Effect of noble metal (M=Ag, Au) concentration on mechanical and biomedical properties of Ti-M matrix thin films co-deposited by magnetron sputtering.

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ABSTRACT

Materials exhibiting superior mechanical properties and excellent biocompatibility are sought after for biomedical applications and implant manufacturing. This work explores a solution to extend the current lifetime of orthopaedic implants by coating the surface with thin films of harder biocompatible alloy systems. $Ti_{(1-x)}M_{(x)}$ (M=Ag,Au), thin films were deposited on glass substrates in increasing concentration of x= 0 to 1 by magnetron sputtering deposition in order to investigate the development of hardness and biocompatibility. As grown thin films were heat treated in Ar environment at elevated temperatures to aid the development of the desired intermetallic phase. Mechanical properties of $Ti_{(1-x)}M_{(x)}$ thin films were characterized by the nanoindentation technique and then corelated to the microstructure and morphology of the thin films studied by X-ray diffraction and electron microscopy. Cytotoxicity of sample extracts were characterized by counting the viable cells after exposure using Alamar blue assay and the corresponding ions leached in the extract solution was measured using inductively coupled optical emission spectroscopy technique. Results show that the Ti-Metal matrix develops different intermetallic structures with varying metal concentration in the thin films and the phase difference between these intermetallic reaches an optimised point with fine tuning of heat treatment condition which enables them to act as an inhibition source for the slipping of dislocation planes thereby enhancing the hardness of the film. A peak hardness value of 7.39GPa is achieved for Ti-Ag thin films from the formation of the tetragonal TiAg phase while a peak hardness of 14.9 GPa is achieved for Ti-Au thin films with the development of the β phase of Ti-Au intermetallic. All the sets of thin films exhibit extremely high biocompatibility with cell viability values greater than 90%.

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