Surface modification of biomedical titanium using silver plasma immersion ion implantation (Invited talk)

Xuanyong Liu*[1] and Cao Huiliang

[1]State Key Laboratory of High Performance Ceramics and Superfine Microstructure, Shanghai Institute of Ceramics, Chinese Academy of Sciences – China

Abstract

Titanium-based implantable devices such as joint prostheses, fracture fixation devices and dental implants, are important to human lives and improvement of the life quality of patients. However, biomedical titanium is lack of osseointegration and antibacterium ability. Plasma immersion ion implantation (PIII) is a physical technique which can enhance the multi-functionality, mechanical and chemical properties as well as biological activities of artificial implants and biomedical devices. Silver (Ag) as a non-specific biocidal agent is able to act strongly against a broad spectrum of bacterial and fungal species, including antibiotic resistant strains. Here, we introduce the current progress of silver plasma immersion ion implantation into biomedical titanium in our group. Silver nanoparticles (Ag NPs) embedded titanium surfaces possesses efficient micro-galvanic effect controlled antibacterial activity and excellent cytocompatibility was fabricated via a single step silver plasma immersion ion implantation (Ag-PIII) process. The Ag-PIII samples inhibit the growth of both S. aureus and E. coli while enhancing proliferation of the osteoblast-like cell line MG63. Silver and nitrogen dual ions were sequentially implanted into titanium. The obtained results suggest that the Ag/N dual ions co-implanted process is an efficient way to obtain the titanium implant with high antibacterial activity, corrosion resistance and hardness. Size tunable Ag NPs are synthesized and incorporated into titanium oxide coatings (TOC) by manipulating the atomic-scale heating effect of Ag-PIII. The resulted Ag NPs/TOC composite coatings possess electron storage capability that gives rise to both controlled antibacterial activity and excellent compatibility to mammalian cells. In addition, silver ions was implanted into the bioactive nanostructural titania coatings using Ag-PIII technology. The surface of Ag-implanted titania coating not only showed a strong antimicrobial effect against oral microorganisms including S. mutans, Pg and C. albicans by the way of direct contact, but also had a great osteoconductivity with increased cell attachment, viability and osteogenic gene expression (ALP, Runx2 and OCN).

*Speaker