

Supplementary Videos

Video S1 *In-situ* TEM observation of nanoscopic deformation of nt-Cu nanopillar under compression at a relatively high strain rate of about $3.1 \times 10^{-4}/\text{s}$ (10 times speed up).

Video S2 *In-situ* TEM observation of nanoscopic deformation of nt-Cu nanopillar under compression at a medium strain rate of about $1.3 \times 10^{-4}/\text{s}$ (10 times speed up).

Videos S3-S6 *In-situ* TEM observation of nanoscopic deformation of nt-Cu nanopillars under compression at an ultralow strain rate of $2.3 \times 10^{-5}/\text{s}$ (5 times speed up).