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Corrosion behavior of additively manufactured stainless steel alloys obtained by laser metal deposition

Andre Hatem [1,2,*], Christiane Schulz [1], Thomas Schlaefer [3], Nikki Stanford [1] and Colin Hall

[1] University of South Australia

[2] ARC Industrial Transformation Training Centre – Surface Engineering for Advanced Materials (SEAM)

[3] LaserBond Ltd

* Correspondence: andre.abou_hatem@mymail.unisa.edu.au

Abstract: The corrosion behavior of additively manufactured stainless steel (SS) parts is reliant on metallurgical aspects given by the process, such as microstructural characteristics, residual stress, porosity level, and surface roughness. In the Laser Metal Deposition (LMD), these aspects can be controlled by several process parameters including, laser power, scanning speed, overlap ratio, build direction, powder size, and shape. The iterative layer-by-layer deposition nature of LMD implies successive cycles of localized heating and rapid solidification in the material, which can promote distinct corrosion behavior on SS alloys when compared to the correspondent conventionally manufactured. In this work, the corrosion behavior of martensitic, austenitic, and duplex SS alloys processed by LMD was investigated in a sodium chloride environment. Potentiodynamic polarization scans were conducted to determine the electrochemical corrosion factors and passivity regimes for the LMD SS alloys. The corrosion performance of the materials was also assessed by salt spray test for periods up to 1000 hours. The results were correlated to morphological investigations of the microstructure and the degraded corrosion defects. This work demonstrates a close link between the corrosion performance of additively manufactured SS alloys and the LMD processing parameters.

Keywords: additive manufacturing; laser metal deposition; corrosion; stainless steel