Wear behaviors and corrosion resistance of aluminum alloys treated by nitrogen plasma immersion ion implantation process

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Abstract

In order to improve the corrosion resistance and wear behavior of aluminum alloys, nitrogen ions were implanted into LY12CZ aluminum alloy by plasma immersion ion implantation (PIII) process. The chemical state, surface hardness, composition distribution, wear resistance, and anti-corrosion behavior of the N-PIII samples in 3.5% NaCl saturated aqueous solution were investigated. X-ray photoelectron spectroscopy (XPS) analysis indicates that the modified layer is mainly composed of AlN phase and a fraction of Al2O3 compounds. The depth profile of implanted nitrogen ion has two peaks, corresponding to 40 nm and 88 nm from the surface, respectively. The surface hardness is improved obviously by dispersion strengthening from AlN phase, and the maximum value increases by 140%. Friction and wear behaviors of all N-PIII samples show that the friction coefficient decreases from 0.47 to 0.38. Compared with the untreated substrate, the anode polarization curves reveal that the corrosion potential (Ecorr) of all N-PIII samples increase and corrosion current density (Icorr) decrease, the maximum Ecorr increases by 200 mV and the minimum Icorr decreases by over two orders of magnitude. It also exhibits that the wear tracks of N-PIII samples are much shallower and narrower than that of LY12CZ aluminum alloy substrate, the minimum wear loss decreases by 43.4%. Wear behavior and corrosion resistance of aluminum alloys strongly depended on the phase composition and element concentration-depth profile of the PIII modified layers.

Keywords: Plasma immersion ion implantation (PIII)LY12CZ aluminum alloysFriction and wear behaviorsCorrosion resistance

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