

# Transmission Electron Microscopy

## Titan TEM/STEM (sub-Å spatial & <100 meV energy resolution)

### Thermo Fisher Scientific Titan Themis S/TEM

Equipped with:

- image and probe correctors, achieving spatial resolutions < 80 pm

Spectrometers for:

- Energy Dispersive X-ray (EDX) spectroscopy and
- Electron Energy Loss Spectroscopy (EELS) as well as Energy Filtered TEM (EFTEM), which, with use of the monochromator, can reach energy resolutions < 0.1 eV

Available acceleration voltages: 300, 200, 80 and 60 kV



### Available sample holders:

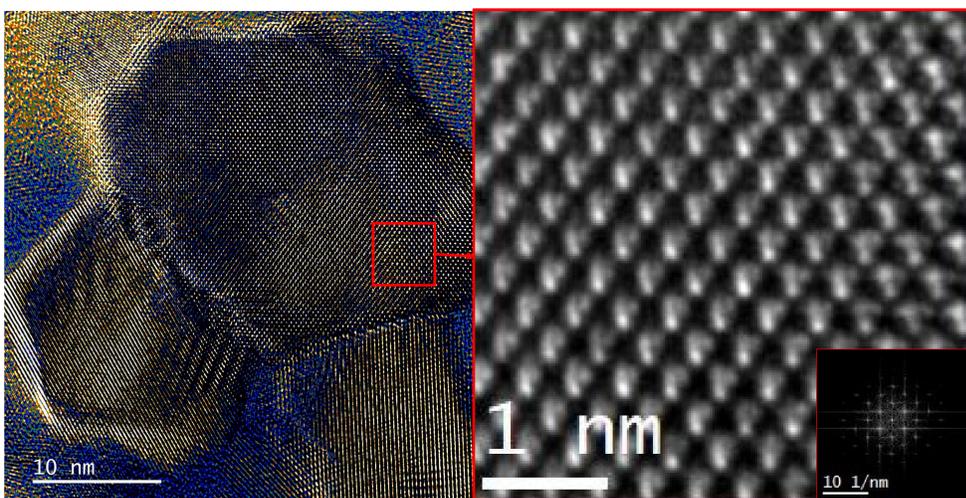
- single tilt, double tilt and tomography holders

- in-situ holders:

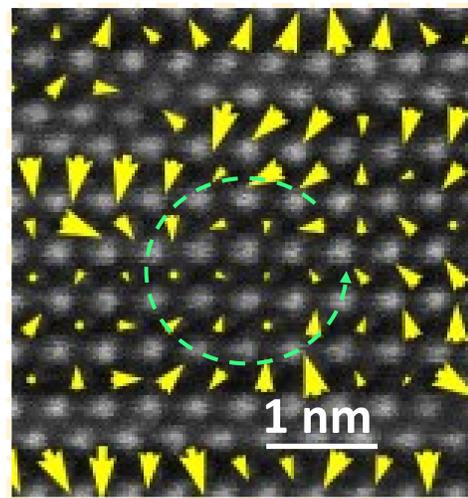
- heating and biasing (*Lightning*) double tilt holder for measurements up to 1300°C at currents down to the pA range
- Gas (*Climate*) holder for measurements up to 800°C at pressures up to 1 bar under gas flows of 0.01 to 0.4 ml/min
- Liquid (*Ocean and Stream*) holders for measurements in static or flowing liquids with flow rates from 25 nL to 10 µL per minute, also under biasing or heating
- Cryo-transfer tomography holder with operating temperatures as low as -175°C for 4 hours at sample tilts up to 80 degrees



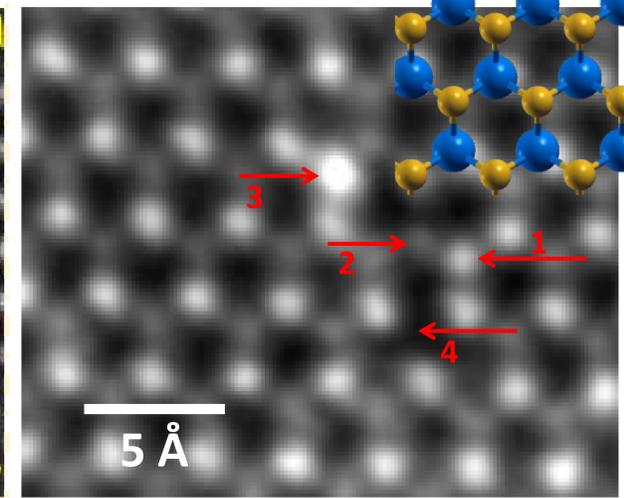
### Example images



Atomic resolution images of organic crystals, i.e., pharmaceutical crystals of flufenamic acid (FFA), exhibiting hexagonal morphology (left image), with the atomic column arrangement in the red box shown magnified in the right image (the inset displays the FFT of this image).



Revelation of sub-Å shifts (indicated by yellow arrows on a relative scale) of individual atoms in a ferroelectric material ( $\text{Bi}_6\text{Ti}_4\text{Fe}_2\text{Mn}_2\text{O}_{18}$ ), leading to electric dipole formations (which, in this image, have the shape of a vortex, as indicated by the green, dashed circle)



2-D  $\text{MoS}_2$  implanted with Se at ultra-low energies ( $\sim 10$  eV) with  $10^{15}$  ions/cm<sup>2</sup> resulting in:  
1 Se in S position,  
2 Foreign atom in Mo position,  
3 Adatom,  
4 Sulfur divacancy

The Bernal Institute has furthermore an FEI Tecnai30 which can be used for TEM imaging