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NEBRASKA CENTER FOR MATERIALS AND NANOSCIENCE
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Novel magnetic separation nanotechnology for nuclear fuel recycling

There is a significant achievement recently on spent nuclear fuel separation and environmental remediation by utilizing conjugates of magnetic nanoparticle-chelator (MNP-Ch). Based on the literature review of recent progress, we have chosen the environmentally benign oxa-diamide chelator, which has the potential to make the separation process more efficient than the traditional PUREX processes using organophosphorus ligands such as tributylphosphate (TBP). The key issues for scaling up this nanotechnology is obtaining high magnetization of superparamagnetic MNPs, the stability of the coated MNPs under harsh process conditions (highly acidic) and MNP monodispersion in acidic solution to maintain the large surface area and high chelator loading density on MNPs for an efficient sorption.

To address these issues, a sol-gel reaction with tetraethoxysilane (TEOS) as a precursor, was used to coat the MNPs with silica coating layer to prevent the iron leaching from MNPs in highly acidic conditions. The silica coating increased the number of reactive surface hydroxyl groups for the introduction of amine groups by silanization with 3-aminopropyltriethoxysilane (APTES) so that ligand loading density increased largely by conjugation of the oxa-diamide chelator with surface amine groups. Morphology and magnetic properties of the conjugated complex were characterized by LSD, SEM, TEM, SQUID and VSM. Comparing with the control samples of uncoated MNPs, the conjugates of MNP-Ch indicated an strong selective sorption efficiency for Am(III), and Pu (IV) from spent nuclear fuel.

Dr. You Qiang is an Adjunct Professor in the Environmental Science Program and Associate Professor of Physics at the University of Idaho. He received a Ph.D. degree in 1997 at the University of Freiburg, Germany. He was a postdoc and research faculty at the University of Nebraska from 1999 to 2002. Dr. Qiang's research focuses on magnetism and magnetic nanomaterials. His expertise includes: synthesis of monodisperse nanoclusters and nanocluster-assembled composites; characterization of magnetic and optical properties as well as transports of the nanomaterials by conductivity, optic and susceptibility measurements, and theoretical investigation of magnetic nanoparticle interactions. He applied magnetic nanoparticles in energy, environmental and biomedical science and nanotechnology.

Host:
Dr. David Sellmyer
Department of Physics & Astronomy

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Friday, April 8, 2011
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