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Natalia Isabel de Azevedo Lopes, Nelson Henrique Jardim Freire, Pedro Damas Resende, Leandro de Arruda Santos, Vicente Tadeu Lopes Buono

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Electrochemical deposition and characterization of ZrO₂ ceramic nanocoatings on superelastic NiTi alloy

Natalia Isabel de Azevedo Lopes*, Nelson Henrique Jardim Freire, Pedro Damas Resende. Leandro de Arruda Santos and Vicente Tadeu Lopes Buono Department of Metallurgical and Materials Engineering, Universidade Federal de Minas

Gerais (UFMG), Belo Horizonte, MG, Brazil

*Corresponding author: nlopes@ufmg.br

Abstract

This study aimed to develop an appropriate nano-sized coating to prevent premature failures of NiTi components and nickel release to the human body. Two zirconyl salts, ZrOCl₂ and ZrO(NO₃)₂, were evaluated for electrodeposition as well as the effects of methanol and polyDADMAC addition. The surface morphology and chemical composition of the coated samples were evaluated using scanning electron microscopy with energy dispersive X-ray spectrometry, X-ray diffraction, and atomic force microscopy. The corrosion resistance was evaluated using potentiodynamic polarization tests in Hank's simulated physiological solution at 37 °C. The results showed that deposition using both ZrOCl₂ and ZrO(NO₃)₂ aqueous solutions reduces the surface roughness and improves the corrosion resistance of superelastic NiTi wires. When a ZrOCl₂ methanolic electrolyte was used, the deposition was heterogeneous and cracks were observed in the film. The addition of PolyDADMAC to aqueous and methanolic electrolytes resulted in more uniform coating surface and higher corrosion resistance in Hank's solution. The deposition of ZrO₂ improved the corrosion resistance of NiTi wires even when no previous electrolytic polishing was applied.

Keywords: nickel-titanium; corrosion; electrodeposition; nanocoating; zirconia; biomaterials.

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