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Compatibility Studies on Mo–Coating Systems for Nuclear Fuel Cladding Applications

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Abstract

To improve the safety factor of nuclear power plants in accident scenarios, molybdenum (Mo), with its high-temperature strength, is proposed as a potential fuel-cladding candidate. However, Mo undergoes rapid oxidation and sublimation at elevated temperatures in oxygen-rich environments. Thus, it is necessary to coat Mo with a protective layer. The diffusional interactions in two systems, namely, Zircaloy-2 (Zr2) on a Mo tube, and iron-chromium-aluminum (FeCrAl) on a Mo rod, were studied by aging coated Mo substrates in high vacuum at temperatures ranging from 650°C to 1000° for 1000 h. The specimens were characterized using scanning electron microscopy (SEM), energy-dispersive spectrometry (EDS) and nanoindentation. In both systems, pores in the coating increased in size and number with increasing temperature over time, and cracks were also observed; intermetallic phases formed between the Mo and its coatings.

Key words: accident-tolerant cladding, high-temperature diffusion, Molybdenum, coating.