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Oxidation behavior of Zr–1Nb in air at 400°C after Titanium Plasma Immersion Ion Implantation

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Zirconium alloys have been widely used in nuclear reactors due to low thermal neutron capture cross-section, excellent corrosion resistance and acceptable mechanical properties. Nowadays several methods apply for improving hydrogen and corrosion resistance such as addition of stabilizing additives (yttrium), deposition of thin solid films, micro-arc oxidation and modification of the surface by electron beam. Despite the multiplicity of the methods hydrogen embrittlement is still a pressing issue. Previous results have shown the positive influence of plasma immersion titanium implantation on the hydrogenation behavior of Zr–1Nb and Zr–2.5 Nb. After Ti implantation hydrogen preferably accumulates in the modified surface layer comprising the implanted Ti. Furthermore, the hydrogen concentration is considerably less inside the zirconium modified sample than in the as-received samples.
The integration of elements into the zirconium lattice can influence the valence of the surface and change corrosion and oxidation rates of the alloys. So it is very important not to decrease the zirconium oxidation resistance due to Ti implantation. Therefore, the purpose of this research is to study of the influence of Ti implantation on surface morphology, oxidation rate and phase structure of the Zr–1Nb alloy after oxidation on air at 400 °C for 5, 24, 72 and 240 h. The results show that the oxidation kinetics after Ti modification of the zirconium alloy changed. Although the weight gain of the implanted sample remains approximately the same, it can be considered that Ti implantation stabilizes the oxide layer and has beneficial influence on the oxidation protection of Zr-1Nb.

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