NUCLEAR ENERGY UNIVERSITY PROGRAMS

Fabrication of Tungsten-Rhenium Cladding Materials via Spark Plasma Sintering for Ultra High Temperature Reactor Applications

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Project Number: 09-477

Initiative/Campaign: IIR

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Abstract

This research will develop an optimized, cost-effective method for producing high-purity tungsten-rhenium alloyed fuel clad forms that are crucial for the development of a very high-temperature nuclear reactor. The study will provide critical insight into the fundamental behavior (processing-microstructure-property correlations) of W-Re alloys made using this new fabrication process comprising high-energy ball milling (HEBM) and spark plasma sintering (SPS). A broader goal is to re-establish the U.S. lead in the research field of refractory alloys, such as W-Re systems, with potential applications in very high-temperature nuclear reactors.

An essential long-term goal for nuclear power is to develop the capability of operating nuclear reactors at temperatures in excess of 1,000K. This capability has applications in space exploration and some special terrestrial uses where high temperatures are needed in certain chemical or reforming processes. Refractory alloys have been identified as being capable of withstanding temperatures in excess of 1,000K and are considered critical for the development of ultra high-temperature reactors. Tungsten alloys are known to possess extraordinary properties, such as excellent high-temperature capability, including the ability to resist leakage of fissile materials when used as a fuel clad. However, there are difficulties with the development of refractory alloys: 1) lack of basic experimental data on thermodynamics and mechanical and physical properties, and 2) challenges associated with processing these alloys.