Influence of macro-segregation on corrosion behavior of high entropy alloy coating

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Abstract The CrMnFeCoNi coatings were fabricated on X65 steel substrate by the tungsten arc cladding method. A macroscopic scale solute segregation within the coated layer was found, and the formation mechanism was revealed. According to the no-slip boundary condition, a zero-velocity laminar fluid layer appears at the fusion pool boundary, which forms the macro-segregation zone. Energy dispersive spectroscopy (EDS) results demonstrated the macro-segregation zone possessed higher Fe element portion compared to the other region. Electron backscattered diffraction (EBSD) and X-ray diffraction (XRD) results indicated that the macro-segregated regions exhibited body-centered cubic structure. Potentiodynamic polarization curves indicated that CrMnFeCoNi coated samples experienced three stages including active, passive and transpassive dissolution. In active stage, preferential dissolution occurred on macro-segregated regions, which can be attributed to two factors: phase portion factor and alloying component factor. In the passive stage, the CrMnFeCoNi coating formed passive film while the macro-segregated zones exhibited active dissolution, resulting in forming deep crevices. Once macro-segregation zones formed deep crevices, the crevice corrosion mechanism would be dominant. As a result, some deeper and wider crevices were formed. In transpassive region, the passive film dissolved, which aggravates the corrosion of the sample.

Keywords: High entropy alloys; Macro-segragation; Galvanic corrosion; Crevice corrosion