Corrosion behaviour of Fe-Si-Zr and Si-Zr thin films on Zr1Nb alloy.

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In recent years, demand for an Accident Tolerant Fuel (ATF) is on the rise due to the limitations of commonly used zirconium alloys as a cladding. One of the main concerns regarding zirconium alloys is their willingness to react with water, and especially with vapour, that can cause substantial damage to the cladding. Modification of a zirconium surface by coating might solve this issue and can be a feasible way towards ATF. In this presented work, an effect of magnetron sputtered Fe-Zr-Si and Zr-Si coatings deposited on Zr1Nb alloy on corrosion properties in the VVER primary coolant was evaluated by electrochemical and spectral techniques. Electrochemical tests, mainly composed of Electrochemical Impedance Spectroscopy (EIS), were performed in autoclave at 280 °C and 8,8 MPa. The layers were analysed prior and after the autoclave exposures using Glow Discharge Spectroscopy (GDS), X-ray photoelectron spectroscopy (XPS) and Raman spectroscopy (RS). The results of surface analysis show that the layers under the exposure conditions were readily oxidized and the main components of the surface were found to be Fe_3O_4 and ZrO_2. Electrochemical data show that the Fe-Si-Zr layers present better corrosion protection compared to the Si-Zr layers. Impedance data show an increased charge diffusion inhibition of the corrosion reaction when the coating is present.