

Cs-exchange in cuprosklodowskite

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In connection with the problem of safe radioactive waste disposal, studies of uranium minerals have recently a particular attention, mostly associated with their ability to incorporate both short- and long-lived radionuclides. The capacity of uranium minerals to absorb Cs and Sr is testified by ion-exchange experiments done on natural samples [1, 2].

The purpose of this work is to study Cs-exchanged form of cuprosklodowskite [3-5] obtained as a result of ion-exchange at 170°C in 2M solution of CsCl. Cuprosklodowskite is a layered uranyl silicate, first described from Shinkolobve deposit. Its structure is based upon uranyl silicate sheets with uranophane topology with Cu^{2+} cations and H_2O molecules in the interlayer [6].

Single crystal study was carried out on diffractometer STOE IPDS II ($\text{MoK}\alpha$), equipped with Image Plate area detector. Natural cuprosklodowskite has triclinic symmetry, $P-1$, $a = 6.654(1)$, $b = 7.048(1)$, $c = 9.255(2)$ Å, $\alpha = 109.9(1)$, $\beta = 109.1(1)$, $\gamma = 89.88(1)^\circ$. Cs-exchanged cuprosklodowskite is also triclinic, space group $P-1$, $a = 6.606(1)$, $b = 6.987(1)$, $c = 22.690(5)$ Å, $\alpha = 81.4(2)$, $\beta = 84.2(2)$, $\gamma = 89.86(1)^\circ$. Structural model of Cs-exchanged cuprosklodowskite indicates that Cs is incorporated into the interlayer space of structure partially replacing and displacing water molecules and Cu^{2+} ions. This also results in distortion of uranyl silicate sheets and formation of double layers with Cs^+ occupying interlayer between adjacent layers. According to chemical analysis, crystal chemical formula of Cs-exchanged cuprosklodowskite should be written as $\text{Cu}_{0.32}\text{Cs}_{1.48}[(\text{UO}_2)((\text{Si}_{0.93}\text{O}_{2.62}(\text{OH})_{1.38}))]_2 \cdot n\text{H}_2\text{O}$.

These data demonstrate the ability of cuprosklodowskite to accumulate radiogenic Cs in various natural and technological processes.

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