Effects of Ion Dose and Irradiation Temperature on Chromium Coatings for Zirconium Alloy Fuel Claddings

Li Jiang[a], Pengyuan Xiu[a], Lumin Wang[a,b,*]

[a] Department of Nuclear Engineering and Radiological Sciences, University of Michigan, Ann Arbor, MI 48109, United States

[b] Department of Materials Science Engineering, University of Michigan, Ann Arbor, MI 48109, United States

*Corresponding authors: Lumin Wang, lmwang@umich.edu.

Recently, the development of accident tolerant fuel is a critical issue in light water reactors. Cr coatings display a promising application in protecting Zr alloys from oxidation and maintaining the fuel performance. In this work, an attempt has been made to systematically investigate the dose-dependent and thickness-related irradiation responses of Cr coatings on the Zr alloy. Three sets of Cr coatings on a Zr alloy with thickness of 5, 10 and 12 μm have been irradiated at 400 ℃ with 6 MeV Au ions to average doses of 10, 25 and 50 dpa. Pre- and post-irradiation microstructures were characterized with transmission electron microscopy and radiation hardening was evaluated by nano-indentation. An obvious thickness dependent columnar grain size is observed before radiation with smaller grains in thinner coatings. Although the sizes of dislocation loops increase with irradiation dose in all samples, the evolution of irradiation defects is delayed in thinner coatings that can be attributed to the smaller columnar grains and larger lattice distortion.