MEP project: Aberration retrieval in SEM

Case

Scanning Electron Microscopes (SEMs) are versatile tools that are widely used for imaging and analysis in both academic research and industry. Knowledge about a sample's structure and composition is of value for life sciences, material research as well as process control in semiconductor manufacturing.

In high resolution scanning electron microscopy, the image quality is determined by the source brightness and the objective lens aberrations. To improve the instrument's imaging performance, an aberration corrector is required. The Charged Particle Optics group of the Imaging Physics department has found a promising approach to cancel these aberrations using a mirror corrector[1]. To tune the aberration corrector for best SEM performance, all corrector electrodes must be energized correctly. Measuring the contribution by any optical element to the total aberrations of the (un)corrected microscope is an essential stepping stone in reaching this condition.

Several ideas exist to quantitatively retrieve aberrations from a SEM image (See e.g. Figure 1). Several SEMs as well as samples are available to test these ideas on feasibility, accuracy and robustness.

Task

The master student (m/f) will work together in a small team of scientists to select the one or two most promising approaches to retrieve the aberrations of a SEM. Some theory needs to be worked out and translated into an experimental plan. For instance, to define the conditions to record distorted SEM images from which the aberrations can be retrieved. And, of course, (s)he will get trained how to operate a state-of-the-art SEM independently.

Daily supervision: Dr. Ir. Diederik Maas d.j.maas@tudelft.nl

Project supervision: Prof. Dr. Ir. Pieter Kruit p.kruit@tudelft.nl

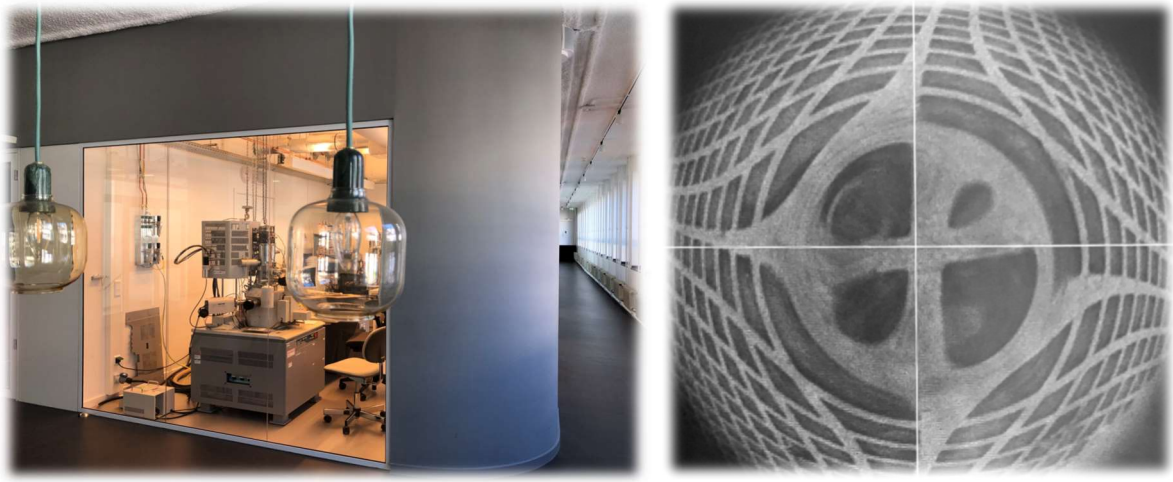

Figure 1 Left: SEM in VLLAIR (ground floor of D-wing TNW building). Right: distorted SEM image of a regular square metal grid, recorded using ''unfavourable'' beam scan conditions to visualize the effect of the SEM's objective lens aberrations.

[1] *Design for an aberration corrected scanning electron microscope using miniature electron mirrors*, Hideto Dohi and Pieter Kruit, Ultramicroscopy **189** (2018) 1–23