High-temperature oxidation and nitridation behavior of PEO-coated ZIRLO alloy in nitrogen-containing environments at 900 and 1000°C

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Abstract Zirconium alloys have been applied as fuel cladding materials in the light water reactors (LWRs) during the past few decades The zircaloys may be exposed in nitrogen-containing environments in the case of open or failed reactor pressure vessels as well as during accidents of spent fuel pools and transport casks[1,2]. Hence, the degradation of zirconium alloys in nitrogen-containing atmospheres need to be investigated.

A compact oxide coating of ~10 μm thick on ZIRLO alloy was fabricated by plasma electrolytic oxidation (PEO). The morphologies, compositions, phase constituents before and after exposures in N_2 and N^{2+}steam environments at 900 and 1000°C were characterized. The PEO coating greatly enhanced the corrosion resistance of ZIRLO alloy in the N^{2+}steam atmosphere at 900 and 1000°C. The kinetic curves transformed from parabolic behavior for bare alloy and exponential behavior for PEO-coated alloy at pre-transition stage to linear at post-transition stage, due to the formation of ZrN and its re-oxidation.

Keywords: ZIRLO alloy; PEO coating; high-temperature nitridation; steam oxidation

Reference

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