Determination of Specific Heat Capacity and Enthalpy of the Alloy 53Nb-47Ti (Mass%) in the Temperature Range 1600 K to 2000 K by a Millisecond-Resolution Pulse Heating Technique and its Comparison to a Thermodynamic Model

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The determination of the specific heat capacity and the enthalpy of the alloy 53Nb-47Ti (mass%), in the temperature range 1600 K to 2000 K is described. The method is based on rapid resistive self-heating of a solid cylindrical specimen from room temperature to the maximum temperature of interest by the passage of a subsecond-duration electric current pulse through it and on simultaneously measuring the pertinent experimental quantities with millisecond resolution. The experimental quantities measured are current through the specimen, voltage drop across the effective specimen, the specimen radiance temperature at two wavelengths and the normal spectral emissivity of the specimen. Specific heat capacity was determined by equating the power input to the specimen with the sum of the power absorbed and the power lost by radiation. Enthalpy was determined by integrating the power absorbed with respect to time from a reference temperature, 298.15 K, up to 2000 K. In addition, electrical resistivity in the same temperature range is presented. The results of the specific heat capacity and enthalpy reported here were compared to those generated from a model of the Nb-Ti system. Additional issues associated with the determination of alloy properties, as compared to pure metals, were identified. The experimental results reported here have shown that the millisecond-resolution pulse heating technique can be successfully extended to the study of thermophysical properties of alloys.