ABSTRACT

TiAl intermetallic have demonstrated excellent behavior at high temperature, however, the processing for producing coatings is not easy due to its high melting point, otherwise the coaxial laser cladding process promise to be an excellent tool for obtaining extensive overlapping coatings, achieving complete fusion and deposition of alloys with high melting point on surfaces with complex shape. In this work we study the parameters of coaxial laser process and preheating the substrate to achieve Ti48Al2Cr2Nb intermetallic coatings on Ti6Al4V sheet 3 mm thick, in order to improve the tribological, oxidation and corrosion behavior of the Ti6Al4V alloy. The geometrical and chemical dilution analysis of the single tracks obtained at different levels in the laser processing variables were able to identify combinations that minimize defects such as cracks, high dilution and inadequate aspect ratio. It found a direct relation between the cooling rate and the coaxial laser process parameters such as the powder feeding rate and scanning velocity. Thus the process was optimized by minimizing the cooling rate with decreasing the velocity. After this was selected as appropriate preheating temperature 350 °C and were obtained coatings with 40% overlap, using process parameters which generate laser specific energy of 70, 80, 90 and 180 J/mm^2, then they have been evaluated by optical microscopy (OM), scanning electron microscopy (SEM), X-ray diffraction (XRD), Vickers micro-hardness (HV) and nanoindentation. The microstructure of the coatings consists γ-TiAl phase and α_2-Ti_3Al.

Preheating the substrate has allowed obtaining coatings with good metallurgical bond, although cracks and pores are observed for some conditions. It is noted that the expected variation in chemical composition from coating surface to the substrate was found, with low dilution of vanadium. The hardness of the TiAl laser coatings is higher than the substrate and the bending tests results shown that the coatings have good adhesion but with limited ductility. The tribological properties of the coatings shows that in the wear tests at room temperature a lower wear rate is obtained compared to the substrate. In the case of high temperature, the coatings have a lower coefficient of friction; however, a higher wear rate is obtained when compared with the substrate. The coatings have good resistance to oxidation evaluated by isothermal oxidation tests in air at 800 °C, when compared with the substrate, the thermal growth oxide up to 12 microns thick for 150 hours were obtained. The structure of the oxide layers is complex and comprises the growth of successive layers from the outer surface of the coating. We also studied the electrochemical corrosion behavior of the coatings obtained. The results indicate that the coaxial laser cladding can be a good alternative to obtain extensive TiAl intermetallic coatings, dense coatings with good substrate bonding and minimal defects were obtained, that improve the oxidation and wear behavior of Ti6Al4V alloy.

Keywords: TiAl, laser cladding, coating, Ti6Al4V, wear, oxidation.