UCF | Department of Chemistry
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Lawrence Livermore National Laboratory

Department of Chemistry Invited Lecture Series

Friday, February 10th 2023
3.30 - 5pm
HPA1-0119, (Health Sciences)

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Lawrence Livermore National Laboratory

Host: Prof. Vasileios Anagnostopoulos

Taggants: An Intentional Forensics Approach to Nuclear Material Provenance Assessment

Intentional Forensics is the deliberate introduction of benign and persistent material signatures into nuclear fuel fabrication and processing. Its purpose is to reduce the lag time between the recovery of a material outside of regulatory control and the identification of its original provenance. The most promising candidates include multi-isotopic taggants with perturbed isotopic distribution that could be easily incorporated into the bulk or on the surface of metallic or ceramic nuclear fuels. Recent work on taggants for nuclear fuels has explored many aspects of the challenges associated with tagging fuels. This work has helped to constrain the potential range of taggant materials, and has helped to identify promising taggant compositions for metallic and oxide fuels.

Research targets have included novel approaches for incorporating taggants into oxide fuels, baseline compositions of selected stable transition metal isotope systems in enriched uranium oxide fuels, approaches to tagging fuel and cladding surfaces, and even the stability of light stable isotope signatures in oxide fuels. Work on tagged metallic fuel synthesis has examined transition metal segregation during casing, and isotopic fractionation induced by the melting and casting of tagged metallic fuels. Several perturbed isotopic transition metal taggants have emerged as promising candidates, and are being progressed for in-reactor testing.

This presentation will give an overview of the challenges in developing a taggant selection scheme that integrates probative value, manufacturability, reactor safety, and persistence in the fuel cycle. Our work has demonstrated that several taggant candidates have significant potential to facilitate provenance assessment and to provide robust, scalable and probative intentional nuclear forensics signatures.