PHYSICAL PROPERTIES OF THE MOST REFRACTORY SUBSTANCES (GRAPHITE AND CARBIDES) IN THE TEMPERATURE RANGE 2000-7000 K

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Experimental studies on the melting of refractory substances (graphite and carbides) at high temperatures, in the solid phase near melting, during melting and in the liquid state (up to 7000 K) are considered. Method of heating- pulsed electric heating for units of microseconds. Specimens - in the form of thin plates (thickness from 1 micron to 200 microns). Pulse currents - from 1 kA to 30 kA, depending on the thickness of the specimens. The heating time is about 5 microseconds. It was measured: input energy, heat capacity, electrical resistance - depending on the measured temperature T. The latter was measured by a high-speed pyrometer based on the high-speed photodetector PDA-10A (Thorlabs).

Calibration of T was used with the help of the temperature lamp up to 2500 K. Above this value the temperature scale was based on the Planck formula with the known normal spectral emissivity of the substance (literature data). A melting model of the blackbody was also used, made of the studied substance in the form of two closed plates with a gap on one side (a wedge-shaped model of the blackbody). The theory and practice of such measurements were published earlier (see books [1, 2]). The report covers the following issues:

1. The use of graphite specimens grade HOPG (Russian analogue UPV-1T) in the form of thin layers of purity 99.99%. Preparation of carbide specimens (ZrC, HfC, TaC) - by magnetron sputtering from a solid phase.

2. Measurement of temperature in a fast heating process (model of a blackbody or selection of normal spectral emissivity). The problem of the graphite melting.

3. Measurement of electrical resistance and heat capacity (including CP and CV).

4. The appearance of non-stationary pairs of Frenkel defects prior to melting.

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1. Graphite melting and the properties of liquid carbon. Fizmatkniga, 2013 or 2014 (2nd edition), 257 pages.
2. Savvatimskiy A.I. Carbon at high temperatures, Springer series in materials science, 2015, V. 134, P. 1-246.