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Calorimetric determination of austenitic nitrous steel 04Cr20Ni6Mn11Mo2NVNb enthalpy increment and evaluation of the material specific heat in the solid state

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Abstract

The need for studying of an austenitic nitrous steel 04Cr20Ni6Mn11Mo2NVNb thermal properties has been caused by a deficit of the reference data required for computer simulation of this steel large-scale production processes. Experimental tests were carried out with the help of multidetector high-temperature calorimeter SETARAM MHTC usable both in differential scanning calorimetry (DSC) and drop calorimetry modes depending on a kind of the measuring detector inserted in the instrument. Temperature and sensitivity calibration of the calorimeter in DSC and drop-calorimetry methods was performed by means of standard samples of a metals and synthetic leucosapphire, respectively. All the measurements had been done under dynamic protective atmosphere of argon with the mass flow rate of this gas about 10 ml/min. The studied and calibrating samples were weighed using analytical balance Sartorius CPA225D with an accuracy of 0.01 mg. The material behavior under heating from room temperature up to 1100 °C was studied by DSC method. The obtained thermoanalytical curve of a heat flow is monotonous and contains no peaks or the step-like changes, usually attributed to phase transitions or chemical transformations in a material. It was concluded that the temperature dependence of the steel enthalpy should be smooth function without intermediate discontinuities. The temperature dependent enthalpy increment of the steel was discovered by drop calorimetry within the range up to 1200 °C. Obtained results on the enthalpy were approximated by linear relationship and specific heat equal to 0.53 J/(g·K) was derived from the slope of this function. New data on the steel thermophysical properties are of significance for modelling of large ingots crystallization processes.

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