Atomic Resolution in-situ Electron Microscopy Study of Micro-twin Enhanced Mechanical Property of Nano-Materials

Ze Zhang

Center of Electron Microscope, State Key Laboratory of Silicon Materials, Department of Materials Science and Engineering, Zhejiang University, Hangzhou, 310027, China

In this talk, we shall report on recent atomic resolution in-situ electron microscopy study of strain induced micro-twins and mechanical properties enhanced by twins. Our results show that the dislocation picture of plasticity from bulk materials gives the way to micro-twins as the size of materials go down to tens of nanometers for FCC material[1].

References

[1] Z. Zhang et al., Nat. Commun. 4 (2013) 1742.

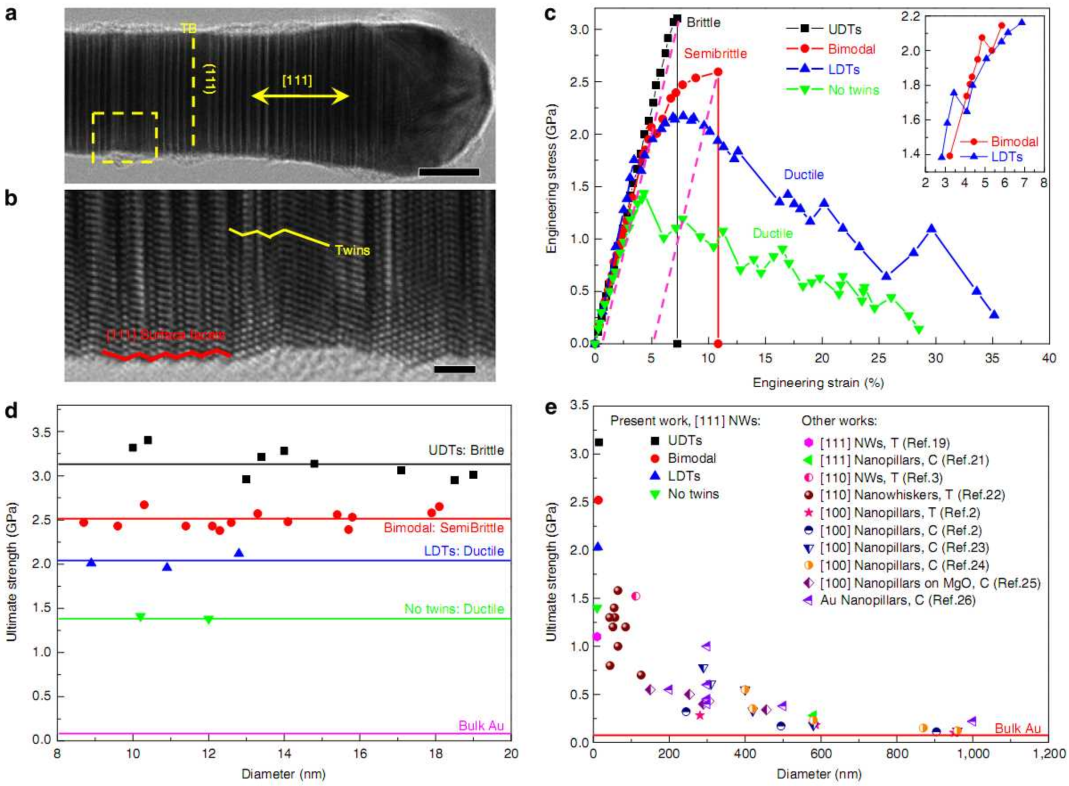

FIG. 1. Microstructure and mechanical properties of ultra-twinned Au NWs. (a) Morphology of as-synthesized Au NW. Scale bar, 10 nm. (b) High-resolution TEM (HRTEM) image of the yellow-boxed area in a shows UDTs distributed along the NW axis ranging from three atomic layers (0.7 nm) to a few nanometres. {111} microfaceting can also be observed at the free surface. Scale bar, 2 nm. (c) Representative stress–strain curves for Au NWs with different structures obtained by in-situ TEM–AFM experiments. Dash lines in pink colour indicate the permanent inelastic deformation after fracture. The diameter of samples with either UDTs or bimodal structures are almost identical, 14.5 and 13.4 nm respectively. The inset shows a close-up view of the yield points in the specimens with bimodal and LDTs. (d) Strength distribution in Au NWs with different fracture modes tested in this study. (e) Comparison of ultimate strengths in Au nanocrystals deformed by tension (T) or compression (C) experiments. The flow stress at 10% strain is used as the ultimate strength of compression tests on nanopillars.[1]