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Microstructural and tribological behavior of in situ synthesized Ti/Co coatings on Ti-6Al-4V alloy using laser surface cladding technique

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ABSTRACT:

The enhancement of the tribological properties of titanium (Ti-6Al-4V) has been the subject of wide range research over the years. The constraints associated with Ti-6Al-4V in severe tribological conditions due of its low hardness and poor wear properties can be enhanced by appropriate enhancement of the microstructure via surface modification technique without altering the bulk material. In this work, Cp-Ti and Co powders were deposited at different admixed percentages by laser cladding on Ti-6Al-4V substrates with respect to laser processing parameters. The laser optimized parameters used are laser power 900 W, powder feed rate 1.0 g/min, beam spot size 3 mm, and gas flow rate 1.2 L/ min while scan speed were varied at 0.6and 1.2m/min. The microstructural evolution as well as wear morphology of the coatings were studied using scanning electron microscope equipped with energy dispersed spectrometry (SEM/EDS) while the phase identification were observed using X-ray diffractometer (XRD). Microhardness values of the coatings were obtained while wear test was conducted using a reciprocating set up. The coatings exhibited a good metallurgical bonding between the coatings and the substrate. Results revealed that laser clad sample with high scan speed was more effective in improving the hardness and wear resistance of Ti-Co/Ti6Al4Vcompared to low scan speed. The coatings possess an average hardness value of 730 HV0.1, a value that is about two times greater than that of the substrate. The enhanced wear resistance with high laser scan speed has been attributed to the presence of flower-like structures and formation of fractions of CoTi2, CoTi, AlTi2, AlCo5, AlCo2Ti, and Al2Ti inter-metallic phases dispersed within the coating matrix. In addition, analysis of worn surfaces and wear mechanism indicated improved resistance to tribological actions.