



HAL
open science

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

Julien Margate, Matthieu Viot, Manon Cot-Auriol, Thomas Dumas, Sergey I. Nikitenko

► To cite this version:

Julien Margate, Matthieu Viot, Manon Cot-Auriol, Thomas Dumas, Sergey I. Nikitenko. Uranyl peroxide pseudomorphs formed under ultrasound-irradiation of UO₂ powder in aqueous solution. Actinides 2023, Jun 2023, Golden, United States. <hal-04766160>

HAL Id: hal-04766160

<https://hal.science/hal-04766160v1>

Submitted on 4 Nov 2024

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire HAL, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



HAL Authorization

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

*J. Margate** [1], *M. Virot* [1], *M. Cot-Auriol* [1], *T. Dumas* [2], *S. I. Nikitenko* [1]

[1] ICSM, Univ Montpellier, CEA, CNRS, ENSCM, Marcoule, France.

[2] CEA, DES, ISEC, DMRC, Univ Montpellier, Marcoule, France

julien.margate@cea.fr

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.

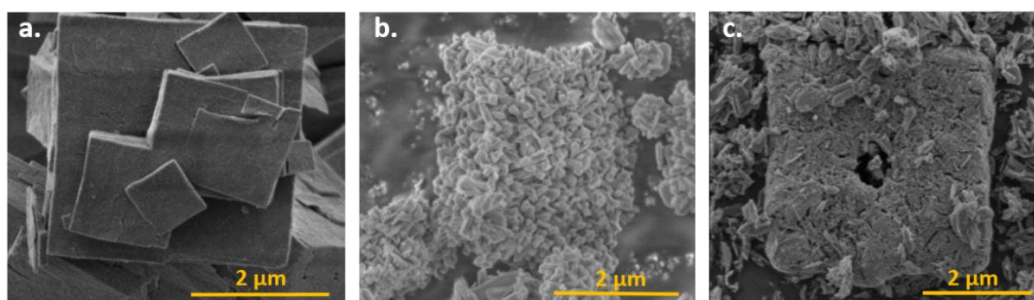


Figure 1: SEM image of a) UO₂ platelets synthesized from the oxalate route; b-c) uranyl peroxides observed after sonication of UO₂ in H₂SO₄ 5.10⁻⁴ M at 346 kHz (20 W.mL⁻¹, 20°C, Ar/O₂, 6 h)

[1] M. Amme, *Radiochimica Acta*, 2002, 90, 399-406.

[2] P.C. Burns, R.C. Ewing, A. Navrotsky, *Science*, 2012, 335, 1184–1188

[3] R. Pflieger, T. Chave, G. Vite, L. Jouve, S.I. Nikitenko, *Ultrasonics Sonochemistry*, 2015, 26, 169-175.

[4] Peter C. Burns and Karrie-Ann Hughes, *American Mineralogist*, 2003, 88(7):1165-1168

