

Calorimetry and structural analysis of uranyl sulfates with rare topologies

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ABSTRACT

Uranyl sulfate minerals are the most rapidly expanding group of uranium minerals, with dozens of species described in the past decade from the localities of White Canyon, U.S.A. and Jáchymov, Czech Republic. Synthetic analogs of a suite of uranyl sulfate minerals were crystallized, characterized, and the standard-state enthalpies of formation (ΔH_f°) were determined. Synthetic lussierite is monoclinic, space group *Cc*, $a = 9.2896$, $b = 28.685$, $c = 9.6155$ Å, $\beta = 93.504^\circ$. Synthetic geschieberite is orthorhombic, space group *Pna2₁*, $a = 13.7408$, $b = 7.2713$, $c = 11.5844$ Å. The standard-state enthalpies of formation from the binary oxides for lussierite, péligotite, shumwayite, geschieberite, and bluelizardite are -3214 ± 78 , -2026 ± 33 , -587 ± 22 , -966.1 ± 10.9 , and -2084 ± 21 kJ/mol, respectively, while the standard-state enthalpies of formation of each phase from its elements are -9743 ± 78 , -7220 ± 33 , -5255 ± 22 , -3916 ± 20 , and -7117 ± 21 kJ/mol, respectively. The ΔH_f° of péligotite was accurately estimated using the ΔH_f° of lussierite, bluelizardite, and literature values of the oxide components of each phase. This implies that estimates can be made accurately of the ΔH_f° of uranyl sulfates of minerals without synthetic analogs.

Keywords: High-temperature drop solution calorimetry, uranyl sulfate minerals, hydrogen atom positions