WEAR RESISTANCE OF HOT SWAGED AND HEAT TREATED TC21 TITANIUM ALLOY

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Titanium alloys have been widely used for advanced structural materials in aerospace applications, petroleum sector and military applications. The properties of titanium alloys can be improved by producing ultrafine grained structure using mechanical deformation. In addition, mechanical surface treatments such as shot peening and ball-burnishing are also widely applied to enhance the mechanical properties of titanium alloys as well as other materials. These surface treatments lead to a characteristic surface roughness, increased near-surface dislocation density (cold work) and development of macroscopic residual stresses. Shot peening is frequently applied to improve the fatigue strength as well as wear resistance. Therefore, in research work a titanium alloy with a composition of Ti−6,55Al−3,41Mo−1,77Zr (wt., %) was cast into bars in a graphite mould using vacuum induction skull melting furnace (ISM). The cast bars were hot swaged at 700 °C to reduce the cast bar diameter from 25 mm to 8,5 mm. Two different regimes of heat treatment were applied on the swaged samples. The first treatment process was applied at 1050 °C (above β-transus) for 30 min and then water quenching for getting fine lamella structure. In the second treatment, a step treatment was used where the samples were firstly heated to 1050 °C for 30 min.

and then the furnace cooled to 800 °C with a cooling rate of 1 °C/min and hold for 30 min at 800 °C then water quenching for getting coarse lamella structure. Both solution treatments were followed by ageing process at 500 °C for 24 h. The grain size of the as-cast structure was estimated to be 660 μm and the swaged samples obtained a very fine grain size in the range of 50 μm, as shown in Fig. 1. The best combination of hardness, tensile properties, and wear resistance of the α + β titanium alloy was achieved by heat treating the samples at 1050 °C due to the obtained fine lamellar structure of α + β. The minimum wear rate was reported for the heat-treated samples with fine lamellar structure and the maximum wear rate was obtained for as-cast samples due to its coarse and heterogeneity microstructure.

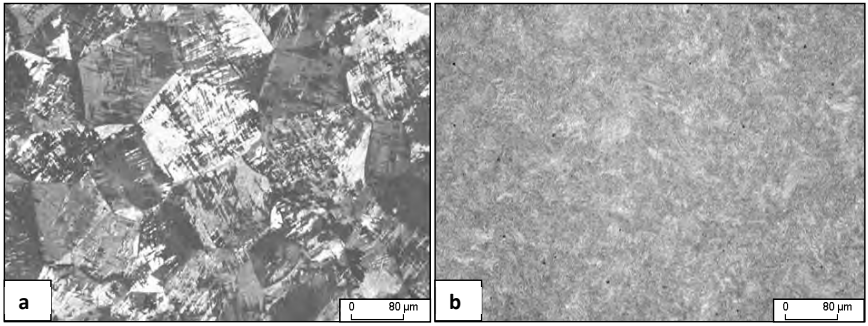

Fig. 1. Microstructure of the investigated TC21 titanium alloy: a – As-cast; b – Swaged