Interface energy and its influence on mechanical behavior of inclined ZrCu/Zr micropillars

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Abstract

In this paper, the interface nature of metallic glass ZrCu/crystalline Zr is characterized through evaluating its energy and validated by the mechanical response of micropillar with ~45° inclined interface under compression. The strong adhesion of the ZrCu/Zr interface is further confirmed by the fact that shear fracture occurs within the Zr layers rather than along the interface when compressing the ZrCu/Zr micropillars with 45° inclined interface.

Results and discussion

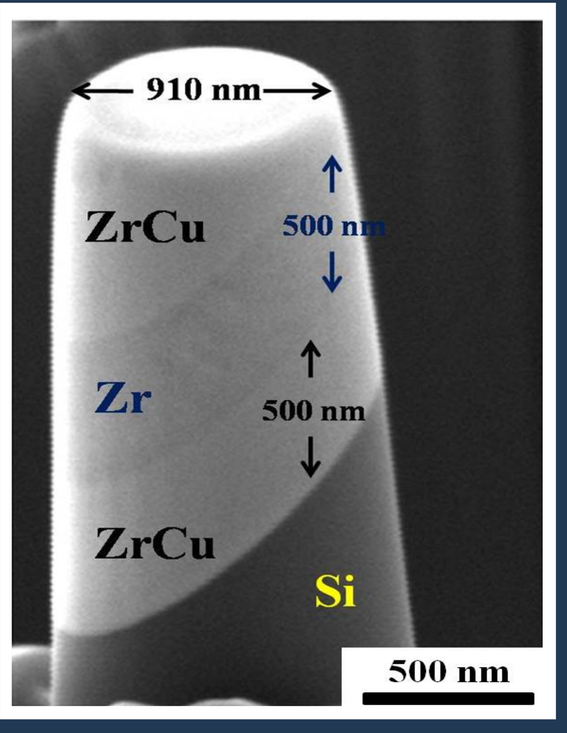

Figure 1 SEM image of the undeformed multilayered pillar, with labels of the diameter, height, and composition.

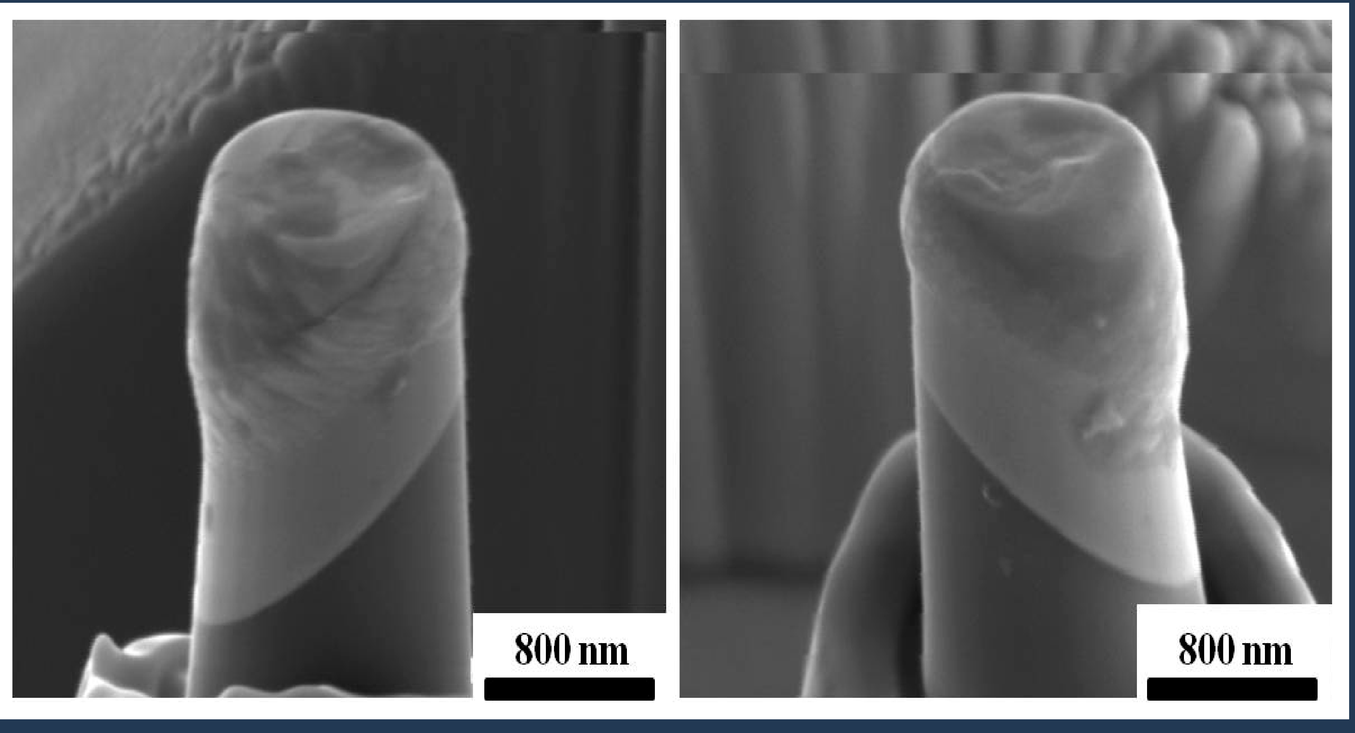

Figure 2 SEM images of the pillar deformed to the preset displacement of 260 nm, taken from two opposite sides of the pillar.

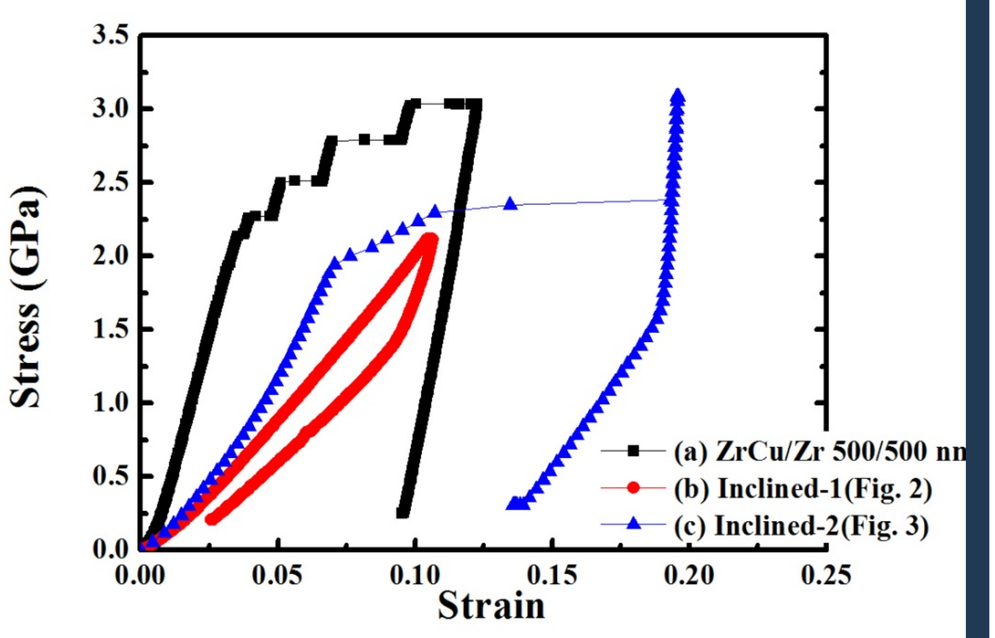

Figure 4 The compression stress and strain curves of the 500/500 ZrCu/Zr multilayered pillars with interfaces perpendicular or inclined to the loading direction.

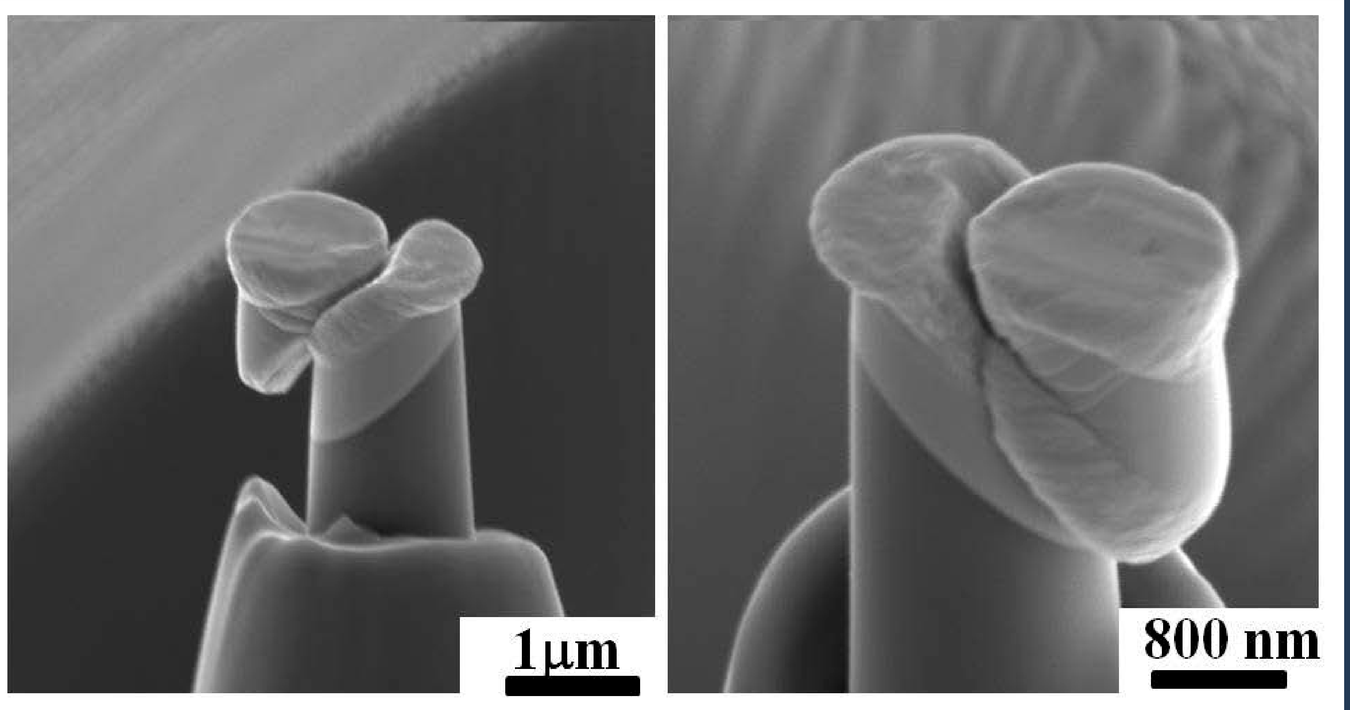

Figure 3 SEM images of the pillar deformed till to failure, taken from two sides of the pillar.

Conclusions

The interfaces were observed to be strong and maintain homogeneous-like deformation during the whole straining process. During inclined micropillar compression, the shear fracture occurs not along the interface, but within the metallic Zr layers. This study provides some useful physical data in designing safe metallic amorphous/crystalline thin film coatings and MEMS devices.