Electrodeposition of Palladium from Extracted Nuclear Waste

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There are more than 57,000 tons of spent fuel being stored at U.S. nuclear power plants today[1]. The spent fuel contains a mixture of radioactive fuel, and radioactive and nonradioactive fission products. Nuclear fuel reprocessing, as an essential part of nuclear fuel cycle, is of great significance from the point of view of both nuclear safety and sustainable development of nuclear energy. A goal for long-term handling is to separate fission products by half-life, recycle the unreacted fuel back to the reactor, and then sequester the much smaller volume, long half-life products in solid form. In the Green Chemistry and Energy Laboratory at the City College of New York, we are assessing the utility of ionic liquids (ILs) in the electrodeposition of palladium, a non-radioactive noble metal part of spent fuel fission products. ILs are salts with melting points below 100°C, can be used as non-flammable, minimally volatile, selective extractants for the separation of fission products from the aqueous system resulting from the acid digestion of spent fuel rods[2] and also act as both the electrolyte and the solvent in elecrodeposition. Ionic liquids [Bmim][NTf_2], [Bmim][DCA] and [Bmpyrr][DCA] will be investigated in the poster. The presentation will focus on how the IL selection and electrochemical conditions impact the electrodeposition efficiency of palladium. The effect of cation and ion, metal substrate and electrochemical conditions on the experiments will be examined. The criteria used for analyzing the electrochemical windows and redox behavior of palladium salts in ILs will be evaluated. The experiments with palladium are imperative because palladium has the highest concentration of noble metals in fission products and has non-radioactive isotopes available that can be used as replica. The work with palladium is also crucial to the overall separation of the product nuclear waste stream because it can be further used to model the recovery of other fission products in ILs.

[1] Fact sheet on licensing Yucca Mountain, U.S. NRC, 2012, http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/fs-yucca-license-review.html. Date accessed 11/26/12

[2] J. F. Wishart, *Energy & Environmental Science*, 2, 956 (2009)