**Supplementary information**

Supplementary Figure 1.

SEM images of the $\phi = 800 \text{ nm} \text{ Cu/HEA} \text{ micropillar with } h = 50 \text{ nm}$ before (a) and after (b) the uniaxial tests. (c) Cross-sectional STEM image of the micropillar. (d) Plastic strain for each constituent layer along the load axis (the red solid line in c) as a function of the number of layers.