Corrosion Behavior of AlCrFeTiMo and AlCrFeTi Multi-principal Alloy Coating in Liquid Lead Bismuth Eutectic at 600 ℃

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Abstract Ferrite / martensite (F/M) steel was addressed as the primary candidate cladding material for Lead-based cooled fast reactor (LFR). AlCrFeTiMo and AlCrFeTi multi-principal alloy coating was prepared on the surface of F/M steel by magnetron sputtering method to improve the compatibility with lead bismuth eutectic (LBE) coolant. Static LBE corrosion tests were concucted at 550 ℃ with oxygen controlled at 1 × 10-6 wt.%, AlCrFeTiMo and AlCrFeTi coating samples were exposed to LBE for 2000h. Phase trasition from amorphous to BCC structure happened to both of the coatings. Oxide scale formed on the surface of AlCrFeTi coating exhibiting uniform and compact feature with the average thickness of 1.2μm, and the TEM measurements have confirmed the composition of outer Cr_2O_3/Fe_3O_4 and inner Al_2O_3/TiO_2. Thickness of oxide scale on AlCrFeTiMo coating reaches 2.56μm after corrosion, localized breakage occurred on the loosened oxide scale, MoO_3 was observed in the interfacial oxide, and segregation of metallic elements of AlCrFeTiMo coating was also identified. The corrosion rates of AlCrFeTiMo and AlCrFeTi coating are at least two orders of magnitude lower than un-coated F/M steel, however, the overall corrosion resistence of AlCrFeTi is superior in LBE at 600℃.

Keywords Multi-principal alloy, Coating, Nuclear material, Lead-bismuth corrosion