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MELTING CURVE OF TANTALUM UP TO 60 kbars

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We considered it of interest to study the melting curve of one of the most refractory metals, viz. tantalum.

The investigations were carried out on tantalum containing several tenths of a percent of niobium.

The experiments were conducted in the chamber described earlier [1], made entirely of various grades of structural steel and designed for optical investigations. The tantalum testpiece was heated by passing an alternating electrical current through it. Electrical contact was achieved by the pistons used to produce the pressure and these were insulated from the chamber walls. The pressure generator was a hydraulic press.

The pressure calibration of the chamber was done on the basis of the polymorphic transitions in bismuth, thallium, and barium (25.4, 27.0, 36.7, 59.6, and 89.0 kbars) according to the scale of Kennedy and Lamory [2, 3].

Crystalline sodium chloride was used as the chamber window material and as the medium to transmit the pressure.

The melting point was determined in accordance with Planck's law, from a study of the testpiece on the basis of the intensity ratios of two narrow spectral ranges:

$$I_1(\lambda_1)\,/\,I_2(\lambda_2) = f(T).$$

The starting point for the measurements was taken as the melting point of tantalum at atmospheric pressure, viz. 3268 ± 50°K [7].

Correction for the selective absorption of radiation by the vapors of the material being studied surrounding the testpiece during heating was made by comparing the I_1/I_2 and I_2/I_3 ratios obtained experimentally with those of a calculated calibration curve for this temperature. The same correction was applied to the measurements for all other temperatures. To reduce the errors associated with

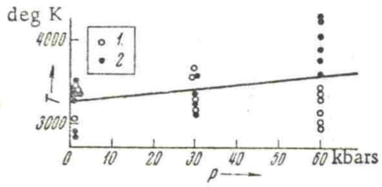

Fig. 1. Melting curve of tantalum: 1) I_1/I_2; 2) I_2/I_3.

variation in selective absorption in the layer of vapors of the material being studied at the different temperatures and pressures, each temperature on the melting curve was determined independently from the ratios of two pairs of intensities $I_1/I_2 = f_1(T)$ and $I_2/I_3 = f_2(T)$.

We have described the measurement procedure in detail in [4-6].

The measurement results are given in Fig. 1, which indicates that the melting point of tantalum rises with the pressure, reaching 3567°K at 60 kbars. The experimental data can be represented by the equation

$$T_m = 3249 + 5.3\cdot10^{-3}P,$$

where T_m is the melting point in °K and P is the pressure in bars.

The probable error of the temperature measurement does not exceed ± 6.0%, while that of the pressure measurement is ± 4.0%.

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