Process parameter interaction effect on the evolving properties of laser metal deposited titanium for biomedical applications

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ABSTRACT

The laser power interaction effects on the evolving properties of commercially pure titanium during laser metal deposition were analysed. The optimized processing parameters obtained for this research study were, spot size of 4 mm, powder flow rate of 2 g/min, gas flow rate of 2 l/min, and the scanning speed set at 0.002m/s. A total of seven samples were fabricated by depositing titanium powder onto a Ti-6Al-4V base metal; using an Nd-Yag laser by varying the laser power from 400 to 1600 watts while keeping all the other parameters constant. The deposited samples were characterised through the evolving microstructure, microhardness, wear and the corrosion behaviour. The microstructural evaluation revealed that the ratio of dilution increased with an increase in the laser power. Furthermore, it was found that as the dilution increased, the wear resistance behaviour of the deposits decreased due to the increased foreign elements (Al and V) from the substrate which inhibited smooth fusion as the molten deposit cooled. Also, the microstructural evaluation showed that finer martensitic microstructures were obtained at lower laser power rating which was associated with inter-layer porosity and due to the low laser-material interaction. However, Widmanstätten structures were observed at higher laser power settings

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