

Effect of building directions on the corrosion behavior of the laser powder bed fused austenitic stainless steels in the hydrochloric acid environment

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Abstract 0Cr21Ni6Mn9N austenitic stainless steels were fabricated by laser powder bed fusion (LPBF) method under the building directions of 0° and 90°. The corrosion behavior of the stainless steel was studied in a hydrochloric acid environment compared to the wrought steel. The microstructures of the steels were analyzed using X-ray diffraction, scanning electron microscopy, electron backscatter diffraction, and electron channeling contrast imaging techniques. Potentiodynamic polarization measurement and electrochemical impedance spectroscopy tests were employed to investigate the properties of the passive film of the 0Cr21Ni6Mn9N steels. X-ray photoelectron spectroscopy was used to analyze the chemical composition of the passive film. The results indicated that building directions did not affect the phase composition of the steels. The samples obtained under the building direction of 90° contained more defects compared to the steels obtained at 0°. The steels exhibited similar passive behavior in the 0.1 M HCl solution. Compared to the LPBF-90° steel, the passive current density of the LPBF-0° sample was lower, indicating higher corrosion resistance. Defects forming during the LPBF process were susceptible to pitting corrosion, especially in the LPBF-90° steel. LPBF-0° steels exhibited higher polarization resistance and passive film thickness, with higher pitting corrosion resistance. The higher ratios of O²⁻/OH⁻ and Cr/Fe in the passive film of the LPBF-0° steel contributed to the higher corrosion resistance.

Keywords Austenitic stainless steel; Laser powder bed fusion; Passive film; XPS; Electrochemical behavior

Reference

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