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Studies on laser surface processing of titanium based alloy (Ti6Al4V) with titanium, carbon and a mixture of titanium and carbon

Gayen, TK; Pityana, Sisa L; Akinlabi, E; Majumdar, JD

Abstract:
The present study concerns the development of titanium carbide (TiC) dispersed titanium matrix composite by laser surface processing of titanium with titanium and carbon (in the weight ratio of 90:10 and 50:50). Laser surface processing has been carried out using a 4 kW continuous wave (CW) Nd:YAG laser with a beam diameter of 2 mm, at varied applied power ranging from 600–900 W and a scan speed of 0.6 m s-1 by pre-deposition of precursor powder and its subsequent melting using laser in argon shroud. Followed by laser surface processing, a detailed characterization of the processed zone has been carried out in terms of microstructure, phase, and composition. Properties of the surface processed zone were evaluated in terms of corrosion resistance in Hank's solution. Finally, the optimum process parameters for laser surface processing has been established through a detailed structure–property-process parameters correlation. The microstructure of the surface processed zone consists of presence of titanium carbides dispersed in a matrix, the mass fraction of carbide phase was found to vary with weight percentage of graphite present in the precursor powder. The corrosion resistance property of the surface was found to be improved in terms of decrease in corrosion rate (range of 0.001 mm to 0.03 mm per year) as compared to as-received Ti-6Al-4V (0.2 mm per year). Laser surface processing with 100% graphite shows a maximum improvement in corrosion and bio-activity.