PO4027

Development of new β-Ti coatings by sputtering process with low Young's modulus and favorable plasticity for medical applications

EMILIO FRUTOS TORRES[1], Jose Antonio Jiménez[2], Tomas Polcar[3]

[1]Czech Technical University in Prague, PRAGUE, Czech Republic [2]National Center for Metallurgical Research/Spanish National Research Council, Madrid, Spain [3] national Centre for Advanced Tribology at Southampton (nCATS)/University of Southampton, Southampton, United Kingdom

frutoemi@fel.cvut.cz

Low modulus b-Ti alloys, composed of non-toxic elements, such as: Ti, Zr, Nb Mo and son on, have been developed for biomedical applications. Their Young's modulus values lie between around 40 and 80 GPa. Nevertheless, yield stress values for metastable Ti alloys with only body-centered cubic (BCC) phase are too low for load bearing applications. Thereby, nowadays, there are many efforts in the search of alloys that combine high yield stress with Young's Modulus as close to the bone. The key to success is a diffuse ω pre-aging microstructure that enables a homogeneous distribution of α precipitation within the β grains. An increase of ageing temperature or time,will allow that ω phase is replaced by α phase, leading to a smaller precipitation and higher strength.
Sputtering techniques are extremely versatile with great potential to produce coatings along a wide temperature range in vacuum conditions, allowing aging precipitation of different phases and the coating during and/or after sputtering process. Therefore it could be a new route to produce b-Ti textured coatings free of toxic elements.
The focus of this work is to produce Ti-20Nb-XZr and Ti-20Mo-XZr (X=13 and 20 wt.%) coatings from singles targets of Ti, Nb, Mo and Zr, playing with various aging treatments that allow the precipitation of different phases (β, α' and ω) in the coating during and/or after sputtering process in order to get coatings with low Young's modulus and high yield stress. Preliminary results regarding to grain size, texture and residual stress magnitude, and therefore the higher and lower percentage of α' and ωphase, as a function of bias voltage on the substrate will be shown. Furthermore, we will correlate the magnitude of these residual stresses with the higher or lower yield stress value in the coatings.

Keywords
Beta-Ti alloys
Residual stresses
Young's modulus
X-ray diffraction
Biomedical applications