THE APPLICATION OF THE FAST PULSE HEATING METHOD FOR INVESTIGATION OF CARBON-RICH SIDE OF Zr–C PHASE DIAGRAM UNDER HIGH TEMPERATURES

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High-temperature properties of carbon and refractory carbides are of interest for the aero-space industry and nuclear technologies (a matrix of nuclear fuels). It is known that zirconium carbide is used as a protective high-temperature covering, i.e. in the form of rather thin layers.

In present work the microsecond technique of electrical pulse heating which gives uniform energy input into a film specimen is considered. ZrC+C specimens in the form of a thin layer (4.9 microns) sputtered on isolating substrates by magnetron sputtering technique were used. Specimens contained (at. %): Zr – 17.88; C – 67.69; N – 8.13; O – 5.98.

Imparted energy, resistivity (referred to the initial size of a specimen), normal spectral emissivity and specific heat were measured in the temperature range of 2100 – 4500 K. The heating rate was on the order of $10^9$ K/s. To obtain true temperature of the specimen the wedge-shaped blackbody design was used. The obtained results are compared with the equilibrium Zr-C phase diagram.

The solid-liquid phase transition (melting) begins at 3150 K and finishes at 3640 K. Thus the obtained temperature for the start of melting almost coincides (taking into account an uncertainty) with the temperature of the eutectic isotherm for the equilibrium phase diagram. The phase diagram shows that the composition with atomic ratio C/Zr = 3.8 (our case) corresponds to the liquidus $\sim$ 4000 K, and we obtained 3640 K. Possibly this discrepancy may be caused by large amounts of impurities.