INFLUENCE OF HOT ROLLING ON β Ti MULTIPRINCIPAL ALLOYS FOR BIOMEDICAL APPLICATION

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SUMMARY

Increasing in life expectancy the revision surgeries have become more frequent in implanted people. Among the main reasons that contribute to this increase, we can mention two meaningful problems. The biomechanical incompatibility, when elastic modulus value of the implant's materials is higher than that of the bone, leading the phenomenon known as stress shielding. The biological incompatibility, the presence of chemical elements such as Al, in Ti-6Al4-V, alloy, and Ni, in stainless steels, can cause health problems, such as Alzheimer's and cancer, respectively). This works aims is to analyze the influence of the hot rolling process (thermomechanical), on the microstructure, and consequently, properties of β-Ti multiprincipal alloys: Ti-27Nb-29Zr, Ti-40Nb-40Zr and Ti-25Nb-25Zr-25Ta (wt.%.) β-Ti alloys (equimassic and with high content of β-stabilizer elements) were cast through an arc melting furnace under argon protective atmosphere of from high purity elements (>99%), named here as the as-cast condition. Subsequently, they were submitted to a hot rolling process at 900ºC until reach 50% of thickness reduction, named as hot-rolled (HR) condition. All samples were subjected to characterization through X-ray diffraction (XRD) to determine the phases present and via optical microscopy (OM) and scanning electronic microscopy (SEM) were realized to characterize the microstructure and confirm the phases obtained through XRD. In the as-cast condition (AC), all alloys presented the β phase, while in the HR

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condition the β phase (body-centered cubic) and α″ - stress-induced martensite (SIM – orthorhrombic) were observed. As consequence, it not observed significant changes in microhardness (from 228 to 227 HV) for the alloy Ti-40Nb-40Zr (wt.%.), while a reduction of the 26% in the elastic modulus (from 91 to 70 GPa) and, 42% in the grain size (from 133 to 71 µm) was observed. A reduction of 5.6% in the microhardness (from 247 to 233), 13% in the modulus of elasticity (from 83 to 72), and 60% in the grain size (from 241 to 96 µm) were observed for the metallic alloy Ti-25Nb-25Zr-25Ta (wt.%.). Similarly, a decrease of 3.3% in microhardness (from 245 to 237 HV) for the alloy Ti-40Nb-40Zr (wt.%.), 46% in the elastic modulus (from 77 to 41 GPa) and, 51% in the grain size (from 242 to 199 µm) was observed. On the order hand, the recrystallization process led to a more refined microstructure after the rolling process. Finally, hot rolling processing was confirmed to be a useful route in order to reduce the elastic modulus for β Ti multiprincipal alloys opening perspectives of application of such alloys as metallic implant materials.

REFERENCES

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