Diffractive Imaging of Individual Molecular Nanostructures

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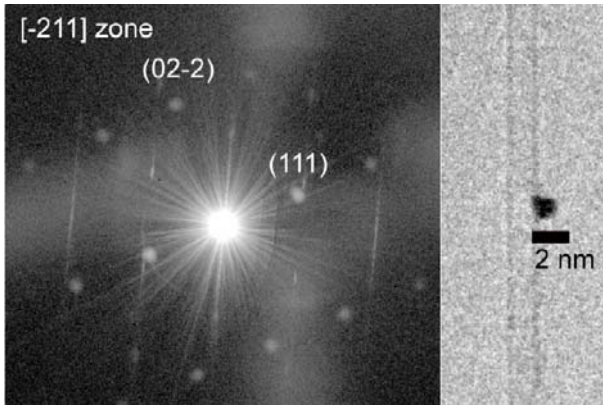
A major scientific challenge is how to determine the 3D atomic structure of small nanostructures, including single molecules. Coherent diffractive imaging (CDI) is a promising approach. Recent progress has demonstrated coherent diffraction patterns can be recorded from individual nanostructures and phased to reconstruct their structure. However, overcoming the dose limit imposed by radiation damage is a major obstacle toward the full potential of CDI. One approach is to use femtoseconds X-ray pulses. In electron diffraction, amplitudes recorded in a diffraction pattern are unperturbed by lens aberrations, defocus and other microscope resolution limiting factors. Sub-Ångstrom signals are available beyond the information limit of direct imaging. Significant contrast improvement is obtained compared to high resolution electron micrographs. Progress has also been made in developing time resolved electron diffraction and imaging for the study of ultrafast dynamic processes in materials. This talk will cover these crosscutting issues and the convergence of electron and X-ray diffraction techniques toward structure determination of single molecules.



Figure, The large scattering cross section of electrons makes it a probe very sensitive to small nanostructures. This electron diffraction pattern was recorded from a single wall carbon nanotube and an Au nanoparticle less than 2nm in diameter. The scientific opportunity and challenge are how to develop such probe for single molecule imaging.

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