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Microstructures, wear and corrosion resistance of laser composite surfaced austenitic stainless steel (AISI 304 SS) with tungsten carbide

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Abstract

This study aims at the development of composite surface on austenitic stainless (AISI 304 stainless steel) by laser surface alloying with WC and Co in the weight ratio of 4:1. Laser processing has been carried out by laser melting of sandblasted AISI 304SS using a 5 kW continuous-wave Nd: YAG laser having a beam diameter of 3 mm and simultaneous addition of powder (WC and Co in the ratio of 4:1) at a rate of 10 mg/sec using He as shroud (at a flow rate of 6 l/min) in the melted surface. The process parameters are applied power (1.75–2 kW) and scan speed (12–30 mm/sec) with a powder feed rate of 10 mg/s. The laser-treated surface has been subjected to microstructural investigation and wear resistance (fretting wear behaviour) testing. There is formation of different carbides (WC, W2C, Fe7C3, Cr23C6, Fe6W6C, and Co6W6C) in the gamma matrix of the treated zone. The microhardness of composite surface is significantly higher (980 VHN) than that of AISI 304SS (242 VHN). The fretting wear kinetics and coefficient of friction (COF) of the composite surface are reduced as compared to the substrate. The mechanism of wear has been established.