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TÉMA

Transmission electron microscopy imaging and spectroscopy of nanomaterials

Marek Malac

**National Institute for Nanotechnology, (NINT)
and Department of Physics, University of Alberta, Edmonton, Canada**

Transmission electron microscope (TEM) has been used for materials characterizations for decades. With the interest in nanoscience and nanotechnology the possibility to reveal morphology, structure and physical properties at nearly atomic resolution led to vigorous development of TEM methods. Here we will discuss two methods in particular: the momentum resolved electron energy loss spectroscopy (qEELS) and hole free phase plate imaging in TEM. Both methods can be combined with all analytical capabilities of a modern TEM providing insights into material structure relation to its properties.

The qEELS allows to study electronic excitations of nanoscale objects and their dispersion relations. As a result it is possible to identify the origin of spectral features such as bandgap transitions and Cerenkov radiation. Furthermore, qEELS is needed to investigate non-dipole regime of excitations in plasmonic devices.

Phase plate imaging in a TEM uses a concept analogous to Zernike imaging in light optics. An unscattered electron wave is phase shifted relative to the scattered beam improving the efficiency and low dose imaging of many radiation sensitive objects. A particular set up, referred to as hole free phase plate, uses an uniform thin film and the incident electron beam itself to set up a phase plate in-situ.

The principle, practical implementation and example applications of the above methods will be illustrated.

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