Thermochimica Acta, 94 (1985) 219
Elsevier Science Publishers B.V., Amsterdam – Printed in The Netherlands

INVESTIGATION OF DISORDER IN METALS BY ADIABATIC HIGH TEMPERATURE CALORIMETRY

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ABSTRACT

The enthalpy and degree of lattice disorder (ΔH_f, γ_o) in metals can be obtained by measurement of the molar heat capacity.
In our experiments the molar heat capacities of copper and silver have been determined by an adiabatic high temperature calorimeter over the temperature region between 300 K and the melting points.
The obtained c_p vs T curves show for large parts of the temperature range the usual linear increase. At temperatures close to the melting point, however, the $c_p(T)$ curves rise stronger than linear.
This increase is due to the anharmonicities of the lattice vibrations and the contribution of the free electrons.
The additional increase at higher temperatures is assigned to the formation of the lattice disorder of the Schottky type. Its quantitative behaviour allows the determination of the enthalpy and degree of disorder.
The temperature dependence of the molar heat capacities can approximately represented by

$$c_p(T) = a_1 + a_2T + \frac{a_3}{T^2} \exp\left(-\frac{a_4}{T}\right)$$

The last term is due to the disorder contribution, with

$$a_3 = \frac{\Delta H_f^2}{R}{}_o \quad \text{and} \quad a_4 = \frac{\Delta H_f}{R}$$

The coefficients a_1 to a_4 are calculated by linear regression in the lower temperature region and by a logarithmic one for the curve's non linear part at high temperatures.
With the knowledge of ΔH_f the degree and enthalpy of disorder and the concentration of dislocation can easily be calculated.

0040-6031/85/$03.30