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Microstructure and high-temperature oxidation resistance of Ti-Al-Nb coatings on a Ti-6Al-4V alloy fabricated by laser surface alloying

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Abstract: In this study, Ti-Al-*x*Nb coatings were deposited on a Ti-6Al-4V alloy by laser surface alloying in order to investigate their oxidation resistance. A Ti-Al coating was fabricated for comparison. It was found that the Ti-Al and Ti-Al-*x*Nb coatings were composed of TiAl and Ti_3Al phases. Nb addition reduced the cracking tendency of the Ti-Al-*x*Nb coatings. The Ti-Al and Ti-Al-*x*Nb coatings exhibited good high-temperature oxidation resistance at 800 °C. In comparison, Ti-Al-*x*Nb (*x*= 10, 20, 30 and 40) coatings had better high-temperature oxidation resistance and Ti-Al-40Nb coating had the best high-temperature oxidation resistance. The mechanism of Nb that improves the high-temperature oxidation resistance of Ti-Al-*x*Nb coatings includes preventing the internal diffusion of oxygen, inhibiting the formation of TiO_2, promoting the formation of Al_2O_3 and increasing the adhesion of the oxide scales.

Keywords: titanium alloy; laser surface alloying; Ti-Al-*x*Nb coating; high-temperature oxidation resistance

1. Introduction

Titanium and titanium alloys are known for their properties such as low density, high specific strength, excellent corrosion resistance and non-magnetism. This explains their early success in the aviation, automotive, chemical industries and medical engineering [1-2].The position and function of titanium and titanium alloys in the national economy and national defense construction are increasingly important [3]. Taking the aviation industry as an example, conventional titanium and titanium-based alloys represent one-third of the weight of modern aircraft engines and are the second most used engine materials following Ni-based superalloys [4]. Titanium alloys are mainly used to make compressor blades and casings of the aircraft engines. With the improvement in the performance of modern aircraft and the thrust-weight ratio of