Radial Heat Flux – Irradiation Synergism in SiC ATF Cladding

PI: Dr. Yutai Katoh, Oak Ridge National Laboratory

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ABSTRACT:

Synergism of neutron irradiation and high heat flux presents unique yet critical challenges for light water reactor (LWR) silicon carbide (SiC) - based fuel cladding concepts due to the steep temperature dependence of early swelling in SiC. The primary goal of the proposed project is to experimentally verify the multi-physics model of prototypical SiC-based fuel clad behavior during neutron irradiation under high radial heat flux that is relevant to practical LWR fuel operation.

Specifically, the project intends to achieve the following two objectives:

1) Irradiation of tube specimens of prototypical and model SiC-based accident-tolerant fuel (ATF) cladding under a high radial heat flux

2) Post-irradiation examination of the irradiated tube specimens

Corresponding with these objectives, the first task includes the fabrication and building of rabbit capsules for an LWR fuel-relevant radial heat flux condition and a subsequent High Flux Isotope Reactor (HFIR) neutron irradiation. Irradiated rabbits will contain variations of SiC-based small diameter composite tube specimens that are prototypical to ATF SiC cladding. Once the irradiation is complete, the second task examines specimens for key properties, thermometry, and residual stress at the Low Activation Materials Development and Analysis (LAMDA) laboratory of the Oak Ridge National Laboratory (ORNL).