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Actinide and Lanthanide Interactions with Engineered Mesoporous Materials

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Ordered mesoporous materials are attractive sorbents due to their extremely high surface areas, large pore volumes, open frameworks, and highly-ordered, tunable structures. Ultimately, they could be used for separating actinide and lanthanide ions from assorted solution matrices, as well as from each other. Furthermore, functionalized mesoporous materials may be useful for a variety of nuclear and non-nuclear applications including the sequestration of radionuclides for proper long-term storage, environmental sequestration of heavy metals, and nuclear waste reprocessing. Processing of nuclear waste via liquid-liquid solvent extraction produces large amount of high-level liquid wastes that in turn hamper their permanent disposal. Replacing the organic radionuclide extractant solutions with functionalized mesoporous materials, that have the extraction ligands chemically bound to the mesoporous surface, will result in a significant volume reduction and reusability of the material. We are synthesizing non-functionalized and functionalized mesoporous silica and carbon materials to study their interaction with aqueous solutions of europium, neptunium, and plutonium over a wide pH range. This presentation will give an overview of the current status of this research field. I will discuss the characterization and effectiveness of the functionalization of mesoporous silica and carbon by a variety of analytical techniques (FTIR-ATR; PZC; SEM; 13C ssNMR and 29Si ssNMR; TEM; XRD; XAS), the uptake of radionuclides as a function of pH, and the kinetics and reversibility of these processes.

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Primary author: Prof. NITSCHE, Heino (UC Berkeley and Lawrence Berkeley National Laboratory)

Co-authors: Dr BRUCHET, Anthony (University of California, Berkeley); Ms MAY, Erin (University of California, Berkeley); Ms URIBE, Eva (University of California, Berkeley); Ms SHUSTERMAN, Jennifer (University of California, Berkeley); Mr JONES, Stephen (University of California, Berkeley); Ms PARSONS-MOSS, Tashi (University of California, Berkeley)

Presenter: Prof. NITSCHE, Heino (UC Berkeley and Lawrence Berkeley National Laboratory)

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