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# Local strain measurements during in situ TEM deformation with nanobeam electron diffraction

A.M. Minor[1,2], C. Gammer[1,2,3], Y. Deng[4], C. Ophus[1], P. Ercius[1], J. Ciston[1]

[1.] National Center for Electron Microscopy, Molecular Foundry, Lawrence Berkeley National Laboratory, Berkeley, CA 94720
[2.] Department of Materials Science & Engineering, University of California, Berkeley, CA 94720
[3.] Physics of Nanostructured Materials, Faculty of Physics, University of Vienna, Austria
[4.] Laboratory of Solid State Microstructure, Nanjing University, Nanjing 210093, P.R. China

This talk will highlight recent advances with in situ Transmission Electron Microscopy (TEM) nanomechanical testing techniques utilizing scanning nanobeam electron diffraction techniques to map local strain [1,2]. In addition to providing insight into 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. With the advent of fast direct electron detectors and controlled *in situ* mechanical testing techniques, local strain mapping can be carried out during in-situ deformation in a TEM with the precision of a few nanometers without stopping the experiment. The technique of local strain mapping consists of recording large multidimensional data sets of nanodiffraction patterns before, during and after the experiment. 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 defects. We have recently used this technique to probe the evolution of strain in metals during *in situ* tension and nanoindentation tests, and in ferroelectric materials during bending and compression. The combined results demonstrate that local strain measurements can provide enhanced information (see Figure 1) during *in situ* mechanical testing with a spatial resolution varying from many nanometers down to atomic resolution.

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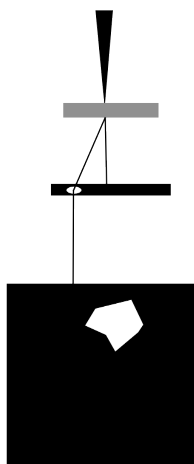


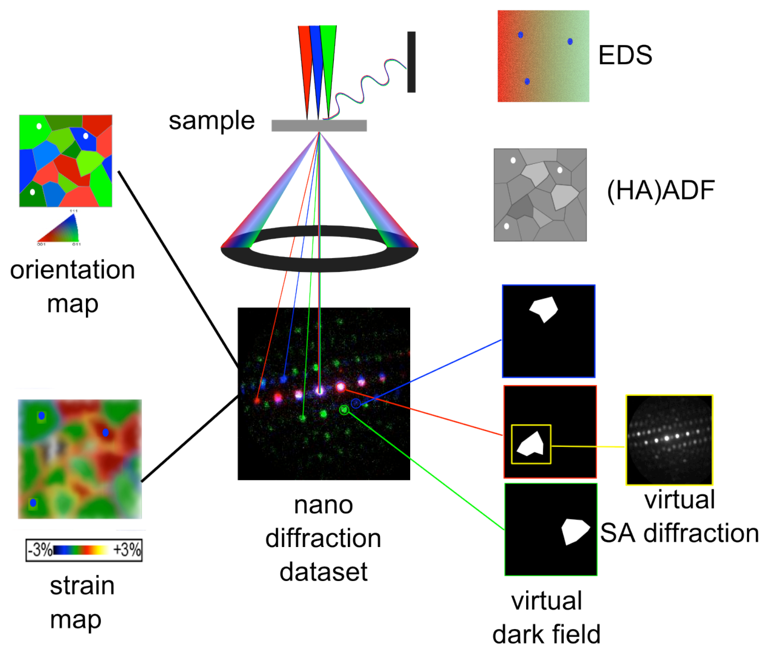


**Figure 1.** Schematic comparing a typical TEM imaging scheme to the information-rich dataset generated by nanodiffraction mapping in an electron microscope.

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