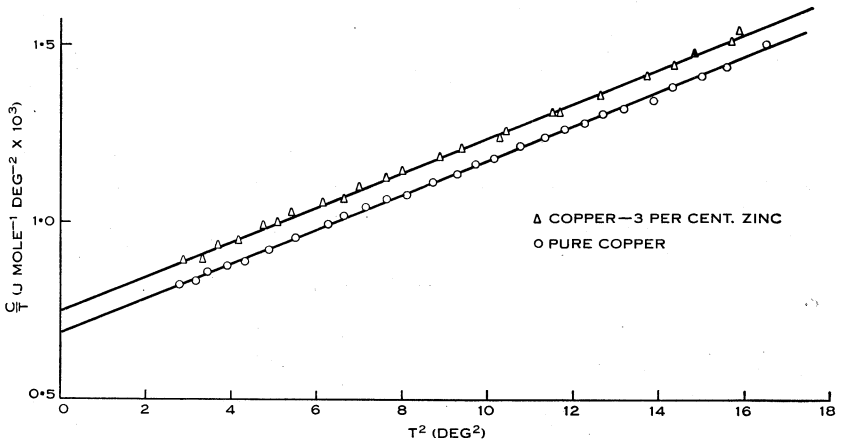

Fig. 1.—Atomic heat of copper-3 per cent. zinc alloy.

alloy was measured. If valence electron effects are predominant, the addition of further divalent atoms would be expected to increase the electronic heat capacity even more.

The results of the measurements, together with those for pure copper, are given in Figure 1 as a plot of C/T versus T^2.

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A least squares fit of a straight line to the experimental points for the alloy gives

$$\gamma = 0 \cdot 750 \pm 0 \cdot 005 \times 10^{-3} \text{ J mole}^{-1} \text{ deg}^{-2},$$
$$\theta = 345 \cdot 1 \pm 1 \text{ °K},$$

the quoted uncertainties including both systematic and random errors.

Clearly the change in γ is considerably smaller than that for the cadmium alloy and hence the large electronic heat capacity of the latter must be connected in some way with the large lattice distortion produced by the cadmium atoms. It is of interest to note, however, that the change in γ for the zinc alloy is considerably larger than that expected from the usual theory of such alloys (Mott and Jones 1936) assuming a valence band of standard parabolic form. Although this discrepancy could be due to a non-spherical Fermi surface in copper, such as postulated by Klemens (1954), no definite conclusion can be reached until the magnitude of the effects arising from lattice distortion in the copper-zinc alloys has been established. Further experiments are being carried out to investigate this point.

References

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