

Supplementary Information

Effects of notches on the deformation behavior of submicron sized metallic glasses: insights from *in situ* experiments

R. Lakshmi Narayan^{1,2}, Lin Tian², Danli Zhang², Ming Dao^{3*}, Zhi-wei Shan^{2*}, K. Jimmy Hsia^{4*}

¹Department of Materials Science and Engineering, Carnegie Mellon University, Pittsburgh, PA 15213, USA

²Center for Advancing Materials Performance from the Nanoscale (CAMP-Nano); Hysitron Applied Research Center in China (HARCC), State Key Laboratory for Mechanical Behavior of Materials, Xi'an Jiaotong University, Xi'an, Shaanxi 710049, P.R. China.

³Department of Materials Science and Engineering, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, MA 02139, USA

⁴Department of Mechanical Engineering and Department of Biomedical Engineering, Carnegie Mellon University, Pittsburgh, PA 15213, USA

*To whom correspondence should be addressed; E-mail: kjhsia@cmu.edu; zwshan@xjtu.edu.cn; mingdao@mit.edu

On comparing TEM images of the specimens before and after failure, we find that the width of the ligament undergoes no change. This confirms that the specimen has undergone failure by shear localization instead of necking. For thinner specimens, on first viewing, it appears that flat fracture has occurred in middle of the specimen. However, we mentioned that out-of-plane fracture occurs in the $t \sim 200$ nm specimen because of two reasons. First, the periphery of the fracture surface has a different contrast than the rest of the specimen, indicating that it has thinned in the thickness direction. And two, we further tilted the indenter holder to 30° after failure and observed that the failed specimen in Fig. 2 (c) has an out of plane slant as seen in the Fig. R1 shown below.

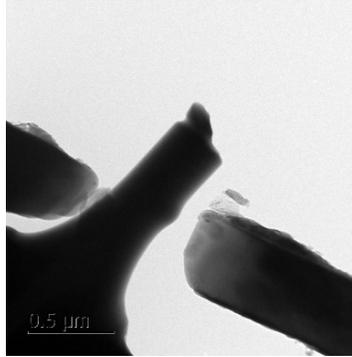


Fig. S1. Post-facto TEM image of the blunt notched specimen ($t \sim 200$ nm) after tilting the specimen holder by 30° .

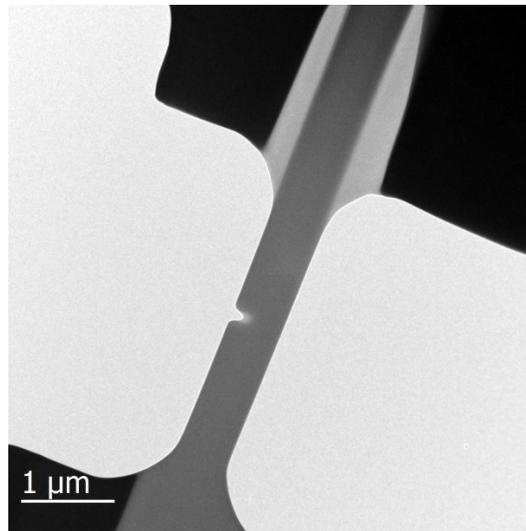


Fig. S2: TEM image of a single edge notch CuZr specimen just before failure. Note the small plastic zone envelope around the notch tip.

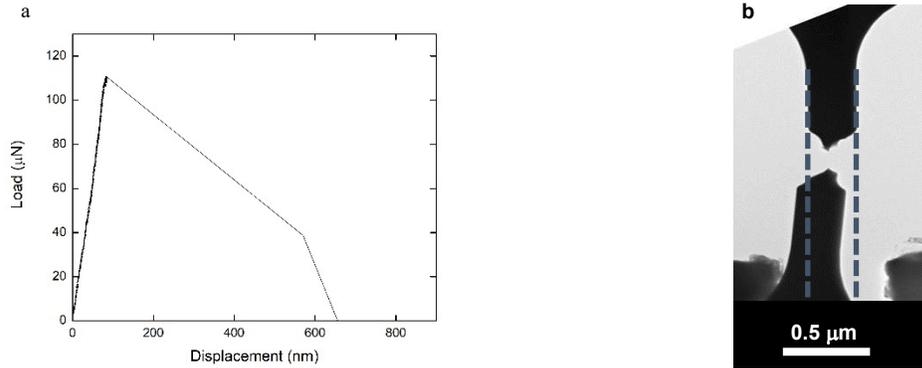


Fig. S3. (a) Load versus displacement curves depicting a large load point displacement during failure and indicating that the fracture surfaces slide over each other during failure. (b) superimposed dotted lines on post-facto image of specimen (see Fig. 2b) to show that the bottom half is horizontally misaligned w.r.t. the top half just after the test (See also corresponding video S1a)

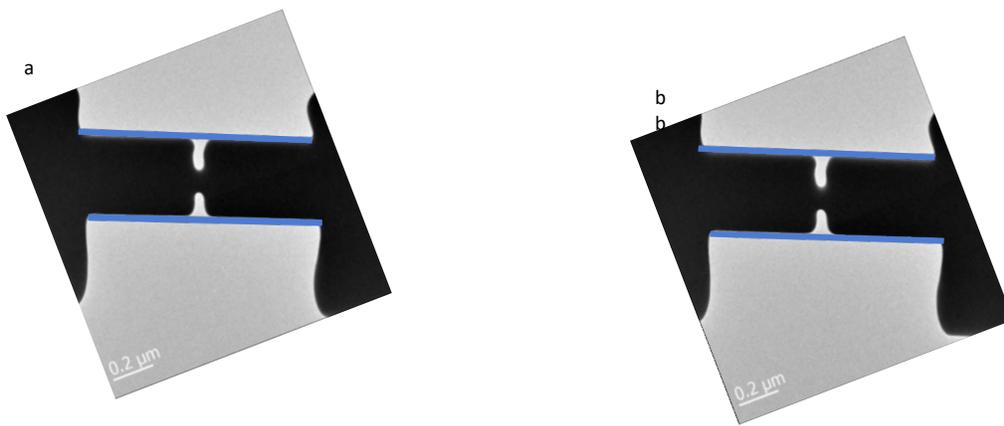


Fig. S4. TEM snapshots of PTP specimen undergoing deformation at (a) 0% strain, and (b) 5% strain. Note that the specimen does not experience any bending displacements throughout the test.