

Raman spectroscopic investigation of ianthinite $[\text{U}_2^{4+}(\text{UO}_2)_4\text{O}_6(\text{OH})_4(\text{H}_2\text{O})_4]\cdot 5\text{H}_2\text{O}$, a rare mixed-valence uranium oxide hydrate

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ABSTRACT

Ianthinite ($[\text{U}_2^{4+}(\text{UO}_2)_4\text{O}_6(\text{OH})_4(\text{H}_2\text{O})_4]\cdot 5\text{H}_2\text{O}$) is an exotic mineral that possesses U in both tetravalent and hexavalent oxidation states and is structurally related to the U_3O_8 polymorphs, which are commonly encountered technogenic materials in the nuclear fuel cycle. Despite the similarities between U_3O_8 and ianthinite, and the importance of ianthinite in U paragenesis, no Raman spectra have been reported for this mineral. To gain a more complete understanding of how structural attributes of ianthinite give rise to observable spectroscopic features and how these may relate to important materials in the nuclear fuel cycle, we provide, for the first time, Raman spectra of ianthinite. Ianthinite readily oxidizes at ambient conditions, complicating analysis of phase-pure material. Several analytical methods are employed herein to decouple the Raman features of ianthinite from its alteration product(s). First, a simple difference spectrum is presented, then results of Raman spectroscopic mapping are employed, and finally, we use a novel processing and analysis method. Each analysis method provides different insight into structural features that are unique to ianthinite, in particular, features that are attributable to U(IV) in distorted octahedral coordination in both ianthinite and U_3O_8 phases.

Keywords: Ianthinite, uranium mineralogy, Raman spectroscopy, U_3O_8