Helium Ion Microscopy (HIM)

The Zeiss Orion Plus Helium Ion Microscope in Bielefeld

A Helium Ion Microscope (HIM) is capable to image conductive as well as insulating samples without special treatment, in particular it allows imaging of unstained biomaterials and cell surfaces. HIM has the potential to become the routine microscopy for material science and nanotechnology, as well as in life science and biotechnology. We are interested in all questions ranging from image formation and contrast mechanisms to materials imaging, bioimaging and lithography. Further information about HIM is provided in our article ‘Das Heliumionen-Mikroskop: Mikroskopie mit geladenen Teilchen’ [link to journal].

Free-standing CNMs

A collection of different CNMs on hexagonal copper grids is presented, exhibiting the different types of features that are visible in HIM images. From these images, one intuitively obtains an impression of the detailed shape of the copper grid and the CNM on top. In a) larger folds on the upper side of the image and one rupture in the centre are visible. b) is an example of a membrane rolling up at a rupture, showing the high flexibility of CNMs. Small folds like those in c) are frequently observed, while wrinkling of the freestanding membrane (d) is less often observed.
Freestanding Carbon Nano Membranes on copper grid (a-c) and graphene (d).

Soot from ethylene flames
Morphological variations of nascent soot collected from the ethylene C3 flame at heights of 0.5, 0.8 and 1.2 cm and imaged by HIM, showing representative primary and aggregate structures. Particles shown in the hexagons are in the apparent size range of 4-8 nm; those in the squares are 14-18 nm. Particles shown in the circles are apparent aggregates.

Iron-cobalt oxide films
HIM images show significant differences in CVD grown film morphology as the composition of iron and cobalt changes. The precursor was varied from 100% iron (left column) to 80% iron (right column).
CVD grown films of iron and cobalt mixed oxides.

Mammalian cells
In specimens sputter coated with gold (top row) with a standard thickness of approx. 10 nm, the cell membrane is covered with clustered gold, masking the true cell surface. The effective charge compensation in HIM allows a high resolution inspection of uncoated cell surface in the native state (bottom row).

Cells on glass with and without coating.