# Fabrication of Ti-Ta binary alloy for surgical implant by powder metallurgy

Present research aimed to develop novel Ti-Ta beta alloys for an objective to replace the classical Ti-6Al-4V alloy in surgical implants owing to its better biocompatibility. Alloys with various concentrations of Ta were prepared by powder metallurgy process. Microstructure and the mechanical properties of these alloys were investigated by using various methods.

The Ti-Ta beta alloys were developed aiming the replacement of the classical Ti-6Al-4V alloy in surgical implants owing to its better biocompatibility. Samples of these alloys were obtained following a powder metallurgy (PM) process: blending elemental powders, cold isostatic pressing at 180 MPa for 2h and a sintering process of the compacts for 2h in the range from 1250 to 1500 0C with a heating rate of 20 0C min-1. Then the alloys were characterized by optical microscopy (OM), scanning electron microscopy (SEM), X-ray diffractory, tensile test and dynamic elastic modulus test. Results indicate that the homogenization of the alloy is diffusion-controlled. Besides, the ultimate tensile strength of Ti-Ta products is greatly affected by the variation of temperature and composition: the specimen sintered at 1400 $^0$C shows the peak value as 917 MPa, and an increase in Ta content leads to a decline. So it is the trend with elastic modulus. It is worth mentioning that the PM products have a much higher ultimate tensile strength and lower elastic modulus than the conventional cast Ti-Ta alloys. A finer grain size and tantalum's solution strengthening may be accounted for the improvement in mechanical strength. The reduction in elastic modulus is closely related to the existence of pores, and a quantified model was conducted to reveal the correlation between porosity and elastic modulus. It has indicated that the Ti-Ta alloys prepared by powder metallurgy process have the great potential for biomedical applications.

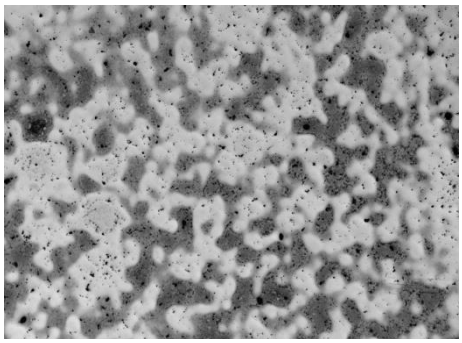
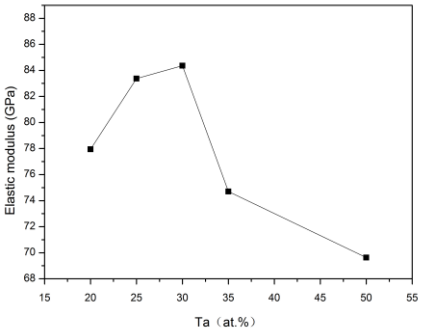


Fig.1 An OM image of typical diffusion-controlled two region structure for Ti-30Ta alloy sintered at 1400 $^0$C.



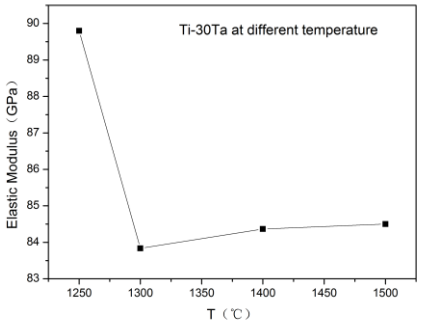




Fig.2 Variation in elastic modulus with sintering temperature and Ta content

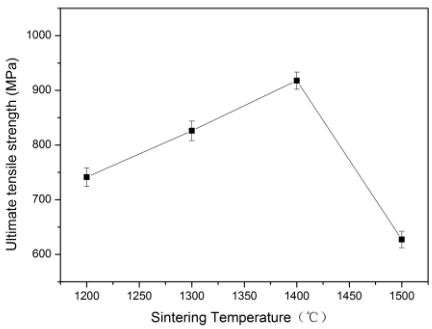



Fig.3 Variation of ultimate tensile strength with sintering temperature for T-30Ta alloy.

Keywords: powder metallurgy, scanning electron microscopy, Young's Modulus,
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