New opportunities within modern transmission electron microscopy

Tom Willhammar
Department of Materials and Environmental Chemistry, Stockholm University

Transmission electron microscopy (TEM) is a powerful tool for characterization at the nano scale. To use electrons as probes have several advantages over the use of photons or neutrons. The charged nature of the electron makes them interact stronger with matter compared to other types of radiation, decreasing the necessary size to obtain single crystalline data. They can also be precisely controlled, which e.g. enables the formation of images. The electrons are accelerated by high voltages, which will result in a short wavelength allowing for imaging at the atomic scale.

Recent developments in the field have opened up new possibilities. Some of these led to the development of Cryo-Electron Microscopy, which was awarded the 2017 Nobel Prize in Chemistry.

One important development is the introduction of aberration correction to modern TEMs. By correcting aberrations introduced by imperfections in the lenses, a sub-Ångström sized probecan be created. This opens up for the acquisition of images with a resolution of ~70pm, but also for spectroscopic maps, so called Electron Energy Loss Spectroscopy, with atomic resolution.

Electron diffraction is also undergoing a significant evolution at the moment where the TEM is now transformed into a single crystal electron diffractometer. By the collection of three dimensional electron diffraction data the TEM has evolved to a powerful tool for the determination of crystal structures from small crystals in the far sub-micrometer range.

This talk will introduce some of these methods and describe how the new aberration corrected ‘Themis Z’-microscope, recently installed at Stockholm University, will bring new opportunities to materials characterization.