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Corrosion Behaviour and Biocompatibility of Nanoporous Niobium Incorporated Titanium Oxide coating for Orthopaedic Applications

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Abstract

This study investigates the surface characteristics, *in vitro* biocompatibility and electrochemical behaviour of nanoporous niobium incorporated titanium dioxide (Nb-incorporated TiO₂) coated 316L stainless steel (SS) for orthopaedic applications. The coating material was synthesized by sol-gel methodology and was deposited on 316L SS by using spin coating technique and heat treatment. The experimental conditions were optimized to obtain a coating with nanoporous morphology. The coating was characterized using attenuated total reflectance-Infrared spectroscopy (ATR-IR), X-ray diffraction analysis (XRD), scanning electron microscopy (SEM) and energy dispersive X-ray analysis (EDX), atomic force microscopy (AFM) and transmission electron microscopy (TEM). The analysis confirmed the formation of a crystalline nanoporous Nb-incorporated TiO₂ coating with hydrophilic nature. Mechanical studies validated that the coating has excellent adhesion to the specimen and also has appreciable hardness value. *In vitro* bioactivity test confirmed that the nanoporous morphology of the coating facilitated enhanced hydroxyapatite (HAp) growth. Electrochemical studies established that the insulative nature of the coating provides excellent corrosion resistance to 316L SS.

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