NUCLEAR ENERGY UNIVERSITY PROGRAMS

SiC Schottky Diode Detectors for Measurement of Actinide Concentrations from Alpha Activities in Molten Salt Electrolyte

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Abstract

Researchers will investigate the use of silicon-carbide (SiC) Schottky diode detectors for measuring actinide concentrations in the process stream for pyrochemical processing of spent nuclear reactor fuel. Research areas include device fabrication, testing, and a modeling-assisted study to unambiguously link damage to detector performance and model reliability and lifetime. The project includes an experimental and computational study of post-irradiation microstructural evolution, as well as *ab initio*-based modeling of the detailed dependence of the electrical properties and detector signal on the damage.

Researchers will test available SiC Schottky diode detectors and fabricate improved detectors. SiC is radiation hard and chemically inert, so with the appropriate electrical contacts, these detectors may be able to tolerate the harsh reprocessing environment and could be used to monitor alpha emitter inventories in such streams. The project's main design challenge is to develop appropriate Ohmic and Schottky contacts. The latter is especially challenging, since it must be thin enough to allow the alpha particles to pass through with little energy loss. The project team will test each device's ability to detect alpha particle at ambient and high-temperature conditions, and will use multi-scale techniques to characterize radiation damage in the SiC and contact materials. In order to predict long-term detector stability, the team will conduct rigorously validated multi-scale modeling that starts with damage creation under irradiation, examines the damage annealing at the elevated processing temperatures, and finally links the created damage (from the atomic level up) to changes in the electrical properties in SiC and the contacts.