Effect of pre-oxidation and plasma electrolytic oxidation on hot salt stress corrosion behavior of TC11 titanium alloy

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Abstract Titanium alloy with excellent all-round properties has been widely used in the manufacture of aircraft engine compressor blades. The surface of titanium alloy blades of aircraft engines serving in marine atmosphere will deposit solid NaCl, which is prone to suffer from hot salt stress corrosion damage. Therefore, it is necessary to investigate effective protection technologies of hot salt stress corrosion of titanium alloy. In this study, the effects of pre-oxidation and plasma electrolytic oxidation on the hot salt stress corrosion behavior of TC11 titanium alloy at 500°C were investigated by slow strain rate tension testing. The results show that the hot salt stress corrosion sensitivity of pre-oxidized TC11 titanium alloy at 500°C is still high, the oxide film formed during high temperature oxidation cannot resist NaCl well. In addition, this oxide film with certain brittleness is not conducive to the improvement of hot salt stress corrosion resistance. Plasma electrolytic oxidation treatment produces an outer oxide layer consisting of nanocrystals and amorphous layers and a dense inner amorphous oxide layer on the surface of the TC11 titanium alloy. The outer oxide layer has an inhibiting effect on the hot salt corrosion of TC11 titanium alloy, and the inner amorphous oxide layer effectively prevents the penetration and erosion of the corrosive media Cl and O into the TC11 titanium alloy matrix. The initiation of hot salt stress corrosion cracking is inhibited and the hot salt stress corrosion resistance of TC11 titanium alloy at 500°C is significantly increased.

Keywords: titanium alloy; hot salt stress corrosion; slow strain rate tension; pre-oxidation; plasma electrolytic oxidation