Nanostructured biocompatible Ti-Nballoys processed by severe plastic deformation

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Titanium and its alloys are the most favored metallic implant materials in the field of trauma and orthopedic surgery. The elastic admissible strain, defined as the ratio of yield strength to elastic modulus, is a useful parameter in orthopedic applications of metallic materials. The higher the admissible strain, the more suitable is the material for such applications.
Ti alloys consisting of mainly the bcc-beta phase and containing non-toxic elements such as Nb,Zr, and Ta have recently drawn substantialattention because they exhibit lower Young'smoduli, reducing the stress shielding effect.
In this work the effect of various severe plastic deformation techniques (Equal Channel Angular Pressing -ECAP, High Pressure Torsion –HPT, and Accumulative Roll Bonding –ARB) on the microstructure and mechanical properties of beta-typeTi-Nb alloys was investigated. As a result of the high imposed strains, coarse bcc grains are effectively refined to the ultrafine or nanoscale level and this leads to superior mechanical properties. Strain-induced nanostructure formation during SPD was investigated by transmission electron microscopy. An increase up to 40% of the strength and/or hardness of the ARB and HPT samples was recorded and that was achieved without a concomitantincrease in Young's modulus (E~ 63 GPa).
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