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HIGH-CYCLE FATIGUE BEHAVIOR IN THE ß-TYPE Ti-35Nb-7Zr BIOMEDICAL ALLOY SUBMITTED TO DIFFERENT HEAT TREATMENT CONDITIONS

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ß-Ti alloys containing non- toxic elements (Nb, Zr, Ta, Mo) have been widely investigated due to exhibit good results in terms of superelasticity, shape memory effect, low elastic modulus, and satisfactory biocompatibility. It has been reported that the Ti-Nb-Zr alloys rich in ß phase have potential characteristics for substituting the conventional materials such as Ni-Ti, Ti-6Al-4V, stainless steel and Co alloys. A flash-thermal treatment technique, which has been developed recently in order to improve the mechanical properties of the ß-type titanium alloys, results a highest ultimate tensile strength the by the ß grains refinement. Furthermore, for the biomaterials, the knowledge of fatigue properties is essential to ensure high reliability for orthopedic, medical and dental implants. The fatigue resistance of titanium and its alloys are reported in the literature as of the utmost importance, since fatigue is a major cause of failed orthopedic implants. The fatigue life of titanium alloys depends directly on the thermomechanical processing route, the cooling rate imposed on the alloy and chemical composition, which are factors responsible for determining microstructure. In view of these facts, this work aims to evaluate the effect of the flash-thermal treatment on high-cycle fatigue behavior Ti-35Nb-7Zr (wt. %) for biomedical applications. This is an ß-Ti alloy and the motivation of this study is based on results of the microstructural and mechanical properties obtained at DEMAR/EEL-USP previously. The Ti-35Nb-7Zr alloy presented in this work was produced from materials of commercial purity (Ti, Nb and Zr) in arc furnace under argon atmosphere. After melting, the ingots with the initial diameter of 18 mm, were submitted to solution heat treatment (homogenized) at 1000°C/2h and water quenching (WQ), cold worked by forging up to 84% in area reduction. The forged bar was recrystallized under two different conditions, 1000ºC/2h WQ and 700ºC/70min WQ, and then submitted to flash-thermal treatment into a pre-heated salt bath of 600ºC for a short time of 360s - WQ. The microstructural analyses were performed by optical microscopy, scanning electron microscopy, X ray diffraction techniques and Vickers hardness test. The mechanical characterization was carried out using a tensile test for determining the tensile strength of proof stress yield strength, the Young's modulus and elongation. The high-cycle fatigue tests were performed by rotary bending fatigue machine. With respect to the set of properties, the best results can be considered for recrystalized condition at 1000ºC/2h + Flash. According to the results of the high-cycle fatigue tests, also the flash-thermal treatment was important to obtaining the higher fatigue life. The results obtained in this work confirm the possibility of using the Ti-35Nb-7Zr alloy for biomedical applications.