Environmental electron microscopy studies of catalyst nanoparticles

The Environmental TEM (ETEM) is a TEM which enables us to observe specimens under a gas-controlled environment. A volume around the specimen is filled with selected gases so that the pressure of the volume is kept higher than that of the TEM column. This is realized by using a differential pumping system, which enables pressures up to 103 Pa around the specimen and still maintaining high vacuum (10-6 Pa) at the electron gun. In combination with heating/cooling TEM holders, the ETEM is used for in-situ observation of reaction processes between the specimen and the introduced gasses, revealing dynamical structural changes in real time and with atomic resolution.

At DTU Cen, one of the largest research areas is catalysis, with particular attention towards methanol production from H2 and CO2. Catalysis research relies heavily on transmission electron microscopy for microstructural characterization. In order to optimize the active surface area, many catalysts consist of metals or metal alloys, deposited onto a support material as nanoparticles. Copper-zinc and Ga-based nanoparticles are very active towards methanol synthesis. Their activity, stability and crystal structure are studied with comparative techniques and with the ETEM, which elucidates the nanoparticle evolution along the designed catalytic path.

Other examples of ETEM studies (Lithography, FEBID, Graphene growth) will be also shown.