Title: XAFS studies of fission products and fuel components in the SiC layer of irradiated TRISO fuel.

Jeff Terry, Department of Physics, Illinois Institute of Technology, Chicago IL 60616
terryj@iit.edu

The structure and speciation of fission products within the SiC barrier layer of tristructural-isotropic (TRISO) fuel particles irradiated to 19.6% fissions per initial metal atom (FIMA) burnup in the Advanced Test Reactor (ATR) at Idaho National Laboratory (INL) was measured with extended x-ray absorption fine structure spectroscopy (EXAFS). As-irradiated fuel particles, as well as those subjected to simulated accident scenarios, were examined. The TRISO particles were characterized using synchrotron X-ray absorption fine-structure spectroscopy (XAFS) at the Materials Research Collaborative Access Team (MRCAT) beamline at the Advanced Photon Source. The TRISO particles were produced at Oak Ridge National Laboratory under the Advanced Gas Reactor Fuel Development and Qualification Program and sent to the ATR for irradiation. XAFS data was collected on K-edges from palladium and silver. L-edge XAFS was collected from uranium and plutonium. All XAFS data was collected using the MRCAT undulator beamline. Analysis of the Pd edge indicated the formation of palladium silicides of the form Pd_xSi ($2 \leq x \leq 3$). In contrast, Ag was found to be metallic within the SiC shell safety tested to 1700 °C. To the best of our knowledge, this is the first result demonstrating metallic bonding of silver from fissioned samples. Pu formed a mix of silicides and carbides as did the uranium. Knowledge of these reaction pathways will allow for better simulations of radionuclide transport in the various coating layers of TRISO fuels for next generation nuclear reactors. They may also suggest different ways to modify TRISO particles to improve their fuel performance and to mitigate potential fission product release under both normal operation and accident conditions.

MRCAT operations are supported by the Depart- ment of Energy (DOE) and the MRCAT member institutions. This research used resources of the Advanced Photon Source, a U.S. DOE Office of Science User Facility operated for the DOE Office of Science by Argonne National Laboratory under Contract No. DE-AC02- 06CH11357. This work was also supported by the U.S. DOE, Office of Nuclear Energy under DOE Idaho Operations Office Contract DE- AC07-051D14517 as part of a Nuclear Science User Facilities experiment and through the Idaho National Laboratory Advanced Reactor Technologies Technology Development Office as part of the Advanced Gas Reactor Fuel Development and Qualification Program.