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Corrosion behavior of Fe-based amorphous/nanocrystalline composite coating: correlating the influence of porosity and amorphicity

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Abstract: Recently, Fe-based amorphous coatings synthesized by different thermal spraying methods are being investigated as a potential candidate for long-term surface protection of various structures attributed to their outstanding wear and corrosion resistance. Defects like porosity and crystallization are inevitable in the thermal sprayed coatings, which are introduced during the synthesis process. Corrosion behavior of these coatings is adversely affected by the presence of such defects. However, identification of a microstructural feature among amorphous content and porosity to have greater influence on the corrosion resistance of thermal sprayed Fe-based amorphous/nanocrystalline coating has remained elusive so far. Thus, to address this problem, in-situ amorphous/nanocrystalline composite coatings were synthesized via high velocity oxy-fuel (HVOF) spraying, along with two melt-spun ribbons of different amorphous content (one fully amorphous, FA-Rib and the other having similar level of amorphicity as that of the coatings, PA-Rib). Results obtained from electrochemical characterizations, Raman analysis and Auger electron spectroscopy revealed reduced amorphicity as the primary factor that affects the corrosion behavior of such coatings. A mechanism has been proposed to explain the role of amorphicity and porosity on corrosion behavior of Fe-based amorphous/nanocrystalline coatings. This study will ultimately help in designing new amorphous composite coatings with improved corrosion resistance.

Keywords: Fe-based amorphous/nanocrystalline composite coating; Thermal spraying; Amorphicity; Porosity; Corrosion resistance; Passive film