

Novel Development on Orthopedic Prosthesis by Nanocrystalline Hydroxyapatite Nanocomposite Coated on 316 L Stainless Steel

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Abstract : Natural hydroxyapatite, NHA, coatings on the surface of 316 L stainless steel implants has been widely employed in order to achieve better osteoconductivity. For coating, the plasma spraying method is generally used because they ensure adhesion between the coating and the 316 L stainless steel (SS) surface. Some compounds such as zircon ($ZrSiO_4$) is employed as an additive in an attempt to improve HA's mechanical properties such as wear resistance and hardness. In this study wear resistance has been carried out in different chemical compositions of coating. Therefore, nanocomposites based on NHA containing of 0 wt.%, 5 wt.%, 10 wt.%, and 15 wt.% of zircon were used as a coating on the SS implants. The samples consisted of NHA, derived from calf heated at 850 °C for 3 h. The composite mixture was coated on SS by plasma spray method. The results were estimated using the scanning electron microscopy (SEM), X-ray diffraction (XRD) techniques were utilized to characterize the shape and size of NHA powder. Disc wear test and Vickers hardness were utilized to characterize the coated nanocomposite samples. The prepared NHA powder had nano-scale morphological structure with the mean crystallite size of 30-50 nm in diameter. The wear resistance are almost 320, 380, 415, and 395 m/g and hardness are approximately 376, 391, 420, 410 VHN in ceramic composite materials containing $ZrSiO_4$. The results have been shown that the best wear resistance and hardness occurred in the sample coated by NHA/ $ZrSiO_4$ containing of 10 wt.% of zircon.

Keywords : zircon, 316 L stainless steel, wear resistance, orthopedic applications, plasma spray

Conference Title : ICOSBCA 2015 : International Conference on Orthopaedic Surgery, Biomechanics and Clinical Applications

Conference Location : London, United Kingdom

Conference Dates : February 16-17, 2015