"Modern electron microscopy at multiple scales”

Many questions in cell and developmental biology ask for 3D imaging of objects at multiple length scales, ranging from entire systems - organs or model organisms - to cellular structures. In the first lecture “Imaging systems at the nanoscale - from cells and tissues to 3D-printed metamaterials” we will introduce some of the most common methods to create such volume data at nanoscale resolution. The advantages and limitations of electron tomography, focused ion beam nanotomography (FIBSEM), and serial blockface scanning electron microscopy (SBFSEM) will be compared with array tomography, the method of our choice. Examples from different fields in biology, medicine, and materials science will illustrate how intelligent imaging strategies (hierarchical imaging) and combining methods can help to reduce the amount of data that have to be generated, handled and analysed.

For the opposite end of the length scale, imaging of subcellular components at quasi-atomic/molecular resolution Cryo Electron Microscopy is the gold standard to obtain information about structure-function relationships of macromolecular complexes. Current state-of-the-art instrumentation and possible future developments will be discussed in the second lecture: “Macromolecular imaging - past, present, future”. In particular, high-resolution Single Particle Analysis (SPA) and Cryo Electron Tomography will be illustrated by biomedical and materials science examples from our lab.

Explanations to images

Lecture 1: Immunological synapse between zebrafish immune cell and human tumour cell (purple, only partially shown), from Wacker et al. Journal of Microscopy (2015) 259:105–13

Lecture 2: ActoS1, from Wulf et al. PNAS (2016) E1844-E1852