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Thermochemistry and the enthalpy of formation of synthetic end-member ($CaTiSiO_5$) titanite

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Abstract

The enthalpy of drop solution of a quickly quenched, clear, titanite glass sample and several synthetic, polycrystalline, samples was measured in a Calvet-type calorimeter in $2PbO{\cdot}B_2O_3$ solvent at 702 °C. The enthalpy of formation of stoichiometric, end-member ($CaTiSiO_5$) titanite is redetermined to be -119.59 ± 2.24 kJ/mol from the oxides and -2610.13 ± 2.90 kJ/mol from the elements at 25 °C. The new value is either 8.725 or 13.525 kJ/mol more negative than the currently accepted values derived from calorimetry and phase-equilibrium experiments. The presence of impurities and possibly nonstoichiometry in the original sample, used in the previous calorimetric studies, are probably responsible for this discrepancy. This interpretation is further supported by the correlation of the variations in the measured enthalpies of drop solution to the documented physical differences among the synthetic polycrystalline samples used in this study. At 25 °C the enthalpy of formation of $CaTiSiO_5$ glass is -38.775 ± 3.37 kJ/mol from the oxides and -2529.31 ± 3.84 from the elements and the enthalpy of vitrification of titanite is 80.78 ± 3.59 kJ/mol.