

## Development of a spatial light modulator for electrons

Jo Verbeeck<sup>1</sup>, Armand Béch <sup>1</sup>.

<sup>1</sup>. EMAT, University of Antwerp, Groenenborgerlaan 171, 2020 Antwerp, Belgium.

During this talk we will present the state of the art and progress in the development of a programmable phase plate for electrons, to be used in a transmission electron microscope. Conceptually, the phase plate consists of an array of 48 einzel lenses that control the phase of 48 coherent electron beamlets through a user-controlled voltage applied to their central electrodes. Such device provides unprecedented control over the phase of a coherent electron beam, allowing applications in complex beam forming, adaptive aberration correction, (adaptive) contrast enhancement, focusing inside thick scattering objects, selective detection of surface plasmonic modes and many more. A proof of concept 2x2 pixel device was demonstrated earlier [1] and here we report a scale-up of this design through an ERC funded POC project ADAPTEM [2]. We report on the outcome of a lithographic production step delivering a range of phase plates with different pixel geometries in a cost-effective and reproducible way. We discuss the mounting of such phase plate chips into an existing TEM and demonstrate the capabilities of the custom designed electronics and software to efficiently control them from a user interface. We show first experimental results of the behaviour of the phase plates in the electron beam and demonstrate some of the new capabilities that are becoming available via this device.

### References:

- [1] J. Verbeeck, A. B ch , K. M ller-Caspary, G. Guzzinati, M. Anh Luong, M. Den Hertog. "Demonstration of a  $2 \times 2$  Programmable Phase Plate for Electrons." *Ultramicroscopy* **190** (2018), 58–65. doi:10.1016/j.ultramic.2018.03.017 and <http://arxiv.org/abs/1711.11373>.
- [2] The ADAPTEM project is funded by the European Research Council as an ERC POC project under grant nr: DLV-789598.