materials proceedings

MDPI

Abstract

Corrosion Behavior of Fe-Based Amorphous/Nanocrystalline Composite Coating: Correlating the Influence of Porosity and Amorphicity †

Sapan K. Nayak [1,*], Anil Kumar [1], Kuntal Sarkar [2], Atanu Banerjee [2] and Tapas Laha [1]

[1] Department of Metallurgical and Materials Engineering, Indian Institute of Technology Kharagpur, Kharagpur 721302, India; kumar.anilsah14@gmail.com (A.K.); laha@metal.iitkgp.ac.in (T.L.)
[2] Research and Development Division, Tata Steel, Jamshedpur 831007, India; Kuntal.Sarkar@tatasteel.com (K.S.); atanu.banerjee@tatasteel.com (A.B.)
* Correspondence: sapan.nayak94@gmail.com; Tel.: +91-993-371-1115
† Presented at the First Corrosion and Materials Degradation Web Conference, 17–19 May 2021; Available online: https://cmdwc2021.sciforum.net/.

Abstract: Recently, Fe-based amorphous coatings synthesized by different thermal spraying methods have been investigated as a potential candidate for long-term surface protection of various structures due to their outstanding wear and corrosion resistance. Defects such as porosity and crystallization are inevitable in the thermal-sprayed coatings, which are introduced during the synthesis process. The 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 that has a 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 with a similar level of amorphicity to 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 in the corrosion behavior of Fe-based amorphous/nanocrystalline coatings. This study will ultimately help to design new amorphous composite coatings with improved corrosion resistance.

Keywords: Fe-based amorphous/nanocrystalline composite coating; thermal spraying; amorphicity; porosity; corrosion resistance; passive film

Citation: Nayak, S.K.; Kumar, A.; Sarkar, K.; Banerjee, A.; Laha, T. Corrosion Behavior of Fe-Based Amorphous/Nanocrystalline Composite Coating: Correlating the Influence of Porosity and Amorphicity. *Mater. Proc.* **2021**, *6*, 24. https://doi.org/10.3390/CMDWC2021-10042

Academic Editor: Luigi Calabrese

Published: 8 May 2021

Supplementary Materials: The conference presentation file is available at https://www.mdpi.com/article/10.3390/CMDWC2021-10042/s1.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Acknowledgments: The author, T. Laha thankfully acknowledges the financial support obtained from Research and Development Division of Tata Steel, India.

Conflicts of Interest: The authors declare no conflict of interest.