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Laser metal deposition of functionally graded Ti-6Al-4V + Mo samples and characterization studies

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Abstract

Ti-6Al-4V is a common alloy known for its use in aerospace and/or biomedical applications. In this study, Mo has been employed to increase the biocompatibility of Ti-6Al-4V. Two samples of Ti-6Al-4V with layers of differing percentages of Mo were produced using laser metal deposition at the National Laser Center of the Council of Scientific and Industrial Research, Pretoria, South Africa. One sample was manufactured with layers containing 15-10-5-0-5-10-15 wt% Mo at 1500W laser power and another sample was prepared with 0-5-10-15-10-5-0 wt% Mo at 1700W. The microstructures of 0% Mo showed Widmanstätten alpha. Adding Mo, the layers indicated lamellar microstructure. The properties of lower and upper layers with the same concentration of Mo were found to vary due to thermal effects occurring in the process of printing and possible intermetallic bonding. This paper discusses underlying factors for the results obtained on graded samples at different laser powers (1500 and 1700 W) in detail. The findings infer that the higher percent of Mo (above 10%) is not advisable for biomedical applications due to cracking and other related issues. The results indicate need for further research to optimize the laser metal deposition process to yield consistent production of functionally graded material.