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Uranyl peroxide pseudomorphs formed under ultrasound-irradiation of UO₂ powder in aqueous solution

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Research about the oxidative dissolution of nuclear fuels under storage as a result of the generation of highly reactive species from radiolysis (H₂O₂, HO[•], HO₂[•] etc.) has been a subject of considerable interest in recent years. Hydrogen peroxide (H₂O₂) can particularly contribute in the corrosion of UO₂-based matrices and promote the dissolution and release of radionuclides in the surroundings through the formation of uranyl peroxide precipitates.^[1,2] In this work we propose an original approach to investigate the behaviour of UO₂ materials in the presence of H₂O₂. With some analogies with radiolysis, sonochemistry allows the generation of radicals and hydrogen peroxide in aqueous solution under mild conditions. Well-known additional physical effects occurring during sonochemical treatment of solids (erosion, mass transfer, fragmentation...)^[3] may contribute in the observation of interesting additional effects on actinide-based materials.

After the preparation and thorough characterization of UO₂ platelets by the oxalic route (Fig. 1.a), their partial or complete conversion into (meta-)studtite [(UO₂(O₂)(H₂O)₂)-xH₂O] was observed in pure water and dilute acidic media sonicated under oxygenated atmosphere.^[4] Investigations on solid residues revealed the formation of (meta-)studtite structures on the surface of the UO₂ platelets with a preservation of the initial morphology (Fig. 1.b) suggesting a complex formation mechanism. Interestingly, platelets were further provided with a central void (Fig. 1.c) which will be also discussed during the presentation.

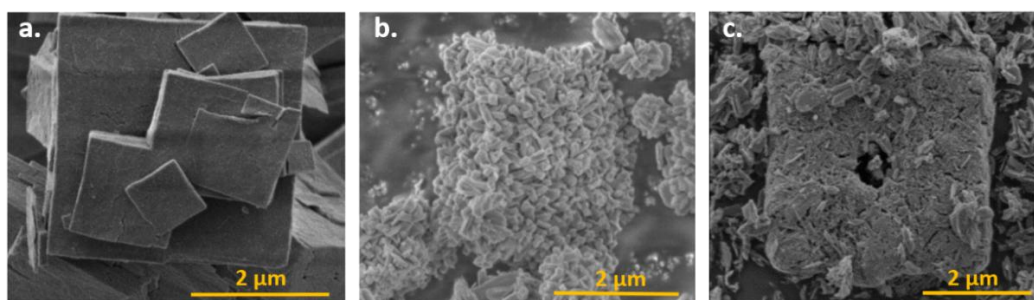


Figure 1: SEM image of a) UO₂ platelets synthesized from the oxalate route; b-c) uranyl peroxides observed after sonication of UO₂ in H₂SO₄ 5.10⁻⁴ M at 346 kHz (20 W.mL⁻¹, 20°C, Ar/O₂, 6 h)

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