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The controllable mechanical properties, cell adhesion, and antibacterial property to TiN coatings by Ag+Cu ion implantation fluence

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Owing to medical titanium alloy (Ti-6Al-4V) has relatively poor hardness, corrosion resistance and antibacterial activity, it is essential to take some surface modification treatments on the medical titanium alloy. In consideration of the excellent mechanical, cell adhesion, and antibacterial properties of implant materials, titanium nitride coatings combined with Ag and Cu ion implantation become the preferred chioice for the surface modification of medical titanium alloy.

TiN coatings were synthesized by multi-arc ion plating system, with medical titanium alloy (Ti-6Al-4V) as substrates. To obtain good cell growth antibacterial property, Ag and Cu ions were implanted to the surface of TiN coatings at different fluences via ion implantation system. The structure was observed by TEM and SEM. The hardness and elastic modulus of TiN coatings before and after ion implantation were surveyed using a Nanoindenter XP system. Cytocompatibility and antibacterial property of TiN coatings at different Ag and Cu ion fluences was evaluated by osteoblast and Escherichia coli(E. coli, DH5α) in vitro.

The hardness and elastic modulus increase with the increasing Ag and Cu contents, and the maximum value achieves 35 GPa and 330 GPa when the Ag+Cu fluence reaches 5×10^{17} ions/cm^2. In the cell proliferation experiment, compared with the group without ion implantation, the number of living cells grown on the surface with Ag+Cu implantation was more and had no downward trend in seven days. The antibacterial property of TiN coatings at 5×10^{17} ions/cm^2 was extremely ideal and almost no E. coli growth.

Keywords
ion implantation
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antibacterial property
cytocompatibility