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# Creep properties of plasma carburized Ti-6Al-4V

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**Abstract** – In order to strengthening the surface of the Ti-6Al-4V alloy, plasma carburizing technique was carried out, although plasma nitriding has been more widely used for its alloy. The effect of this treatment was analyzed and compared with the untreated alloy by short-term creep tests.

In the last years, an intense research effort has been made to develop new structural alloys and to optimize the alloys commercially available, which could withstand the demanding operational conditions of both airframes and gas turbine engines. A substantial part of these research activities has been dedicated to titanium alloys where the process optimization of certain properties like short-term strength, long-term creep strength and improved oxidation resistance can lead to an additional increase of the temperature range, allowing use of these alloys in gas turbine engines for increased efficiency [1]. Titanium alloys for aerospace applications contain both alpha and beta stabilizing elements in various proportions depending on the applications and of the required mechanical properties combinations. These alloys can be worked to control the microstructure through processing as well as heat treatment variations and to fully optimize the mechanical behavior. In the context, Ti-6Al-4V containing an ($\alpha$+$\beta$) structure continues to be the workhorse of the titanium industry due to their high specific strength, corrosion resistance, excellent high temperature properties and metallurgical stability. Due to the great background of successful application in the aerospace industry, Ti-6Al-4V play a very important role in the manufacturing of components such as disk and blades for aircraft turbines and structural forgings [2,3].

In the context, various surface modification techniques by thermo-chemical process such as carburizing have been studied for the improvement of the resistance of titanium alloys. In this work, the plasma carburizing was performed with a pulsed d. c. discharge in a industrial furnace at 725ºC during 6h in 50%Ar – 45%$H_2$ – 5%$CH_4$ gas mixture. The samples were characterized using microhardness testing, scanning electron microscopy and X-ray diffraction. The carburizing treatment resulted in a layer of about 1,5µm with a hardness of 809 HV, consisting of TiC. The effect of plasma carburizing on the creep resistance of Ti-6Al-4V was investigated. Short-term creep tests were performed under constant load at 600ºC. The creep properties of carburized specimens were improved in comparison with those of the uncarburized Ti-6Al-4V alloy.

## References

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