TITLE: Mechanical performance of biocompatible Ti-Au thin films grown on glass and Ti_6Al_4V substrates.

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ABSTRACT

Ti-Au intermetallic based material systems are being extensively studied to develop hard and wear resistant biocompatible thin film coatings over implant devices to extend their lifetime [1, 2]. However, the measurement of these mechanical characteristics depends upon factors such as surface properties of the substrates and their temperature during thin film deposition. In this work, Ti-Au thin films were deposited by magnetron sputtering on both glass and Ti_6Al_4V substrates at two different temperatures. These films were studied for their mechanical properties by the nanoindentation technique in both load control and displacement control modes using a Berkovich tip. XRD patterns and cross section SEM images detail the microstructure while AFM images present the surface morphology of these Ti-Au thin films. Biocompatibility of the films is verified by cytotoxicity tests on L929 mouse fibroblast cells using Alamar blue reagent and the ions leaching in the film extracts is measured using the ICPOEMS technique. Standard deviation for hardness of films on glass substrates is ~4 times lower than that on Ti_6Al_4V substrates and is corelated to a corresponding increase in surface roughness from 2nm for glass to 40nm for Ti_6Al_4V substrates [3]. Increasing substrate temperature leads to an increase in film hardness from 5.1 to 8.9GPa and is related to the development of a super hard β phase of the Ti_3Au intermetallic. The standard deviation of this peak mechanical hardness value of 8.9GPa is reduced by 3 times when measured in displacement control mode compared to the value measured in load control mode due of the effect of nanoindentation tip penetration depth. All the Ti-Au thin films exhibit excellent cytotoxicity values above 95% and ion leaching below 100ppb. This work presents a comparative study to optimize hardness measurement of Ti-Au thin films, critical for a better understanding of these super hard biocompatible coatings.

Keywords: Nanoindentation, sputtering, biocompatible, Ti-Au Thin film,

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