Ph.D. defense

Institut de Chimie Séparative de Marcoule / CEA Marcoule
(UMR 5257, CEA, CNRS, Université Montpellier, ENSCM)

ÉLODIE DALODIÈRE

will present her Ph.D. dissertation

Sonochemistry of plutonium: synthesis and speciation in solution and at the colloidal state

The defense will take place on **Friday, November 24, 2017** at **2.00 pm**
in the ICSM Auditorium

Plutonium is a radioactive chemical element produced in nuclear power plants by uranium oxide fission reactions. This element has been found in the environment due to, for example, nuclear weapon testing, nuclear submarines and radioactive accidents. Pu has been dispersed under particle forms with various chemical compositions and morphologies and can potentially migrate under colloidal forms. The knowledge of the structure and reactivity of this species is of paramount importance to understand and predict their eventual migration into the environment. In this context, sonochemistry is considered as an innovative approach for the preparation of pattern Pu colloid suspensions. First, sonochemical kinetic formations of H_2O_2 in pure water and nitric media have been studied in prevision of experimentations with Pu. Pu(VI) behavior in sonicated aqueous solution has then been investigated for the preparation of relatively pure and stable Pu(V) solutions which have been rigorously characterized (XAFS, NMR, DFT, UV-vis, etc.). Besides, sonication of Pu(III) aqueous solutions lead to the formation of a hydrosoluble polynuclear complex of Pu(IV) never reported in the literature. Studies carried out in heterogeneous solid/liquid systems allowed to develop a synthesis method for the preparation of Pu intrinsic colloids. Colloids resulting from PuO_2 sonolysis in pure water have been compared to hydrolytic and autoradiolytic colloids thanks to several characterization techniques (HR-TEM, XAFS, STXM, NEXAFS, etc.). The proposed formation mechanisms involves the dispersion and reduction of oxide particle sizes followed by redox reactions leading to accumulation of Pu colloids. Colloids can be described as quasi-spherical, monodisperse and nanometric particles (7 nm under ultrasound against 3 nm for hydrolysis) with a core/shell structure composed of a crystalline PuO_2 core covered by a hydrolyzed Pu(IV) surface.

Keywords: Plutonium; Sonochemistry; Colloids; Ultrasound; Redox