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Anode Plasma Electrolytic Saturation of Titanium Alloys with Nitrogen and Oxygen

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Highlights

- Temperature of anode nitriding from 600 to 1050 °C is controlled by the 120–260 V
- Nitrided layer is 95 μ m in the electrolyte of 10% NH_4Cl and 5% NH_3 for 10 min
- Weight wear of nitrided CP-Ti decreases from 57 mg to 0.52 mg at lubricant friction
- Corrosion rate of nitrided CP-Ti in H_2SO_4 (4.5%) and HCl (0.2%) decreases by 2 orders

In this work, we investigated the features of the anode plasma electrolytic saturation of titanium alloys with nitrogen and oxygen. In this case, the titanium samples may be heated to 1050 °C using aqueous solutions of ammonium chloride as working electrolyte. The weight of titanium samples is found to change due to their oxidation and anode dissolution. An X-ray diffractometer, a scanning electron microscope, nuclear proton backscattering and an optical microscope were used to characterize the phase and elemental composition of the modified layer. The electrolyte composition (10 wt% ammonium chloride, 5 wt% ammonia) and processing mode (850 °C, 5 min) of commercially pure titanium (CP-Ti) allowing to obtain the hardened surface layer up to 0.1 mm with microhardness of 220 HV were proposed. Surface roughness R_a of samples after their nitriding for 5 min at 800 °C decreases from 1.67 to 0.082 μm. The anode plasma electrolytic nitriding could decrease friction coefficient and increase wear resistance of the CP-Ti. It is found that the anodic nitriding of low alloy titanium alloys reduces their corrosion rate in an aqueous solution of sulfuric (4.5%) and salt (0.2%) acids by 2 orders of magnitude. Results of cyclic testing show that anodic nitriding of commercial titanium leads to a decrease in corrosion rate by 8 times in solution of hydrochloric acid (6%) with addition of protein and vitamin.