THERMODYNAMIC PROPERTIES OF REE STANNATES

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Compounds with the pyrochlore structure are considered potential thermal barrier materials due to their unique characteristics: high melting points, absence of phase transformations over a wide temperature range, and low thermal conductivity. Stannates of rare earth elements (REE) $REE_2Sn_2O_7$ form a complete series of pyrochlores from La to Lu [1]. A distinctive feature of the pyrochlore structure is the presence of oxygen vacancies. These vacancies are believed to play a key role in reducing thermal conductivity, which is crucial for thermal barrier materials [2,3].

The work defines temperature-time regimes for obtaining stannates by various methods and shows that high temperatures are required for the formation of ceramic samples. Porous ceramic samples of $Ln_2Sn_2O_7$ stannates with crystallite sizes of ≈100–400 nm were obtained. All obtained stannates were indexed under the assumption of a cubic syngony with parameters characteristic of compounds of the pyrochlore structural type. The chemical composition of the obtained stannates and the absence of impurities were confirmed using X-ray fluorescence spectroscopy.

Heat capacity measurements were performed in the temperature range of 5-350 K using a BKT-3 adiabatic vacuum calorimeter and at high temperatures (330-1300 K) using a Netzsch STA 449F1 Jupiter® differential scanning calorimetry (DSC). The temperature curves for the heat capacity of the studied stannates show no visible anomalies, indicating the absence of phase transitions in the temperature range under study. Based on smoothed values of the rare-earth stannate heat capacity in the range of 0–1300 K, the temperature dependences of standard thermodynamic functions—entropy $S^0(T)$, enthalpy increment $H^0(T)–H^0(0)$, and reduced Gibbs free energy Φ^0(T)—were calculated.

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