UNIVERSITY OF CENTRAL FLORIDA

NANOSCIENCE TECHNOLOGY CENTER
ADVANCED MATERIALS PROCESSING & ANALYSIS CENTER

GRADUATE RESEARCH SEMINAR SERIES

Friday
November 6, 2015

12:15 PM

Research Pavilion
NSTC
Conference Room 475

Pizza and drinks will be provided

Evaluation of Phase Constituents and Microstructure in Hot Isostatic Pressed Monolithic U-Mo Fuel Plates in AA6061 Cladding with Zr Diffusion Barrier

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The Materials Management and Minimization Reactor Conversion (MMMRC) program seeks to develop low-enriched fuel system to replace high-enriched fuel system for research and test nuclear reactors. The U-10 wt.% Mo (U10Mo) monolithic fuel, consisting of bcc γ-U solid solution, fabricated via co-rolling and hot isostatic press (HIP) is being developed for the higher performance research and test reactors. The HIP process was carried out as functions of temperature and time to bond 6061 Al-alloy to the Zr diffusion barrier that had been co-rolled with U10Mo fuel monolith prior to the HIP process. Scanning and transmission electron microscopies were employed to examine the phase constituents, microstructure and layer thickness of interaction products from interdiffusion. At the interface between the U10Mo and Zr, following the co-rolling, the UZr_2 phase was observed to develop adjacent to Zr, and the α-U phase was found between the UZr_2 and U10Mo, while the Mo_2Zr was found as precipitates mostly within the α-U phase. The phase constituents and thickness of the interaction layer at the U10Mo-Zr interface remained unchanged regardless of HIP processing variation. Observable growth due to HIP was only observed for the $(Al,Si)_3Zr$ phase found at the Zr/AA6061 interface, however, with a large activation energy of 457 ± 28 kJ/mole. In bcc γ-U solid solution, localized eutectoid decomposition of γ-U (U10Mo) into γ'-U (U2Mo) and orthorhombic α -U were observed, and the kinetics of phase transformation was related to the time-temperature-transformation diagram of U10Mo alloy. Furthermore, the regions of limited interaction between the U10Mo and Zr barrier decreased with increases in HIP temperature and duration. UC and UO_2, formed during the initial casting of U10Mo, frequently associated with the regions of limited interaction. Findings of the study are discussed to optimize the HIP parameters that optimize the integrity of fuel system constituents (e.g., fuel, diffusion barrier and cladding) and minimize the γ to γ'+ α decomposition.