VIRTUAL EUROCORR

The influence of size and nearest neighbour distance of intermetallic particles in cast Al-Si alloys on the localized deposition of cerium conversion coatings

Salil SAINIS[1], Ehsan GHASSEMALI[1], Caterina ZANELLA[1]

[1] School of Engineering, Jönköping University, Sweden

Corrosion inhibiting cerium conversion coatings (CeCC) reduce corrosion by preferentially forming cerium rich deposits onto cathodic sites and thereby reducing their electrochemical activity upon immersion in cerium containing baths. The spontaneous and localized deposition of CeCCs, which is driven by the local rise in pH on cathodic sites as a result of oxygen reduction reaction, occurs by the combination of OH^- and Ce^{3+} ions, forming an insoluble precipitate of cerium oxides and/or hydroxides. The rate of pH rise has been previously reported to be governed by; the cathodic activity of intermetallic particles (IM). Nevertheless, the role of the substrate's microstructure on CeCC deposition behaviour, specifically the influence of different IMs' size and nearest-neighbor-distance on the deposition, has not been studied in detail. This paper aims to shed some light on the mentioned gap by depositing cerium-conversion coatings, on two microstructures each containing IMs with relatively different nobilities - (a) more noble Cu-rich θ-Al_2Cu (b) Fe-rich IM β-Al_5FeSi with different sizes and spatial distribution. Model alloy composition of Al-7wt.%Si-2wt.%Cu-1wt.%Fe was solidified at different cooling rates, allowing formation of the two different microstructures that consists of (1) β and θ IMs of large size (10-143 µm) with relatively larger nearest-neighbor distance and (2) β and θ of small size (2-23 µm) with relatively closer nearest-neighbor distance. Uncoated alloy and CeCC deposited microstructure as well as associated local and global electrochemical properties, were characterized with optical microscopy, scanning electron microscopy, energy-dispersive X-ray spectroscopy, atomic force microscopy, scanning Kelvin probe force microscopy and potentiodynamic polarization techniques.

Acknowledgement: The authors sincerely acknowledge the funding received from the European Union's Horizon 2020 research and innovation programme under the Marie Sklodowska-Curie grant agreement No 764977.