Influence of irradiation temperature on fission product and actinide distribution in AGR-2 TRISO fuel

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Tristructural-isotropic (TRISO) coated particle fuel provides a versatile fuel design for the next generation of nuclear reactors. Each component in the TRISO construction is integral to the overall performance of the fuel concept with the inner pyrolytic carbon (IPyC), silicon carbide (SiC) layer, and outer pyrolytic carbon (OPyC) layers acting in concert as the primary barrier to release of fission products not retained in the kernel. The second irradiation experiment (AGR-2) conducted by the Advanced Gas Reactor Fuel Qualification and Development (AGR) Program explored the fuel performance of TRISO fuel compacts with uranium oxide fuel kernels with or without a uranium carbide oxygen getter. Compacts experienced burnups of 7.26–13.15% fission per initial metal atom (FIMA), fast fluences of 1.94–3.53x10^{25} n/m^2 (E>0.18 MeV) and cumulative time-average, volume-average (TAVA) irradiation temperatures at end-of-life of 987–1296 °C. These conditions expanded the performance envelope relative to the first irradiation experiment (AGR-1). In particular, the maximum AGR-2 compact TAVA temperature was 160 °C higher than the maximum AGR-1 compact TAVA temperature. Insights on fission product and actinide transport within the TRISO coated particle fuel system will be presented based on individual particle gamma analysis and scanning electron microscopy analysis. A focus will be on the AGR-2 Capsule 2 compacts, which experienced the highest TAVA temperatures, to better understand the impact of temperature on fission product and actinide transport.

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