**. CCMX-ScopeM … ..**

**2024**

**Aberration corrected STEM/TEM**

Rolf Erni

Empa, Electron Microscopy Center

Abstract

Introduced into commercial electron microscopes about two decades ago, aberration correctors have become standard optical units in state-of-the-art (scanning) transmission electron microscopes. These complex optical units have boosted the spatial resolution in imaging as well as the sensitivity in analytical measurements. Later is mainly due to a higher flexibility in balancing electron probe size versus beam current, and of course, also benefits from new technologies in analytical equipment used for electron energy-loss spectroscopy and energy-dispersive X-ray spectroscopy. The improved spatial resolution in imaging that comes along with the aberration-corrected optics enables single-atom imaging as well as atomic-scale imaging at reduced electron energies. Nowadays, high-resolution images images can be analyzed to extract quantitative data about the amount of atoms. The enhanced sensitivity in imaging has led to atomic 3D imaging of nanomaterials. Moreover, reducing the electron energy while maintaining sufficient resolution to observed individual atoms, makes it possible to image certain classes of beam sensitive materials that otherwise would be damaged during the exposure to the high-energy electron beam.

This lecture provides a brief introduction into the concepts of aberration-corrected (scanning) transmission electron microscopy. After discussing a couple of practical examples that demonstrate the benefits of aberration-corrected electron microscopy, a classification of aberrations is introduced, followed by a brief historical overview of the development of nowadays aberration correctors. Finally, the two main optical approaches are introduced that are used to correct spherical aberration and practical implications for aberration-corrected high-resolution TEM and STEM are discussed. Finally, a short outlook beyond correction of the spherical aberration is given.

Contact details

Empa – Swiss Federal Laboratories for Materials Science and Technology

Electron Microscopy Center

Ueberlandstrasse 129

CH-8600 Dübendorf, Switzerland

E-mail: [rolf.erni@empa.ch](mailto:rolf.erni@empa.ch)

Phone: +41 58 765 4080