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Synthesis and study of Lithium Triuranate Li2U3O10·6H2O

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In this work, a method of synthesis of lithium triuranate hexahydrate Li2U3O10·6H2O is described. The chemical and functional composition of this compound has been investigated; its crystallographic characteristics have been determined; the state of H2O and its role in the formation of the structure have been studied.
Synthesis of the investigated compound is a reaction of shoepita UO3•2.25H2O with aqueous solution of lithium nitrate under hydrothermal conditions at 200OC. The synthesized lithium triuranate hexahydrate is an easily reproducible individual crystalline compound. The X-ray diffraction picture contains a series of reflections from planes with indices which, in combination with an intense reflection peak at 2θ= 12.04°, indicate a typical layered structure of the triuranate.
For evaluation of its functional composition of Li2U3O10·6H2O, we have performed the IR spectroscopic research. The spectrum contains two groups of vibrations associated with H2O and uranyl group. The vibrations of H2O are very characteristic. The band of δ(H2O) vibrations at 1620 cm−1 is not split. Due to the participation of H2O molecules in the formation of the branched system of H-bonds, the bands of vibrations νs and νas represented in the spectra by a broad and intense band with faint maxima at 3511 and 3414 cm−1 . On the whole, all H2O molecules in the IR spectrum of Li2U3O10·6H2O retain their vibrational identity. The vibrations of the uranyl group are represented in the spectrum by the only band νas at 917 cm−1, which is typical for the seven-fold coordination of uranium(VI) in its uranium–oxygen polyhedron. The absence of the band allows us to consider the uranyl group as having a linear and the equal-shoulder configuration.
To specify the state of H2O in Li2U3O10·6H2O and to estimate its position in the structure, we have performed thermographic study. According to the first effect in the DTA curve at 162°C, the elimination of four H2O molecules per Li2U3O10•6H2O formula unit proceeds in a single stage. The elimination of the two additional H2O molecules also proceeds in a single stage, but at a higher temperature 393°C. The dehydration process is completed at 393°C by the total destruction of the crystal structure and the transition into the amorphous state. The crystallization of Li2U3O10 over wide time and temperature ranges occurs above 393°C.

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