Paper Number: 3702
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DP session

Anti-bacterial Performance of Zirconia Coatings on Titanium Implants

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Bacterial adhesion and colonization are considered to play a key role in the pathogenesis of peri-implant disease, an inflammatory process leading to soft and hard tissue destruction around a Ti implant. The osseointegration of titanium implants is related to their composition and surface treatment. Zirconia coatings have been proved to increase their applications in the biomedical fields such as orthopedic devices and dental implants by improving implant osseointegration. In this study, doped ZrO_2 coatings with different Ag and Cu contents were deposited on bio-grade pure Ti implant materials. A twin-gun magnetron sputtering system was used for the deposition of the ZrO_2-Ag(Cu) coating. The Ag and Cu contents in the deposited coatings were controlled by the magnetron power and bias voltage. The films were then annealed using rapid thermal annealing (RTA) at 350 °C for 8 min to induce the nucleation and growth of Ag(Cu) particles on the film surface. WDS was used to characterize the composition of the deposited ZrO_2-Ag(Cu) coatings. The crystalline structure and bonding states of the coatings were analyzed by XRD and XPS. The antibacterial behavior will vary, depending on the amount and size of the Ag(Cu) particles on the coated Ti sample. In this study, *Actinobacillus actinomycetemcomitans* (*A. actinomycetemcomitans*) and *Staphylococcus aureus (S. aureus)* found frequently in the implant-associated infections, were chosen for *in vitro* anti-bacterial analyses by a fluorescence staining method employing Syto9 and bacterial viability agar tests. The antibacterial activity was quantified as the fluorescence detected at 488 nm by an ELISA (enzyme-linked immunosorbent assay). It showed that the nanostructure and Ag and Cu contents of the ZrO_2-Ag(Cu) coatings were correlated with the antibacterial performance.

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Keywords：Zirconia, Silver, Copper; Dental implants, Thin film, Nano structure