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Recent Development of Laser Based Treatment on Titanium Alloys: From Coating to Treatment – A Review

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Abstract: **-- The tribological properties, in specific, oxidation and hot corrosion behavior were found to be a dominant property to improve the surface characteristics of titanium alloys and many researchers tried different methods to improve it. In order to achieve a better coating, there are numerous surface treatment techniques have been performed. The techniques, such as nitriding, carburizing, oxidation, physical vapor deposition (PVD) and chemical vapor deposition (CVD) executed to improve the surface properties of titanium alloys. In addition to this, laser was also used in surface modification. The coatings made by laser techniques exhibited strong metallurgical bonding with the substrate materials, owing to their high energy density. It was also found that the technique satisfied the industrial requirements for all applications.**

Index Terms— **Microhardness, Laser Surface Melting, Laser Metal Deposition, Microstructure, Ti6Al4V.**

I. INTRODUCTION

Titanium is the most significant metal of major industrial applications. The exceptional properties of titanium alloys incorporate high strength and astonishing erosion resistance. Titanium alloys are found in aviation applications where the mix of quality and corrosion resistance is unavoidable. The one of the major utilization for titanium alloys is in the aviation gas turbine motor compressor blades. The compressor disks and blades of the first stages are used at low temperatures about 300°C (low pressure compressor) are made from Ti-6Al-4V, a titanium alloy [1]. Ti-6Al-4V is extensively used alloys in aero engine turbine blades. These aero engine blades, after thousands of operating hours are mostly encountered fatigue and creep which are reducing the actual service life of the component. The blades subjected to wear and fretting are most of the times getting replaced rather than refurbished [2]. There are extensive research work to improve the material properties through various coatings, in order to the service life of Inconel 718 and Ti-6Al-4V [3].

II. COATING ON TITANIUM ALLOYS

The tribological properties of pure titanium (cp-Ti) was improved by deposition of Ti-Si-N coating through laser (LENS) processing [4]. The evaluated microstructures were evidenced in the coating along with in-situ shaped stages. The dendritic microstructure of the coatings was greatly influenced by the Si, as accumulation of Si impacted the solidification behavior of the melt pool. Increase in Si accelerates the solidification rate and in this way it prompted to better and more discernable dendrites. This influenced the mechanical properties of the deposited region. The experiment further demonstrated that the changes in microstructural varieties and phase impacted on hardness and wear resistance specifically. The top surface of the coating exhibited with higher hardness qualities and the same was reported in all specimens. Besides, the sample without Si had relatively high wear rate and it was reported that Si enhanced the tribological execution of the coatings.

Similar performance improvement was achieved with nanocomposite deposition WC1-x/C on titanium alloys is depicted in figure 1 [5].

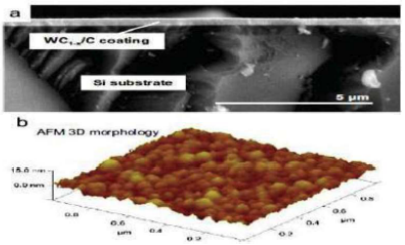

Fig. 1. Nanocomposite deposition WC1-x/C (a) SEM image of coating (b) AFM morphology [5].