Investigation of High Energy Heavy Ion Irradiation of ALD Coated LEU U-Mo in a Dispersion Fuel Mini Plate

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ABSTRACT

Atomic layer deposition (ALD) is an advanced coating technique considered for application in U-Mo dispersion fuel. ALD would be utilized to deposit a diffusion barrier on the U-Mo fuel particles to suppress inter-diffusion layer formation between the fuel and the aluminum matrix. The in-pile performance of the ALD coated ZrN U-Mo dispersion fuel will not be known until the Post-Irradiation Examination (PIE) of samples in the European Mini-Plate Irradiation Experiment (EMPIrE) experiment. Thus, high-energy ion irradiation has been conducted on a low-enriched uranium (LEU) U-10Mo dispersion fuel at Argonne Tandem Linac Accelerator System (ATLAS), Argonne National Laboratory, to simulate the irradiation behavior of the fuel. Two ZrN coated LEU U-10Mo samples were exposed to 84 MeV Xe ions to achieve a final dose of 4.80×10^{16} and 1.47×10^{16} ions/cm^2. The irradiation temperature was ~150ºC. The irradiation damage levels were estimated to be 471 dpa, and 144 dpa for the high and low dose samples, respectively. Preliminary PIE on the irradiated samples was performed with a FEI Strata 400 focused ion beam (FIB) system. After ion irradiation, the integrity of the ALD coatings on the fuel particles was preserved. No inter-diffusion layer was observed on either irradiated sample.