

Study on corrosion properties of 2507 duplex stainless steel produced by laser powder bed fusion in seawater

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Abstract The superior mechanical properties and corrosion resistance of duplex stainless steel 2507 are primarily attributed to its nearly balanced dual-phase structure^[1]. However, during the laser powder bed fusion additive manufacturing process, the material tends to develop a high ferrite content due to the rapid cooling rate^[2]. As a result, heat treatment is necessary to restore its optimal performance^[2,3]. In this study, 2507 samples produced by laser powder bed fusion (L-PBF) were prepared using a laser power of 210 W and a scanning speed of 700 mm/s. After being solution-annealed at 1000 °C, 1050 °C, and 1100 °C for 60 minutes, the samples were water-quenched. The properties of the rolled samples, L-PBFed samples, and heat-treated samples were then compared. The results indicate that the L-PBFed sample exhibits an almost entirely ferritic microstructure, distinct from that of the rolled sample, and contains a large number of dislocations. The yield strength of L-PBFed 2507 reaches 1198 MPa, while its ultimate tensile strength is 1269 MPa, both of which surpass the properties of traditional rolled stainless steel. A near-equilibrium two-phase structure (austenite-ferrite ratio of 43:57) was achieved at 1100 °C. The corrosion properties of the rolled samples, L-PBFed samples, and those heat-treated at 1100 °C in seawater are comparable: the corrosion current density is 10^{-5} A/cm², and the pitting potential is approximately 1.2 V. This study demonstrates that 2507 duplex stainless steel produced by laser powder bed fusion can achieve properties comparable to traditional rolled stainless steel after heat treatment. These findings offer valuable insights for advancing the development of additive manufacturing of duplex stainless steel.

Keywords Laser powder bed fusion, stainless steel, corrosion properties, seawater

Reference

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