Mapping strain, charges, and bandgaps at sub-nm spatial resolution by transmission electron microscopy

Prof. Christoph Koch, HU Berlin

The mechanical, electrical, magnetic, and even optical properties of bulk materials and nanostructures depend on the 3-dimensional arrangement of atoms and charges within them. Modern transmission electron microscopy (TEM) makes it possible to see atomic arrangements in 3D, measure strain, electrostatic, and magnetic fields with sub-nm spatial resolution, and obtain spectroscopic information from individual atoms. After a short introduction of the technique and its capabilities I will first present our own recent work on pushing the limits of TEM in the area of mapping charge distributions and strain in semiconductor devices as well as electronic properties and eigenmodes of plasmonic nanostructures with sub-nm spatial resolution. I will also show how the theory of artificial neural networks helps us to invert the inevitable multiple scattering of the probing electrons and extract the three-dimensional arrangement of atoms it encodes.