MATERIALS ENGINEERING
SEMINAR

"THE DESIGN, DEVELOPMENT, AND TESTING OF AN ADVANCED NUCLEAR REACTOR *IN-SITU* CREEP CAPSULE THAT ACCOMMODATES MULTIPLE SPECIMEN GEOMETRIES"

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Purdue MSE M.S. Thesis
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ABSTRACT

Nuclear reactors operate under extreme environmental conditions, such as neutron bombardment, elevated temperatures, and high pressures. Over time, the harsh environmental conditions affect the material properties of structural materials and fuels. Studying the mechanical properties of structural materials and advanced fuels is common practice that is required to validate the material performance for deployment within the next-generation reactors. Next-generation reactors, such as Generation-IV reactors, will operate in more extreme environments than the current fleet of power reactors, with temperatures reaching potentially over 1,000℃ and the use of corrosive coolants, such as lead, lead-bismuth, and liquid sodium. Studying *in-situ* mechanical properties, such as irradiation creep, is challenging, particularly in next-generation reactor conditions. The instruments used to measure *in-situ* irradiation creep must collect data in real-time while experiencing harsh in-reactor conditions. Many historical *in-situ* creep capsules have implemented unique designs to measure irradiation creep. The current study designed, developed, and tested a novel, modular *in-situ* creep capsule to address the challenges of testing candidate materials for next-generation reactors. The *in-situ* creep capsule utilizes modern manufacturing methods, instrumentation, and alloying to address extreme environmental temperatures. Implementing modern technology has positioned the critical components of an *in-situ* creep capsule near the specimen, improving the accuracy of measuring irradiation creep in real-time. The modular design of the *in-situ* creep capsule allows the testing of various specimen geometries, thus making it a first-of-a-kind.

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