HEAT TREATMENT OF METASTABLE BETA TI ALLOY APPLIED TO PRODUCE IMPLANTS WITH ADJUSTABLE STIFNESS

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Ti alloys are usually applied in the manufacturing of femoral hip stems due to high biocompatibility, high corrosion resistance and low elastic modulus. It is well known that high elastic modulus stems increase bone stress shielding, while less rigid materials lead to micromotions at the bone/implant interface. The problem is to design a device that addresses both limitations at the same time and the answer involves a stems with adjustable rigidity. Metastable β Ti alloys can show different mechanical properties. These properties are related to types and amounts of alloying elements, processing route and phase transformation pathway. In this work, a new concept of hip stem with graded stiffness is presented. Aging heat treatments are applied to adjust mechanical properties of metastable β Ti alloys and obtaining a variable stiffness hip stem. In this device, the proximal region of the stem was heat treated to assist α phase precipitation and hence, obtaining high elastic modulus, while the proximal section was subjected to solution heat treatment to result in low elastic modulus. The results obtained show that it is perfectly possible designing orthopedic devices from metastable β Ti alloys with graded mechanical behavior. Stem with elastic modulus varying from 65 GPa to 110 GPa was produced.