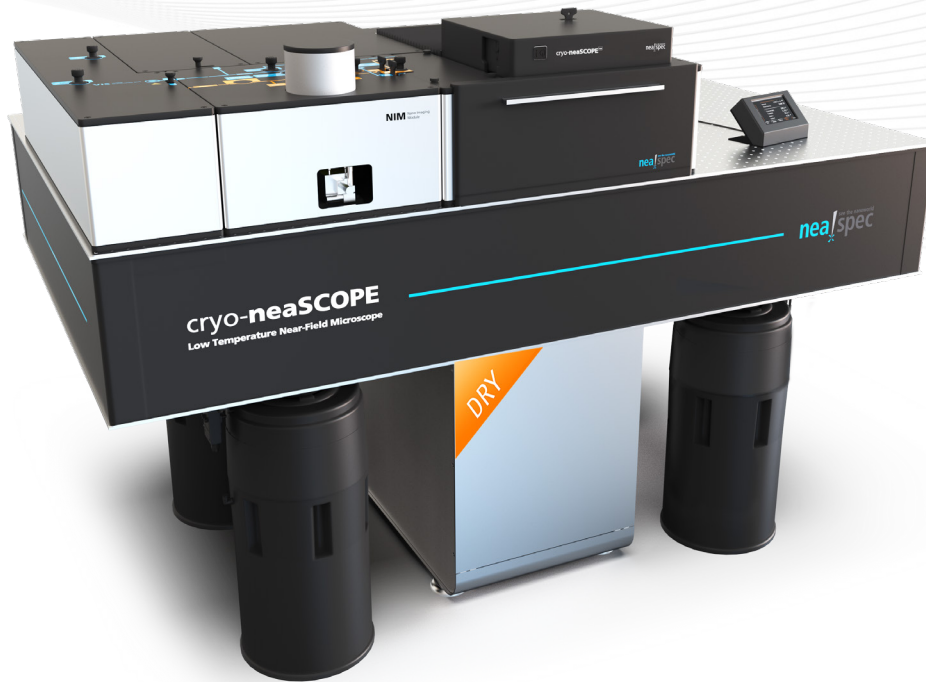




attocube

WITTENSTEIN group



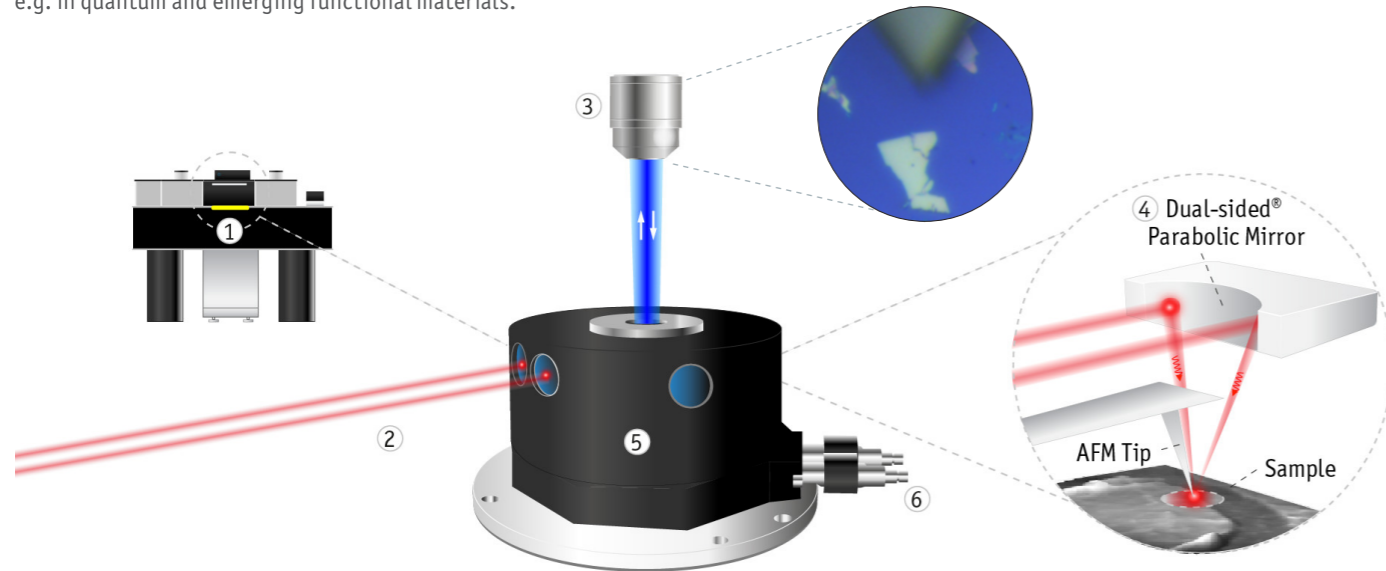
cryo-neaSCOPE^{+xs}

nano-imaging and spectroscopy at extreme environmental conditions

Optical Nanoscopy at Cryogenic Temperatures

exploring material properties across broad wavelengths and temperature ranges

cryo-neasCOPE⁺ enables near-field optical nanoimaging and spectroscopy at variable temperatures down and below 10K. The instrument is designed for high-quality near-field optical measurements in an unmatched spectral range from visible to IR and even THz frequencies. The system thus provides access to a full range of relevant energy scales for studying physical properties and a wide range of novel phenomena, e.g. in quantum and emerging functional materials.



- ① unique vibration isolation designed for high interferometric stability
- ② two optical access ports to the parabolic mirror for extra flexibility
- ③ top-view objective for optical sample inspection, widefield microscopy and confocal access

- ④ patented dual-beam parabolic mirror for precise focusing of multiple noncollinear beams
- ⑤ exclusive closed-cycle cryostat with high thermal stability for high-quality AFM and repeated measurements on the same ROI
- ⑥ integrated electric feedthroughs for electrical & photocurrent measurements



Low Vibration cryo-AFM
designed for high-sensitivity AFM and interferometric s-SNOM measurements across full temperature range.



Fast Turnaround Time & Low Costs
due to a fully automated cryogen-free closed-cycle dry cryostat.



Covering VIS, IR and THz
due to reflective optics and patented parabolic mirror design.

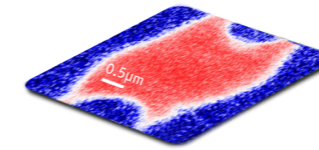


Pump-Probe Support
using integrated pump sources for investigating nanoscale ultrafast dynamics.

Highlighted Use-Cases

for condensed matter physics research

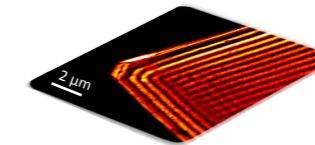
cryo-neasCOPE⁺ users investigate the intricacies of electronic transport, phonon polaritons, 2D electron gases, exciton polaritons, and phase transitions at the nanoscale, enhancing our understanding and driving innovations that promise to revolutionize key research areas and transform crucial industries.



Local Semiconductor Transport Properties

Investigate conductive properties such as carrier concentration, mobility, confinement at interfaces.

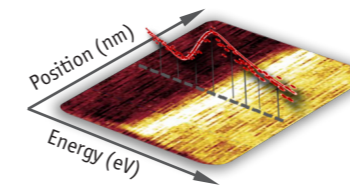
Boselli et al., Phys. Rev. B 103, 075431 (2021)



Surface Polariton Dispersion Engineering

Manipulate and study polariton propagation, damping and confinement in a wide range of materials.

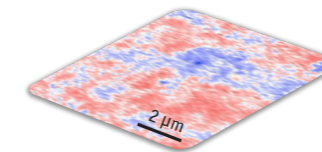
see e.g. L. Liu et al. Nature 644, 76 (2025)



Exciton Properties at the Nanoscale

Visualize the effect of local defects, strain and twist in the exciton spectra of 2D materials with unprecedented spatial resolution.

A. S. Roche et al., Nano Letters 25, 12166 (2025)



Metal-Insulator Phase Transitions

Study the effect of nanoscale domains formation, their stability and dynamics as a function of temperature.

K. Tiwari et al., Adv. Func. Mat. e07075 (2025)



General instrument specifications

system operation	automated cool down, fully integrated AFM and nano-IR operation
cryostat type	fully damped, low vibration, closed cycle cryostat integrated in optical table
temperature range	variable: sub 10 K < T < 300K
sample inspection	integrated top-view optical microscope; optical resolution < 2 μm
sample coarse positioning	closed-loop patented slip-stick positioners; range in x,y,z: 10 mm x 8 mm x 3 mm
supported spectral ranges	VIS, NIR, mid-IR, THz; suitable windows are provided
focusing optics	motorized, high-NA dual sided parabolic mirror objective (NA = 0.49)
electrical feedthroughs	up to 4 shielded SMA feedthroughs thermalized to sample temperature

AFM specifications

AFM design	optical readout AFM; sample scanning
supported AFM modes	tapping & contact AFM (topography, phase, error signal); KPFM
AFM scan range @ LT	x,y,z: 24 μm x 24 μm x 3 μm
AFM topographic z-noise (RMS)	typical: < 400 pm @ both cryo & room-T

Optical measurement modes

nano-FTIR imaging & spectroscopy	reflectivity and absorption nano-spectroscopy and mapping based on patented interferometric near-field detection of tip scattered light (nanoFTIR, PsHet)
nano-THz	reflectivity and absorption spectroscopy and spectrally averaged imaging
time-resolved nano-spectroscopy	femtosecond VIS/NIR pump for ultrafast pump-probe nano-FTIR & nano-THz spectroscopy
Raman & PL	hardware- & software-integrated spectrometer, optical coupling using parabolic mirror objective
nano-photocurrent	supports nanoscale-resolved mapping of photocurrents

Certified light sources

QCL	coverage of mid-IR fingerprint: 950 - 1725 cm ⁻¹ (ca. 5.8 – 10.5 μm)
widely-tunable OPO	near-continuous coverage of mid-IR fingerprint & functional groups: 625 – 7140 cm ⁻¹ (ca. 1.4 – 16 μm)
THz-TDS	coverage for near-field: 0.2 – 2.0 THz , high power THz emitter: ca. 300 μW
VIS & NIR	flexible coverage via a variety of certified laser sources, single-frequency and tunable