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# Sonochemical transformation of uranium dioxide ( $\text{UO}_2$ ) into uranium peroxide ( $[(\text{UO}_2(\text{O}_2)(\text{H}_2\text{O})_2) \bullet x\text{H}_2\text{O}]$ ): Unveiling intriguing morphologies

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# Sonochemical transformation of uranium dioxide (UO<sub>2</sub>) into uranium peroxide ((UO<sub>2</sub>(O<sub>2</sub>)(H<sub>2</sub>O)<sub>2</sub>)·xH<sub>2</sub>O) : Unveiling intriguing morphologies

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Chemical toxicity and radioactivity of spent nuclear fuel raise concerns regarding the prediction of radionuclide behavior in the geosphere and deep underground storage and its interaction with water. Hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>), a key product of water radiolysis, may contribute to the corrosion of UO<sub>2</sub>-based matrices, forming uranium peroxide precipitates such as studtite and metastudtite. These species can facilitate the dissolution of radionuclides and their release into the environment.[1-3]

Sonochemistry, using ultrasound to influence chemical reactions, shares similarities with radiolysis by generating *in-situ* hydrogen peroxide.[4] However, the literature about sonochemistry of actinides remains limited. Sonolysis of UO<sub>2</sub> powder (20 to 1047 kHz) in pure water or slightly acidic solutions saturated with an oxygenated atmosphere revealed the formation of (meta)studtite [(UO<sub>2</sub>(O<sub>2</sub>)(H<sub>2</sub>O)<sub>2</sub>)·xH<sub>2</sub>O].[5] Analyses of the solution aliquots (UV-Vis absorption spectroscopy, ICP-OES) and solid residues (SEM, XRD, FTIR) attributed this behavior to H<sub>2</sub>O<sub>2</sub> generated by sonochemistry. The complete conversion of UO<sub>2</sub> into (meta)studtite occurred while preserving the initial morphology (Figure 1.b). Surprisingly, specific sonochemical conditions led to the reproducible formation of cavities at the center of the platelets (Figure 1.c).

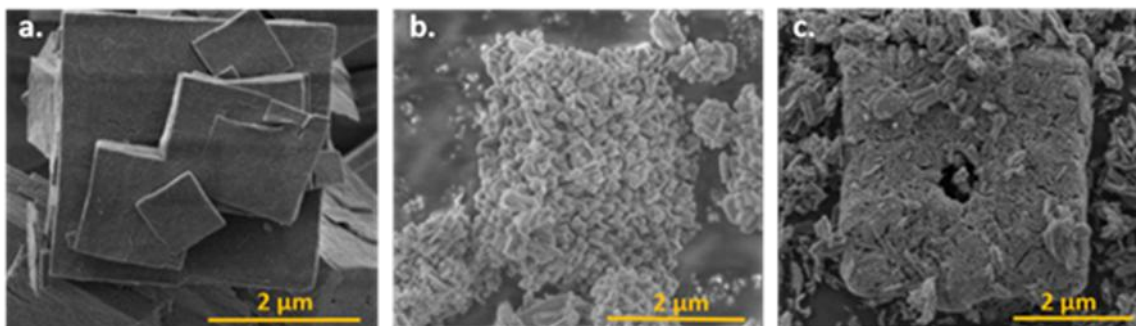


Figure 1: a) SEM picture of UO<sub>2</sub> platelets synthesized by the oxalate route. b) and c) SEM images of uranyl peroxydes after UO<sub>2</sub> sonolysis in 5.10<sup>-4</sup> M H<sub>2</sub>SO<sub>4</sub> at 346 kHz (20 W.mL<sup>-1</sup>, 20°C, Ar/O<sub>2</sub>, 6h)

## Keywords (max. 3)

Morphology, Ultrasound, peroxide

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