Corrosion Resistance of Ti-6Al-4V/TiC Composite Produced by Additive Technologies

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The goal of our research was to compare the corrosion resistance of various components of a hybrid material, designed for aerospace applications. The aim was to verify the corrosion resistance of this material in a 3.5 wt. % NaCl saline environment. Samples J (core) and JH (core, heat treated) were simulating the core of the hybrid material and were manufactured using laser powder bed fusion technology. Sample J was analyzed in the as-built state, and sample JH was heat-treated for two hours at a temperature of 800 °C. Samples P (surface) and PH (surface, heat treated) were simulating the surface of the hybrid material and were manufactured using direct energy deposition technology. Sample P was analyzed in the as-built state, and sample PH was heat-treated at 800 °C for two hours. Sample C1, a conventionally built Ti-6Al-4V alloy, was used to compare the results of the additively manufactured samples. Samples P and PH, which contained TiC, showed a decreased corrosion rate in a corrosion environment of 3,5 wt. % NaCl obtained from Tafel plots compared to samples J, JH, and C1. However, they exhibited a significantly lower pitting potential than the samples without TiC, indicating the negative effects of TiC on the formation of pits during prolonged exposure to the corrosive medium. Electrochemical impedance spectroscopy was done on heat treated samples JH and PH in 3,5 wt. % NaCl. Both samples exhibited growth of the passive layer during exposure, but the passive layer formed on the sample PH formed a more porous structure, indicated by lower charge transfer resistance over time. Despite a marignal increase in the speed of corrosion of sample PH due to the formation of a secondary Ti(α) phase during heat treatment, the results of electrochemical impedance spectroscopy indicated the formation of a stable passive layer. The addition of TiC to the matrix lowered the pitting potential of the material; however, we conclude that both samples P and PH are suitable for use in proposed applications.