Dilution Properties of Laser Directed Energy Deposition of Different Metal Powders on Cast Iron

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Joining of dissimilar materials in additive manufacturing, when depositing high-performance alloys onto cast iron substrates using laser beam directed energy deposition (DED-LB), poses a major challenge in achieving clads with optimal dilution, minimal porosity and cracking. The selection of suitable materials and process parameters for DED-LB metal powder based cladding of cast iron to repair and improve its surface properties in various applications remains a critical issue [1]. Although various materials and alloys have been investigated for this purpose, less attention has been paid to Ni based alloys [2]. In this study we focus on three different Ni based metal powders, maraging steel (18Ni300), Inconel 718 (In718), and Iron-Nickel (FeNi36). Experiments were conducted to determine suitable processing parameters for each material considering different laser beam powers and mass flow rates. The dilution properties and material integrity of the clad cross-section were evaluated using optical microscopy, scanning electron microscopy, and EBSD. FeNi36 clads showed the least favorable results, with a lack of dilution and high porosity observed in the deposited layer. On the other hand, 18Ni300 clads showed minimal dilution with the substrate while maintaining the overall integrity of the deposited material with low porosity. In contrast, the In718 clads showed the desired symmetric dilution across the interface with no visible porosity. Furthermore, the hardness trend across the cross-section of the clad with a transient drop in the dilution zone confirms the selection of the In718 as the most suitable material.

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