RERTR 2015 — 36th INTERNATIONAL MEETING ON
REDUCED ENRICHMENT FOR RESEARCH AND TEST REACTORS

OCTOBER 11-14, 2015
THE PLAZA HOTEL
SEOUL, SOUTH KOREA

A Comparative Post Ion-irradiation Study of ALD and PVD Coated ZrN U-7wt% Mo Dispersion Fuel Microplates

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ABSTRACT

Zirconium nitride (ZrN) is proposed to serve as a robust diffusion barrier to stop the detrimental reaction that can occur between U–7wt%Mo and aluminum (Al) when a dispersion fuel is irradiated to very high doses. In this study ZrN coating was applied utilizing two techniques: Physical Vapor Deposition (PVD) and Atomic Layer Deposition (ALD) process. The ALD was carried out at Argonne National Laboratory (ANL), where one micron of ZrN was deposited on U-7Mo powder. PVD was used at SCK-CEN (Studiecentrum voor Kernenergie, Centre de l'Energie Nucléaire) Belgium to deposit a similar ZrN layer on U-7Mo powders. . Microplates made from both ALD and PVD coated powders were irradiated at the Argonne Tandem Linac Accelerator System (ATLAS) facility. Fifteen samples, including both ALD and PVD coated U-7Mo (1 mm diameter punched from the microplates) were irradiated with 80 MeV xenon ions under controlled conditions with doses ranging from (0.71-1)x10^{17} ions/cm^2 at 150^{o}C. Post irradiation examination of the irradiated samples with Focused Ion beam (FIB-SEM) reveals that there is almost no difference in terms of surface morphology and net formation of interaction layer between the ALD and PVD coated U-7Mo fuel plates. Further characterization is in progress to study the nature of the coating and the interface between the coating and the U-7Mo, both before and after irradiation.