ZIRCONIUM CARBIDE PHASE DIAGRAM. EXPERIMENTAL RESEARCH AND MATHEMATICAL MODELING.

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Experimental data on the phase diagram of zirconium carbide ZrCx preceded by the results of numerical simulation of the experiment, are presented. The main problem of modeling was the absence in the literature of comprehensive data on the equation of state in a wide range of temperatures and compositions, including solid and liquid phases. An approximate method to calculate the ZrCx enthalpy is proposed. Calculations of surface thermograms for conditions close to the experimental ones are carried out. In particular it is shown that for any compositions there are no any features on thermograms corresponding to the beginning of melting (solidus). Experimental data were obtained by laser heating, one of the most promising methods for the study of phase diagrams of high-temperature materials. Its effectiveness was demonstrated, in particular, in the study of non-stoichiometric uranium dioxide phase diagram [1]. Samples for the study were made using a one-way static pressing of powders followed by sintering in a vacuum furnace. Zirconium carbide powders of controlled composition were obtained by self-propagating high-temperature synthesis (SHS). The samples were heated by a powerful YAG laser. Different methods for the simultaneous surface state diagnosis during its heating and cooling were used: high speed filming in reflected light, the spectrum of radiation of multichannel spectrophotometers, registration of the nature of the reflection from the surface of radiation of the auxiliary laser. Simultaneous processing of all signals made it possible to reliably detect solidus, liquidus and high-temperature eutectic temperatures in a wide range of compositions, as well as to determine the spectral emissivity of solid and liquid phases. The obtained experimental data are qualitatively fully consistent with the results of calculations.

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1. Manara D., Ronchi C., Sheindlin M., Lewis M., Brykin M. Melting of stoichiometric and hyperstoichiometric uranium dioxide. J. of Nucl. Mat. V. 342 (2005), Issue 1-3, pp. 148-163.