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# Cellular responses to titanium successively treated by magnesium and silver PIII&D

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## Abstract

Titanium and its alloys have been extensively used as materials for implantable biomedical devices because of their excellent properties in mechanics and corrosion resistance. Although these devices have achieved high success rates in improving the life quality of aged or injured individuals, still two major complications may be encountered: the lack of osseointegration and the device associated infections. Hence, surface modification of titanium based materials with selective function is highly desired, i.e. inhibit the adhesion of pathogenic bacteria but promote the positive responses of mammalian cells.

Accordingly, polished pure titanium plates were successively treated by plasma immersion ion implantation & deposition (PIII&D) with ion sources from filtered cathodic vacuum arcs of magnesium and silver (designated Mg PIII&D and Ag PIII&D), respectively. Scanning electron microscopy (SEM) observations revealed that nanoparticles were precipitated and bound to the titanium surface after Ag PIII&D. X-ray photoelectron spectroscopy (XPS) results indicated that these particles are metallic silver. Responses of both bacterial and mammalian cells were studied. The response of *Staphylococcus aureus* (*S. aureus*) and *Escherichia coli* (*E. coli*) cells were evaluated by the bacterial counting method and observed by SEM. The proliferation of osteoblast-like cell line MG63 cells on the titanium surfaces was examined according to the AlarmaBlue assay. The results indicated that the titanium surfaces can be functioned of balanced activity to bacterial and mammalian cells via the duplex PIII&D procedure.

Therefore, we conclude that the property of titanium can be balanced by simultaneously taking advantage of the biological nature of nutrient and toxic components, such as magnesium and silver.

**Keywords:** ion implantation, titanium, bacteria, magnesium, silver

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