Reports of the Academy of Sciences of the USSR

Corresponding Member of the Academy of Sciences of the USSR V. A. Kirillin, A. E. Sheindlin,

1962

SovietRxiv

Abstract

Full Text

Reports of the Academy of Sciences of the USSR
1962. Vol. 144, No. 2

PHYSICAL CHEMISTRY

Corresponding Member of the Academy of Sciences of the USSR V. A. Kirillin,
A. E. Sheindlin,
V. Ya. Chekhovskoi, and V. A. Petrov

EXPERIMENTAL INVESTIGATION OF THE ENTHALPY OF TUNGSTEN IN THE TEMPERATURE RANGE $2400 \div 2820^{\circ}$C

A comparatively large number of works by various authors have been devoted to the experimental determination of the heat capacity and enthalpy of tungsten. In the field of high temperatures, such studies using the incandescent-filament method have been carried to 2250° ([1]). The maximum temperatures of studies performed recently by the mixing method substantially exceeded the temperature of 1604°, which was record-breaking at the time ([2,3]), and reached values of 2000° ([4]) and 2340° ([5,6]).

In the present work, the enthalpy of tungsten was studied up to considerably higher temperatures—the experiments were carried out in the temperature range from 2408 to 2820°. The mixing method was used in the investigation. The experimental procedure and the apparatus employed are described in ([7]). To attain such high temperatures, a TVV-type furnace with a tungsten heater was substantially reconstructed. Before the furnace was modified, the highest experimental temperature that could be achieved did not exceed 2400°. The specimen on which the enthalpy of tungsten was determined was machined from a rod prepared by powder metallurgy and weighed about 110 g. The amount of impurities in the metal did not exceed 0.05%. The surface of the specimen was polished beforehand and remained polished after the experiments, which were carried out in an argon atmosphere at a pressure of 1.05 ata.

The temperature of the specimen was measured with a standard optical pyrometer OP-48, manufactured and calibrated by the Kharkov State Institute of Measures and Measuring Instruments. For these measurements, a model of an absolutely black body was created in the specimen ([7]). The error of temperature measurement by the pyrometer above 2000° is 0.5%. In experiments carried out at high temperatures, the accumulation of gases and vapors in the upper part of the heater and furnace along the radiation path from the specimen to the pyrometer is dangerous. This may be the cause of an underestimated value of

the measured temperature. Therefore special attention was paid to the blowing, with a weak stream of argon, of the space between the specimen and the prism of total

Table 1

Experimental data for determining the enthalpy of tungsten

No.	t, °C	$i_t - i_0$, kcal/kg	t'_n, °C	$i_t - i_{t'_n}$, kcal/kg	$\bar{c}_p\|_0^t$, kcal/kg · deg
1	2408	93,25	28,76	92,32	0,03872
2	2489	96,92	28,79	95,99	0,03894
3	2561	99,93	28,72	99,00	0,03902
4	2640	104,39	29,38	103,44	0,03954
5	2820	113,72	30,22	112,74	0,04033

Note. t is the temperature of the specimen in the furnace; t'_n is the final temperature of the calorimeter, taking into account the correction for heat exchange; $i_t - i_0$ is the change in the enthalpy of tungsten from 0°C to temperature t; $i_t - i_{t'_n}$ is the change in the enthalpy of tungsten from temperature t'_n to t; $\bar{c}_p\|_0^t$ is the mean heat capacity in the interval 0°C—t. The change in the enthalpy of tungsten from 0° to t'_n was taken from the data of ([8]). The relation between the calorie and the absolute joule is: 1 cal = 4.1840 abs. J.

of internal reflection, through which the pyrometer was aimed at the specimen. In order to verify the correctness of the measurements of the specimen temperature when blowing was used, control experiments were carried out in vacuum to determine the enthalpy of tungsten and other refractory metals at temperatures above 2000° ([6,8]). These control experiments were in good agreement with the results obtained in an argon atmosphere.

Table 1 gives the experimental data obtained in the present work. The maximum calculated random error of the experimental determination of enthalpy at the highest temperatures is estimated at 1.2%.

Analysis of the newly obtained experimental data showed that the empirical equation proposed in ([6]) for the temperature interval 0–2400°

$$i_t - i_{0^\circ C} = 0.03170\,t + 2.75 \cdot 10^{-6} t^2 + 8.1 \cdot 10^{-11} t^3, \text{ kcal/kg} \qquad (1)$$

can be used up to a temperature of 2820°. It is in satisfactory agreement with the newly obtained experimental points. The deviations of these points from the values obtained from equation (1) are, on average, 0.35%, and the largest deviation is observed for experiment No. 3 and is about 0.7%.

Laboratory of High Temperatures
Moscow Power Engineering Institute

Received
30 I 1962

References

1. C. Zwikker, *Zs. Phys.*, **52**, 668 (1928).

2. F. M. Jaeger, E. Rosenbohm, *Proc. Acad. Sci. Amsterdam*, **30**, 457 (1930).

3. F. M. Jaeger, E. Rosenbohm, *Rec. trav. chim.*, **57**, 1 (1932).

4. V. Ya. Chekhovskoi, B. Ya. Shumyatskii, K. A. Yakimovich, *Inzh.-Fiz. Zhurn.*, **5**, No. 9 (1962).

5. V. A. Kirillin, A. E. Sheindlin, V. Ya. Chekhovskoi, *DAN*, **142**, No. 6, 1323 (1962).

6. V. A. Kirillin, A. E. Sheindlin, V. Ya. Chekhovskoi, *Teploenergetika*, No. 2, 63 (1962).

7. V. A. Kirillin, A. E. Sheindlin, V. Ya. Chekhovskoi, *Inzh.-Fiz. Zhurn.*, **4**, No. 2, 3 (1961).

8. V. A. Kirillin, A. E. Sheindlin, V. Ya. Chekhovskoi, *DAN*, **139**, No. 3, 645 (1961).

9. K. K. Kelley, *U.S. Bureau of Mines, Bull.* No. 476 (1949).

Note: Figure translations are in progress. See original paper for figures.