Infrastructure Support for In-situ Transmission Electron Microscopy Examination of Structure, Composition and Defect Evolution of Irradiated Structural Materials at University of Nevada, Reno

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Collaborators: N/A

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ABSTRACT:

The objective of this proposal is to establish a new in-situ nano-scaled structure, composition and defects evolution examination infrastructure system for irradiated structural materials – using the Hysitron PI-95 TEM PicoIndenter – designed to work in conjunction with a state-of-art high resolution transmission electron microscope (TEM), which will allow in-situ characterization under mechanical strain in a variety of irradiated materials with unique nano-scaled structures and defects at University of Nevada Reno (UNR).

The Department of Chemical and Materials Engineering (CME) at UNR has a number of current Nuclear Science and Engineering programs such as determining the stress-strain response of irradiated metallic materials via spherical nanoindentation from sub μm-to- μm volumes, in situ Raman spectroscopy for determining actinide speciation and concentration, and development and experimental benchmark of computational models to predict cladding temperature and vapor removal from UNF canisters during drying operations. The department also offers a minors program in Nuclear Materials. The courses offered in the nuclear materials program focus on design, fabrication, mechanical behavior, environmental degradation and electron microscopy of nuclear structural materials.

This proposal targets the following specific area of interest: Nuclear fuels and materials examination (characterization) and is aimed towards design of novel advanced structural materials that can potentially improve the reactor performance. The proposed instrument will serve a critical need for a nanomechanical testing system that can acquire quantitative nanomechanical data with the power to precisely control the test position, as well as observe the sample before, during, and after each test for a more complete understanding of deformation and failure processes, from room temperature to elevated temperature.

The Hysitron PI-95 TEM PicoIndenter was chosen as the best combination of system performance and cost target. the instrument will directly complement the micro-mechanical testing capabilities of the Alemnis in-situ SEM Indenter system, which was awarded to UNR through the DOE FY 2018 General Scientific Infrastructure (GSI) Support for Universities program. While the Alemnis SEM Indenter system from last year's DOE Infrastructure Support allows us to conduct in-situ mechanical testing inside the SEM, such testing at the TEM level is currently not possible without the proposed Hysitron PI 95 in-situ TEM nano-scaled straining test system.