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Microstructures and immersion corrosion behavior of laser thermal sprayed amorphous Al-Ni coatings in 3.5 % NaCl solution

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Abstract: Amorphous Al-Ni coating with the Al and Ni mass ratios of 3:2, 3:1 and 4:1 was sprayed on S355 steel of offshore platforms using a laser thermal spraying (LTS). The surface-interface morphologies, chemical element distribution, phase compositions and crystallization temperature of the obtained amorphous Al coatings were analyzed using a scanning electron microscope (SEM), energy dispersive spectrometer (EDS), X-ray diffractometer (XRD), and differential scanning calorimetry (DSC), respectively. The immersion corrosion behaviors of the Al-Ni coatings in 3.5 % NaCl solution for 720 h were investigated. The results shows that the Al-Ni coating is composed of Al-Fe alloy, $AlCrFe_2$, Ni_2MnAl and amorphous Ni-Mn-Al alloy, the metallurgical bonding is formed at the Al-Ni coating interface due to the diffusions of Al, Ni and Fe elements, and the tensile residual stress induced by LTS accelerated the crack expansion. The amorphous Al-Ni coatings have a certain amount of amorphous component at the crystallization temperature of ~510 ^{o}C. The laser thermal sprayed Al-Ni coating generates the dense oxide film immersed in NaCl solution, hindering the anion from entering, which improving the corrosion resistance of Al-Ni coatings. The electrochemical corrosion resistance of Al-Ni