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Sonochemical conversion of UO_3 into U(VI) intrinsic colloids in near-neutral conditions

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Under oxidizing conditions, the corrosion of the spent nuclear fuel may result in the leaching of water soluble uranyl(VI)-based species.[1-3] The speciation of the generated forms is complex and the potential formation of intrinsic colloids from U(VI) hydroxo complexes appears particularly poorly reported in literature. Such a phenomenon could however significantly contribute in the migration of radionuclides in the environment.[4-6] Therefore, a better knowledge in the speciation and reactivity of these species seems particularly relevant. This presentation describes the characterization of uranium(VI) intrinsic colloids obtained by sonolysis of amorphous and crystalline UO_3 in near-neutral conditions. Using carbon monoxide to inhibit the formation of hydrogen peroxide, the application of ultrasound results in the complete conversion of UO_3 powder into (meta-)schoepite precipitates and the observation of very stable uranium(VI) nanoparticles in the liquid phase. A thorough investigation of these colloids with HR-TEM, SAXS and XAS techniques confirmed the formation of quasi-spherical nanoparticles measuring ca. 3.8 ± 0.3 nm in diameter and exhibiting a schoepite-like crystalline structure (Figure 1). The possible formation of environmentally relevant U(VI) colloidal suspensions using sonochemistry appears significantly interesting for the preparation of reference systems without added ions and capping agents.

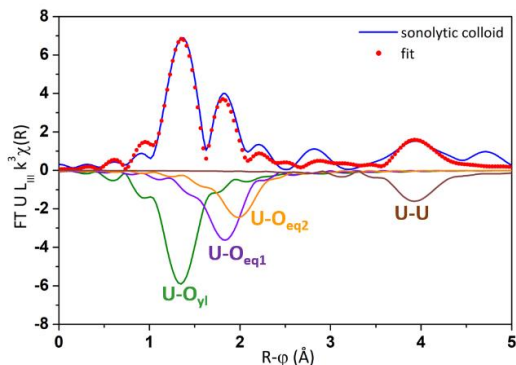


Figure 1: Fourier transforms of the k^3 -weighted range spectra of U(VI) colloids and corresponding fit. The four main wave components of the fit are plotted with negative amplitude.

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