Ph.D. defense

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

MANON COT-AURIOL

will present her Ph.D. dissertation

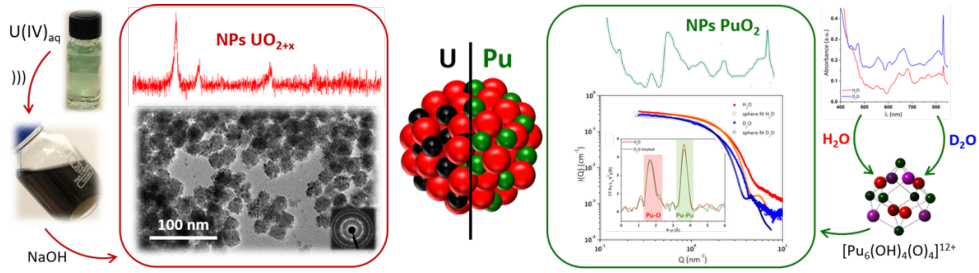
Synthesis and characterization of colloidal actinide nanoparticles (U, Pu) and study of their formation mechanisms

The defense will take place on **Thursday, March 2nd, 2023** at **9:30 AM**

in the ICSM Auditorium

The chemistry of actinides (An) is extremely rich and complex, and generally well-referenced in the literature. However, there is only a little data on actinide colloids, particularly those resulting from the hydrolysis properties of An cations (intrinsic colloids) and related formation mechanisms. The physico-chemical properties of these species in relation to their structure (size, morphology, local structure, etc.) are of fundamental interest, as well as the technological purpose for the preparation of advanced nuclear fuel. Particular attention is also given to the observation of colloidal An nanoparticles in the environment and their potential role in the migration of radioactivity.

This work aims to improve the knowledge of intrinsic uranium and plutonium colloids, in particular by providing a better understanding of their formation mechanisms and structural properties. A better fundamental knowledge about these species could contribute to a better prediction of their behaviour in environmental or industrial conditions but also to a possible control of their formation in the context of potential industrial applications. In the first step, the formation mechanisms of intrinsic Pu(IV) colloids were studied, by carrying out kinetic studies in different media (H_2O, D_2O, or electrolytes). A kinetic isotopic effect was observed and attributed to the difference in zero-point energy of the OH and OD bonds. This work allowed us to observe, for the first time, the participation of a reaction intermediate (oxo-hydroxo cluster of Pu(IV)) in the formation mechanism of intrinsic Pu(IV) colloids. On the other hand, colloidal nanoparticles of uranium (IV) and uranium (VI) were prepared under ultrasound irradiation. This work showed that sonochemistry offers an alternative to existing preparation methods. The uranium and plutonium colloidal species were characterised using state-of-the-art techniques (synchrotron and laboratory techniques including SAXS, XAS, TEM, etc.) in order to propose a formation mechanism and provide new insights about their structures and morphologies.



Keywords: Colloid; Plutonium, Uranium, Sonochemistry