Surface Engineering - Applied Research and Industrial Applications
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Surface Engineering – Applied Research and Industrial Applications Poster Session

IA-ThP-1 Corrosion Resistance of CrN, AlCrN and TiAlN deposited on Waspalloy, *Giovany Biava, Gelson Biscaia de Souza,* State University of Ponta Grossa, Brazil*; Irene Bida de Araujo Fernandes Siqueira,* Instituto Lactec, Brazil*; Rodolpho Fernando Vaz,* University of Barcelona, Spain*; **ANDERSON Geraldo Marenda PUKASIEWICZ [anderson@utfpr.edu.br],*** Federal University of Technology Paraná, Brazil

Corrosion problems in many components used in oil refineries are subject to corrosion issues. The cause of failure for these parts is primarily due to material degradation, as they are inserted into a corrosive atmosphere with significant sulfur concentrations and other oxidizing agents. Several types of coatings are reported in the literature that are feasible under the equipment's conditions, aiming to mitigate the effects of corrosion at both high and room temperatures. Thus, the present study aimed to evaluate the behavior of thin coatings deposited by the physical vapor deposition (PVD) technique against corrosion phenomena at room temperatures, as a component in aggressive environments where they are applied. To understand the behavior of the Waspaloy alloy and PVD coatings against corrosion at room temperature, an electrochemical corrosion test was performed according to ASTM G59 and G102. Surface analysis of the CrN, AlCrN, and TiAlN coatings revealed the presence of some protuberance-like particles and pores, which are closely related to the processing parameters of the PVD coatings. Based on microscopy of the coatings' surfaces, it is clear that the presence of defects in the CrN coatings is significantly lower than in the AlCrN and TiAlN coatings. Visual observations using SEM analysis of the coatings indicate, in all cases, a smooth and dense surface with few pores and particle inclusions. The average thickness of the CrN coating is approximately 2.77 μm, the AlCrN coating is approximately 3.5 μm, and the TiAlN coating is approximately 6.0 μm. The OCP values for all three PVD coatings studied are higher than those for the Waspaloy superalloy. This indicates that a protective film is easily built on the surface of the coated samples in aggressive environments; or that the components that make up the coating are chemically more stable in aggressive environments than the Waspaloy base metal. The lower OCP value for TiAlN, in relation to the other coatings, indicates that this coating is more susceptible to corrosion than the others, and is also related to the greater number of defects and porosity. Based on the Ecorr and icorr values, it can be seen that the corrosion resistance of AlCrN is better than that of TiAlN and CrN coatings. This is due to the ability of AlCrN coatings to form a passive layer on the surface. The addition of a third element (such as Al) to transition metal nitrides improves corrosion resistance. During corrosion, Al readily forms an Al2O3 layer on the coating surface, which passivates the surface and prevents further corrosion attacks.

IA-ThP-2 Interface-Engineered Grain Boundary Diffusion for Enhanced Coercivity, Corrosion Resistance, and Thermal Stability in Thick NdFeB Magnets with Efficient Rare-Earth Utilization, ***Ching-Chien Huang [huangcc@nkust.edu.tw],*** National Kaohsiung University of Science and Technology, Taiwan

Grain boundary diffusion (GBD) has emerged as a powerful interface engineering strategy to enhance the magnetic performance and environmental durability of sintered NdFeB magnets. This study presents a single-stage GBD process utilizing dysprosium (Dy) vapor adsorption, followed by subsequent aging treatment, to overcome coercivity degradation and thermal instability in thick-section magnets. By precisely controlling the diffusion temperature between 940 and 950 °C and the duration from 8 to 16 hours, significant improvements in intrinsic coercivity ($_iH_c$) were achieved. For samples with thicknesses of 5.5 mm and 6.5 mm, $_iH_c$ increased to 25.78 kOe and 25.06 kOe, corresponding to enhancements of 34.06 % and 30.32 %, respectively. These improvements enabled a magnetic grade transition from N44H to G42UH without compromising remanence (B_r) or maximum energy product ($(BH)_{max}$). Microstructural analysis using glow discharge optical emission spectroscopy (GDOES) and field-emission electron probe microanalysis (EPMA) confirmed uniform Dy enrichment at grain boundaries and the formation of thermally stable $(Nd, Dy)_2Fe_{14}B$ intergranular phases, supporting deep and homogeneous diffusion. Electrochemical evaluation via Tafel polarization revealed substantial reductions in corrosion current density and increased polarization resistance, indicating enhanced grain boundary chemical stability. The proposed method enables simultaneous enhancement of coercivity, thermal stability, and corrosion resistance. This interface-focused strategy provides a scalable and resource-efficient solution for fabricating high-performance NdFeB magnets for electric vehicles, offshore wind turbines, and aerospace applications.

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