

FEASIBILITY OF NIOBIUM OXIDE-BASED FILMS TO PREVENT CORROSION OF AISI 304 STAINLESS STEEL IN NUCLEAR FUEL REPROCESSING PLANTS

Olandir Vercino CORREA¹, Mara Cristina L. de OLIVEIRA², Renato Altobelli ANTUNES³, Mitiko SAIKI¹, Oswaldo Pereira Vilela da Silva JUNIOR⁴, Marina Fuser PILLIS¹

¹Nuclear and Energy Research Institute, IPEN-CNEN/SP, Materials Science and Technology Center, ²Electrocell Ind. Com. Equip. Elétricos LTDA., ³Federal University of ABC (UFABC), ⁴Prest Vácuo Ltda., São Paulo, Brazil, ovcorrea@ipen.br

The integrity of metallic materials is a major concern in nuclear fuel reprocessing plants due to the possible leakage of radioactivity if the component fails. Surface degradation by corrosion processes is regarded as a relevant failure mechanism in this environment. Typically, nitric acid is employed as the processing medium in nuclear fuel reprocessing plants. Thus, metallic materials should withstand surface degradation in contact with nitric acid solution at different concentrations and temperatures. Protective coatings are the technological approach to improve the surface properties of austenitic stainless steel components used in nuclear reprocessing plants. Niobium oxide-based films have been reported to enhance the corrosion properties of austenitic stainless steel substrates in near-neutral and sulfuric acid-based acidic solutions^{1,2}. However, the effectiveness of these films to protect austenitic stainless steels in typical nuclear reprocessing plant environments is not addressed in the literature. In this context, the aim of this work was to investigate the influence of Nb₂O₅ films on the corrosion properties of AISI 304 stainless steel substrates in nitric acid solutions. The corrosion resistance was evaluated using electrochemical impedance spectroscopy (EIS) and potentiodynamic polarization tests. The presence of metallic ions in the testing solutions was assessed using neutron activation analysis (NAA). The corrosion morphology was observed using scanning electron microscopy (SEM). The results indicated that the presence of Nb₂O₅ films effectively improved the corrosion resistance of the stainless steel substrate by reducing the corrosion current density and increasing charge transfer resistance. The amount of Fe, Ni and Cr ions released to the testing solution significantly decreased for the coated-specimens as determined by NAA. Nb₂O₅ films can be considered promising candidates to protect stainless steel components against corrosion in nuclear fuel reprocessing plants.

REFERENCES

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