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Fabrication of Ti-O/Ti-N Duplex Coatings on Biomedical Titanium Alloys by Plasma Immersion Ion Implantation#

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In China, valvular problems account for 30% of heart diseases, and 100,000 patients need new heart valves every year. Currently, low temperature isotropic pyrolytic carbon (LTIC) is the best material for artificial heart valve, but it is brittle and its blood compatibility is still not sufficient for prolonged clinical use. As a result, thrombus often occurs, and patients need to take anti-coagulation drugs. Hence, a new material with good blood compatibility as well as mechanical durability is needed by the biomedical industry. The blood compatibility of titanium oxide has also been studied in recent years. Rutile type titanium oxide have good blood compatibility, its blood compatibility is better than that of LTIC. Hence, titanium oxide is a hopeful candidate to substitute for LTIC in artificial heart valves. TiN, with its superior properties in wear and corrosion resistance, and low friction coefficient, is being widely used for cutting tool coatings. In this paper, the Ti-O/Ti-N duplex coatings were synthesized by PIII. For Ti-O/Ti-N duplex coatings, the main effect of Ti-O was to improve blood compatibility and the main effect of Ti-N was to improve mechanical properties. A series of experiment was carried out to examine the influence of N_2 partial pressure, N_2 plasma density and substrate bias voltage on the microhardness and wear resistance of the duplex coatings. The microstructure and surface feature of the Ti-O/Ti-N duplex coatings were characterized by XRD, TEM and SEM techniques.

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