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Creep behavior of plasma nitrided Ti-6Al-4V alloy

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Abstract – In order to strengthening the surface of the Ti-6Al-4V alloy, plasma nitriding technique was carried out. The effect of this treatment was analyzed and compared with the untreated alloy by short-term creep tests.

Ti-6Al-4V is currently used in aeronautic and aerospace industry mainly for applications that require resistance at high temperature such as blades for aircraft turbines and steam turbine blades. The affinity of titanium for oxygen is one of the main factors that limit the application of titanium alloys as structural materials at high temperatures. The high solid solubility of oxygen in titanium results in material loss and in the formation of hard and brittle layer during elevated temperature air exposure. The development of titanium alloys with the objective of improving the creep properties have been observed, although the surface oxidation limits the use of these alloys in temperatures up to 600°C. A substantial part of the creep research has been devoted to Ti-6Al-4V due to its industrial and technological importance[1,2,3] .

In the context, various surface modification techniques by thermo-chemical process such as nitriding have been studied for the improvement of the resistance of titanium alloys. In this work, the plasma nitriding was performed with a pulsed d. c. discharge in a industrial furnace at 725ºC during 6h in H_2 – 75% N_2 gas mixture. The samples were characterized using microhardness testing, scanning electron microscopy and X-ray diffraction. The nitriding treatment resulted in a compound layer of about 4 µm with a hardness of 1539 HV, consisting of Ti_2N and TiN. The effect of plasma nitriding on the creep resistance of Ti-6Al-4V was investigated. Short-term creep tests were performed under constant tensile load in air at 600ºC using a dead-weight-creep-rupture machine. The creep properties of nitrided specimens were significantly improved in comparison with those of the unnitrided Ti-6Al-4V alloy.

References

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