The Effect of Nano Structure Orientation on Biological Properties of Electrophoretic Hydroxyapatite Coated of Titanium Implants

Armin Tahmasbi Rad[1,2] , Shahab Faghihi[2*], Mana Novin[2], Ehsan Sadeghian Dehkord[3], Mehran Solati-Hashjin[1]

[1] Nanobiomaterials Laboratory, Faculty of Biomedical Engineering, Amirkabir University of Technology, Tehran, Iran

[2] Department of Tissue Engineering & Biomaterial, National Institute of Genetic Engineering and Biotechnology, Tehran, Iran

[3] Pyhysico-mechanical characterization of biomaterials and living tissues Laboratory, Amirkabir University of Technology, Tehran, Iran

[*] Faghihi@nigeb.ac.ir

INTRODUCTION

The integration of hard tissue to implant surface is one of the most important properties to optimize the stability and efficiency of tissue-implant interface. To meet this conditions the formation of appropriate interface of tissue and biomaterial is necessary to occur tissue regeneration and optimal interaction of tissue and implant. Titanium alloys are widely used to manufacture orthopedic implants. One approach to enhance the integration of tissue to implant is using biocompatible coatings on implant surface. Hydroxyapatite is known as the most bioactive material to coat on implants surface. Many coating techniques have been employed for the preparation of HA coatings; however Electrophoretic Deposition (EPD) process exhibits some advantages over other alternative processes, such as simplicity in setup, capability to form complex shapes and patterns, high degree of control of coating deposit morphology [1, 2].

EXPERIMENTAL METHODS

In this project two different surface crystallographic orientations of commercially pure titanium samples were studied. First sample was formed in the “Rod” shape that prepared with extrusion. The second sample was rolled to form the “sheet” shape. Each sample rubbed with sand papers with different degrees of roughness from 60 to 1200. The final polishing was done using soft polishing machine. Remained wear and waste products on the surface of samples were removed using sonic bath machine. Due to increase the surface roughness, samples are etched by a solution of 10 % Nitric Acid, mixed with 10% Hydrochloric Acid for one hour. Due to alkaline treatment samples were submerged in a 5 Molar NaOH solution for 48 hours. Hydroxyapatite powder prepared via the precipitate method using Tetra Hydrated Nona Hydrated Calcium Nitrate and Diammonium Hydrogen Phosphate in alkaline pH range. Then 5% Hydroxyapatite suspension was prepared in ethanol solution and dispersed by adding 0.25% CMC. The EPD process was accomplished under a constant voltage of 60 V for 45 seconds at 25 °C to coat HA on each sample. Samples were dried at room temperature for 24 hours and the coated substrates were sintered at 600 °C for 2 hours at a heating and cooling rate of 1 °C/min. The X-ray diffraction (XRD) and Fourier transform infrared spectroscopy (FTIR) techniques were used to characterize structure and composition of coated samples. To study the cellular attachment and cell morphology, mesenchymal bone marrow stem cells were cultured on the surface of samples. The proliferation test and mechanical behaviors of the coating is under performing.

RESULTS AND DISCUSSION

The results demonstrated that homogeneous HA coating on both samples can be obtained with those post-treatments and coated samples showed meaningful better bioactivity and cellular attachment. The scanning electron microscope (SEM) images illustrated that the both coated Rod and Sheet substrates showed better cell

morphology and better cellular response than uncoated pure titanium. Furthermore thick film of coating cracked easily.

CONCLUSION

EPD can be used as an accurate and flexible method and thin film of HA coating that makes the implant much more bioactive and biocompatible.

REFERENCES

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