THERMODYNAMIC PROPERTIES OF RE-CONTAINING TBC MATERIALS

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Focusing to the study of thermal and thermodynamic properties of thermal barrier coating (TBC) materials explains by the possibility to advance, sufficiently, the parameters of gas turbine or aero-engine parts. Requirements for such materials (such as high melting point, absence of phase transformations, low thermal conductivity, low ionic conductivity, compatibility with the metallic material of the part (superalloy)) significantly limit the range of substances that can be used as TBC materials.

Heat capacity of different RE-containing substances with the high melting point ($REPO_4$, $RENbO_4$, $RE_2Zr_2O_7$, $RETaO_4$; RE=Sc, Y, Ln), acceptable for TBC, was studied in the temperature range from 2 K to 1300 K. Thermal properties were investigated from 350 to 1800 K using the differential scanning calorimetry (DSC). Different types of calorimetric measurements were used (quasi-adiabatic (relaxation) (from 2 to 100 K), adiabatic (from 6 to 340 K), DSC (from 350 to 1300 K), and drop calorimetry (from 400 to 1500 K)) in this study.

Lanthanide compounds undergo a set of phase transitions due to the electronic structure in f-level. As a rule, these transitions (magnetic, Jahn-Teller, Schottky anomaly) do not cause the change of crystal structure, but affect a shape of heat capacity curve, and, consequently, lead to additional contributions in a heat capacity and in related thermodynamic functions (entropy, enthalpy change and change of Gibbs energy).

Joint application of different calorimetric methods allows to increase the reliability of obtained results, especially for high-temperature region because of the high possibility of systematic errors in DSC and drop-calorimetric measurements.

Different variants of joint fitting of low and high temperature heat capacity data were used to receive the consistent data.

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