Deformation characteristics of Ta-based amorphous alloys in microcompression test

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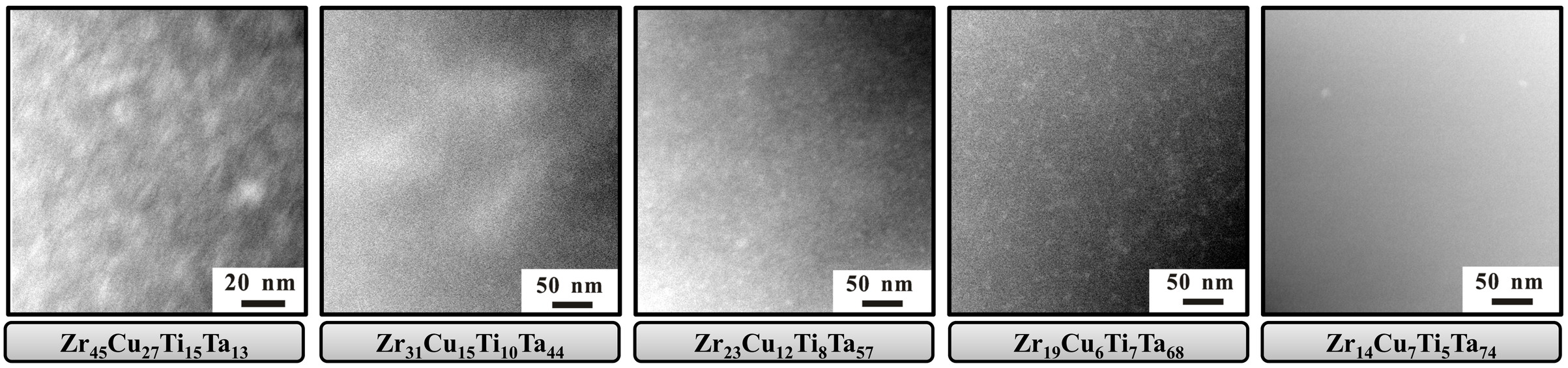
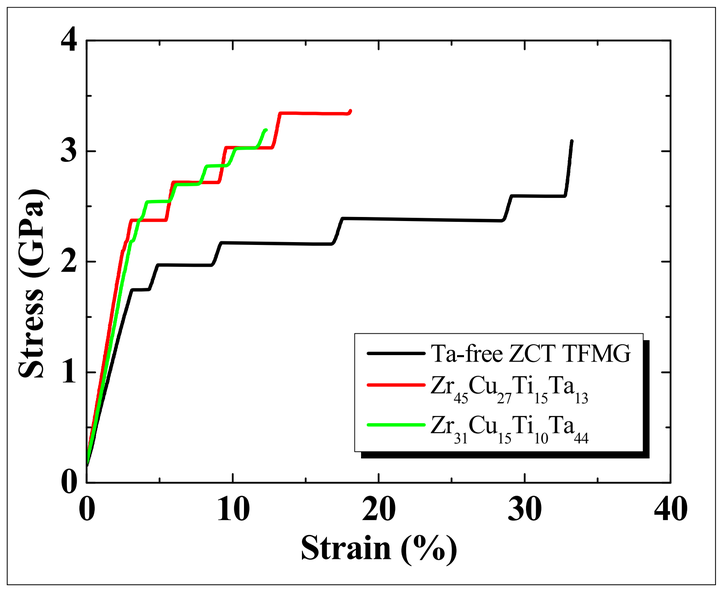
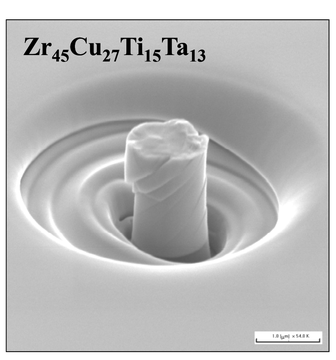
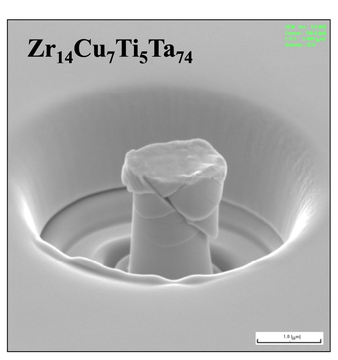
Abstract

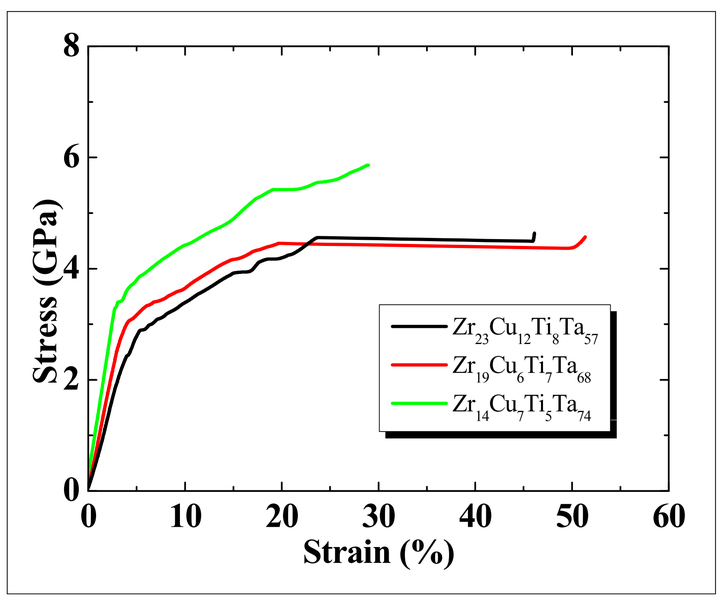
The amorphous alloys composed by the immiscible alloy system are usually hard to fabricate because of a low glass forming ability. However, the vapor deposition technique let the fabrication of the kind of amorphous alloys become possible. In this study, the high-strength TaZrCuTi thin film metallic glasses were fabricated via magnetron sputtering. The elastic modulus and hardness is ~140 GPa and ~10 GPa, respectively, by the nanoindentation measurement. In addition to a higher elastic modulus and hardness, how the micropillar in the Ta-based alloy system deforms in the uniaxial mechanical test is interesting. Utilizing the focus-ion-beam technique, the micropillars of Ta-based thin film metallic glass are fabricated. The microcompression test is performed at nanoindenter platform equipped with flat-end tip. The stress-strain curve revealing the deformation closed to continuous deformation implies the deformation might be homogenous, indicating that the deformation phenomena in Ta-based thin film metallic glass is different from that in typical amorphous alloy systems.

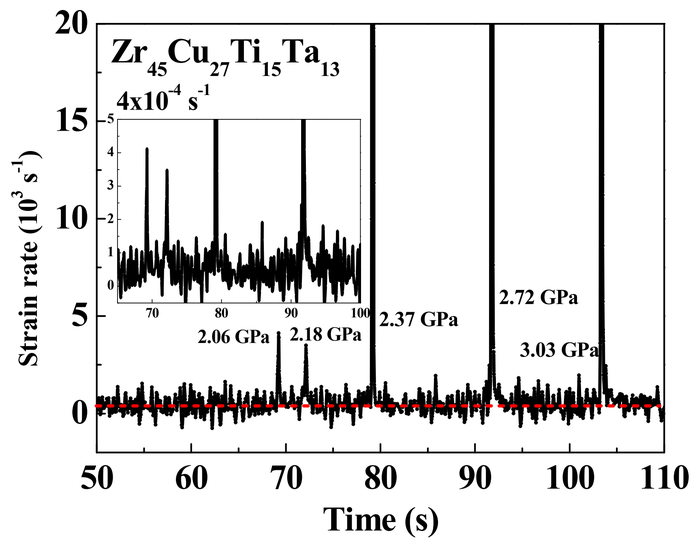


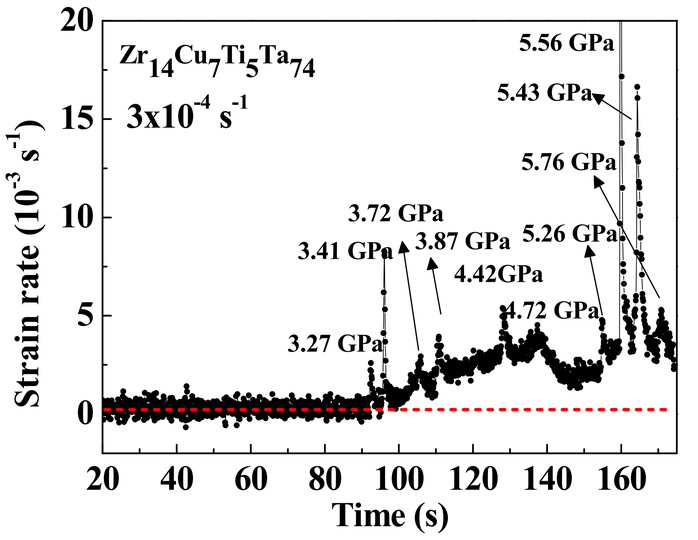


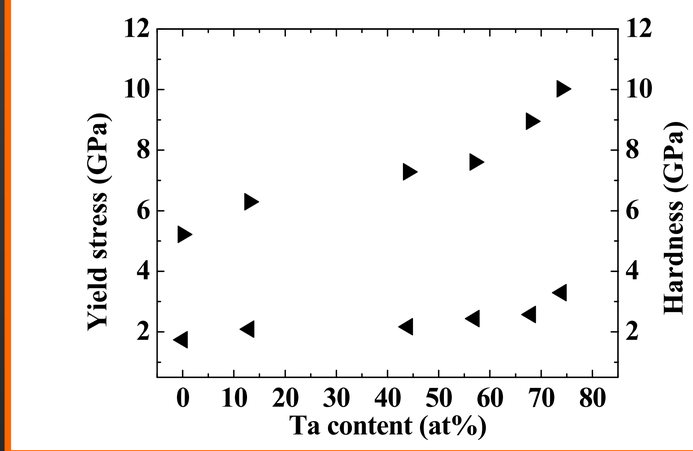


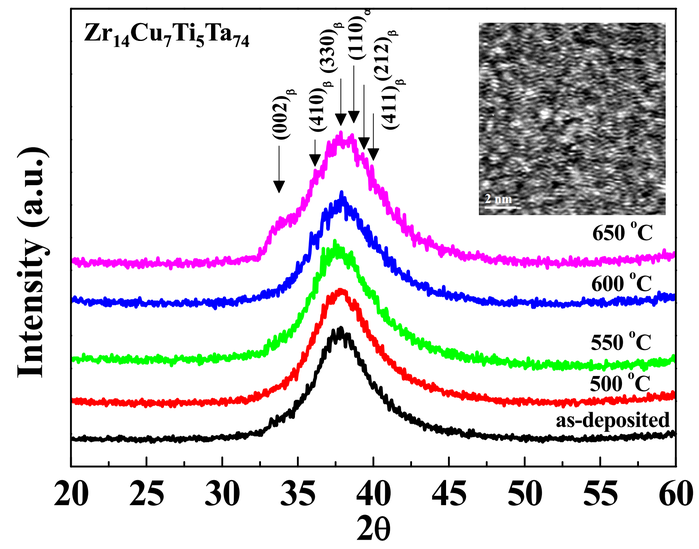












Conclusion

- ***Except for the W-, Ni-, Co, and Fe-based amorphous alloys, Ta-based TFMGs exhibit the higher modulus and hardness values, reaching 140 GPa and 10 GPa, respectively.***
- ***Ta-Ta self-type bonds which induces the structural inhomogeneity in Ta-rich ZrCuTiTa TFMGs are the key factor influencing the non-linear increment in hardness***
- ***The nanoclusters in shear bands would move with shear-band propagation. The friction between these nanoclusters and matrix exhausts the kinetic energy of shear bands. Thus, shear bands can not propagate immediately.***