New modes of imaging for in situ TEM nanomechanical testing

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This talk will highlight recent advances with in situ Transmission Electron Microscopy (TEM) nanomechanical testing techniques that provide insight into small-scale plasticity and the evolution of defect structures in materials. In addition to measuring the strength of small-volumes, measuring the evolution of strain during plastic deformation is of great importance for correlating the defect structure with material properties. Here we demonstrate that strain mapping can be carried out during in-situ deformation in a TEM with the precision of a few nanometers without stopping the experiment. Our method of local strain mapping consists of recording large multidimensional data sets of nanodiffraction patterns using a high-speed direct electron detector. This dataset can then be reconstructed to form a time-dependent local strain-map with sufficient resolution to measure the transient strains occurring around individual moving dislocations. This talk will describe our recent results from in situ TEM nanomechanical testing that provide insight into multiscale phenomena using these techniques, such as the role of short range ordering in Ti alloys, superelastic deformation in oxides and deformation phenomena in metallic glasses.

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