Paragraph Ran in the Queries

Paper Title: Medium-entropy Zr–Nb–Ti alloys with low magnetic susceptibility, high yield strength, and low elastic modulus through spinodal decomposition for bone-implant applications

Content :

Mechanical testing

Dog-bone-shaped samples were prepared with a gauge length of 8 mm, a width of 2.5 mm, and a thickness of either 2 mm or 0.4 mm for tensile tests, as described in a previous study [53]. Tensile tests were conducted at a deformation rate of 0.3 mm/min using a universal testing machine (Instron 5565, Canton, MA, USA) at RT. A strain gauge (Instron, AVE 2-2663-901) was used to measure the strains of the tensile samples. Following tensile testing, the fracture surfaces of the samples were examined using SEM. The microhardness measurements were conducted using a microhardness tester (ZHVST-30F, China Shanghai Yuanlong Optical Machinery Technology Co. Ltd.) under a load of 5 kgf and a dwell time of 15 s.

Friction and wear testing

Friction and wear tests of the three ZNT−650 MEAs and commercial Ti64 (annealed) were performed using a high-speed reciprocating friction tester (HSR-2M, Lanzhou Zhongke Kaihua Technology Development Co. Ltd., China). The tests were carried out under a wear load of 200 gf, friction stroke length of 5 mm, friction frequency of 1 Hz, and testing time of 30 min using an Al_2O_3 ball (5 mm in diameter) as the friction pair. Samples with a gauge length of 10 mm, width of 5 mm, and thickness of 0.4 mm were prepared by EDM and ground with SiC paper up to 2000 grit. The surfaces of the samples and friction pair were cleaned using ethanol before the dry sliding wear test. To ensure the reproducibility of the results, each group of samples was tested at least three times. The mass wear loss of the samples before and after the friction and wear testing was measured using an electronic balance.

Mechanical properties of ZNT MEAs

Tensile true stress-strain curves for the ZNT−AC, ZNT−650, and ZNT−800 MEAs and bar charts of their mechanical properties are shown in Fig. 4. For a clear comparison, the tensile properties of the alloys are also summarized in Table 1. Fig. 4(a) shows the true stress-strain curves for all ZNT–AC alloy samples. The σ_{ys} and σ_{uts} gradually decreased but ε increased with increasing Ti content. As shown in Fig. 4(b), the ZNT–650 MEAs exhibited better mechanical properties than the ZNT–AC MEAs. ZNT_{10}–650 exhibited the highest σ_{ys} and σ_{uts} of 1223 MPa and 1295 MPa, respectively, and the σ_{ys} increased by about 263 MPa compared with its AC counterpart, followed by ZNT_{15}–650, with a σ_{ys} and σ_{uts} of 1203 MPa and 1264 MPa, respectively, and the σ_{ys} increased by about 251 MPa compared with the AC counterpart. The ε of ZNT–650 MEAs increased slightly compared with the ZNT–AC MEAs, suggesting that spinodal decomposition simultaneously enhanced the strength and ductility of the ZNT MEAs. As for the ZNT–800 MEAs, their σ_{ys} and σ_{uts} were significantly lower than those of the ZNT–650 MEAs, but still higher than those of the ZNT–AC MEAs. Moreover, the ZNT–800 MEAs showed the highest ductility due to recrystallization. Overall, the ZNT–650 MEAs exhibited the best comprehensive tensile properties.