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Study of Surface Free Energy in Titanium Heart Treating

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Abstract – In this paper disks of commercially pure titanium grade 2 was heart treated and surface free energy of each disks were investigated. The contact angle was measuring using the sessile drop method and the surface free energy (SFE) were calculated using Fowkes Method. Surface free energy values were different for all disks studied.

The present study was performed on commercially pure titanium grade 2. Disks of 1,5 mm in thickness and 15 mm in diameter. Divided in seven groups of treatment, according to figure 1. After the thermal treatments, the disks were prepared through a metallographic procedure and, then, they were ultrasonically cleaned during 30 min, first in enzymatic detergent, secondly in ethanol (PA) and finally in water distilled to remove the fats present in the disks surfaces.

The sessile drop method was used in the wettability tests. The drop image was stored by a video camera and an image analysis system (surftens) calculated the contact angle from the shape of the drop. Three liquids were used as a probe for surface free energy calculations: glycerol, formamide and distilled water. The final contact angle used for calculation or for comparison of different samples was the average of each drop. The surface free energies of the different disks were calculated using a Fowkes model.

Fig. 2 clearly show that all disks presented different surface free energy. In order to compare the results more easily, histograms are drawn for the overall results. The surface free energy values are agreement with Ponsonnet, et al [1]. Clearly indicates that all groups of disks are visible different.

Thermal treatment	Symbol	Temperature	Cooling
Quenching	Q	1 100 °C	Air
Tempering at 200°C	T200	Quenching at 1 100°C and tempering at 200°C	Quenching – air Tempering - furnace
Tempering at 300°C	T300	Quenching at 1 100°C and tempering at 300°C	Quenching – air Tempering – furnace
Tempering at 500°C	T500	Quenching at 1 100°C and tempering at 500°C	Quenching – air Tempering - furnace
Thermal treatment at 300°C	TT300	Treated at 300°C	Furnace
Thermal treatment at 500°C	TT500	Treated at 500°C	Furnace
Commercial (annealed)	C	Without treatment	-

Figure 1 – Treatments and symbology.

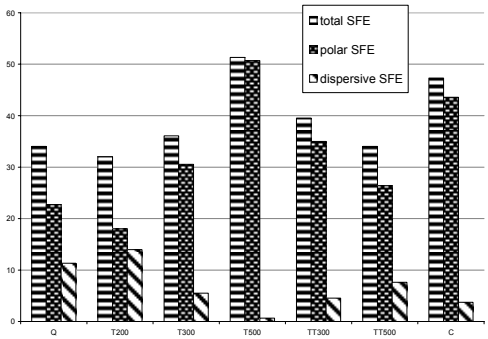

Figure 2 – Total surface free energy γ^s and for the polar (γ^p) and dispersive (γ^d) components of surface free energy calculated using the Fowkes approach.

[1] L. Ponsonnet, K. Reybier, N. Jaffrezic, V. Comte, C. Lagneaub, M. Lissac, C. Martelet. Materials Science and Engineering C 23 (2003) 551–560.