COMPARATION OF SPARK AND SOFT REGIMES IN THE PEO PROCESS: CORROSION AND WEAR PERFORMANCE OF AZ31 ALLOY

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Abstract

Plasma electrolytic oxidation is a highly effective technique for enhancing the corrosion resistance of Mg alloys in biodegradable implants, while also promoting cell adhesion and proliferation. However, PEO coatings exhibit high internal porosity, which can compromise their long-term performance. To solve this, the soft regime, which employs lower current densities and gentler sparks, is used in contrast to the spark regime, producing coatings with reduced porosity and greater compactness. In this study, PEO coatings were developed in a Si-F electrolyte using both the spark and soft regimes, with a bipolar pulse wave, to compare their properties. Morphology and chemical composition were analysed using SEM/EDS, a roughness meter, and XRD measurements. Corrosion and wear performance was evaluated by EIS and immersion tests under conditions simulating the human body, and alternating dry sliding at room temperature. Both regimes produced coatings with similar morphologies and compositions, although the soft regime resulted in a more compact coating due to lower microdischarge intensity which led to higher wear resistance. Both coatings significantly improved corrosion resistance after 24 hours of immersion, attributed to the protective barrier layer. However, localized corrosion appeared after 48 hours, although corrosion progress was mitigated by the precipitation of Ca-P compounds in PEO defects.

Keywords: Magnesium, Plasma electrolytic oxidation, Spark regime, Soft regime, Bipolar, Implant.

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