In-situ Microscopy for Sub-10nm Materials

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With the development of semiconductor technology, the 10 nm feature size of fabrication is approaching. It is thus quite essential to explore more precise nanofabrication and characterization method to evaluate the shape/structure stability and possible new properties of sub-10nm material components, especially under external stimuli such as strain, electric, or thermal fields. Along with the reduction of dimensions, the surface-to-volume ratio of the materials increases. For a 10 um particle, only about 0.036% of atoms occupy the surface positions, and the percentage rise to ~36% and ~62% for a 10 nm and a 6 nm particle respectively. Furthermore, surface atoms are preferably reconstructed for adapting their geometrical and electronic structure to the environment. Thus, the surface structure begins to dominate material properties ranging from electronic and structural aspects when the characteristic dimension is reduced to sub-10 nm. Here we review our recent progress in atomic resolution nanofabrication and dynamic characterization of sub-10nm individual nanostructures and nanodevices based on the idea of "setting up a nanolab inside a transmission electron microscope".