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Tissue Engineering 2017: Synthesis of TiO2 nanotubes over Ti6Al4V surface to improve osteocompatibility of bone implants_SahelySaha_National Institute of Technology, India

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Statement of the Problem: Rapid growth has been witnessed in the field of implant fabrication, in the last decade. Titanium alloys are among the most used metallic biomaterials, particularly for orthopedic applications, as they have low specific weight, excellent mechanical properties, immense resistance to corrosion in biological fluids, good wear resistance and very low toxicity towards the host. Further, to improve bone fixation and enhance the biocompatibility of the titanium-based implants, bone cements are used in conjugation with the implant materials during the joint replacement surgeries. However, such implants fail due to de-bonding of cementing material followed by accumulation of the particulate causing toxicity and cell death. Also, bone loosening might occur at the cement-prosthesis interface and/or cement-bone interface, thereby increasing the chances of implant failure by two-folds. To address this limitation, surface modification of Titanium implants has been considered to enhance the biocompatibility of the substrate. Methodology & Theoretical Orientation: In the present study the surface of Ti6Al4V was modified through the synthesis of TiO2 nanotubes using anodic oxidation. The nanostructured surface was expected to enhance the surface area for cellular interaction and increase osteoconductive property of the implant without the release of toxic particles from coating material. Findings: TiO2 nanotubes were synthesized and characterized for its morphology, surface roughness, wettability and osteocompatibility. Conclusion & Significance: It was observed from the study that the nanostructured surface significantly enhanced the osteoconductive property and biocompatibility of the Ti6Al4V implant surface.

Titanium and its alloys especially Ti6Al4V have long been used in biomedical implants. Although, Ti6Al4V is biocompatible, yet there has been consistent effort to improve its osteoconductive and osteogenic property to enhance the implant performance. In this regard, surface modification of Ti6Al4V implants with TiO2 nanotubes and subsequent application of biopolymeric coating has started emerging as a promising approach. Keeping this perspective in mind, here we have coated nano TiO2 modified Ti6Al4V surface with silk fibroin isolated from B. mori cocoons. The coating of silk fibroin was done on the implant using electrophoretic deposition technique at three different voltages. Topography analysis by AFM confirms the uniform coating of silk fibroin. A variation in contact angle from 89.7 ± 2° to 83.6 ± 2° was observed when tested for wettability using drop shape analyzer. The biocompatibility studies showed SF coated substrates support the adhesion of both MG63 bone cells and human mesenchymal stem cells (hMSCs). The formation of peripheral vinculin complexes on SF surface confirmed the adhesion through focal adhesion points. Consequently, SF coating improved the cellular expression of alkaline phosphatase by 1.1 times compared to the polished Ti6Al4V surface (PTi64). Increased expression of late osteogenic markers osterix and osteocalcin was also observed in hMSCs cultured on SF coated nanotubular surface compared to PTi64. These results together implied that coating of silk fibroin on TiO2 modified Ti6Al4V surface improve the osteogenic potential of the implant.

The present work deals with the generation of H2 through water splitting using titania (TiO2) nanotubes (NTs) prepared via rapid breakdown anodization. The anatase TiO2 NTs sensitized with Pt, Pd and Ni nanoparticles (NPs) to investigate the efficiency of water splitting of these nanocomposites. The Pt, Pd and Ni NPs were loaded over TiO2 NTs through chemical reduction of the respective precursors. The morphology of the TiO2 NTs was observed to be produced as bundles. The metal NPs sensitized TiO2 NTs as spherical deposits. The H2 generation is larger with the addition of metal NPs and moreover lower quantity deposits produced better results. Pt NPs addition was better among the group in terms of H2 generation over the other metals of the same group. The Pt/TiO2 NTs with 5% metal sensitization generated H2 with a specific release rate of 241.8 μmol g^{-1} min^{-1}.

Biography:
Sahely Saha is Research Scholar at the Department of Biotechnology and Medical Engineering, National Institute of Technology in India under the supervision of Dr. Amit Biswas. Her current area of research includes biomaterials and tissue engineering. Previously, she has completed her Master's degree in Biotechnology and carried out a study based on bio-beneficiation of bauxite ore, as a part of her final year research work.

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