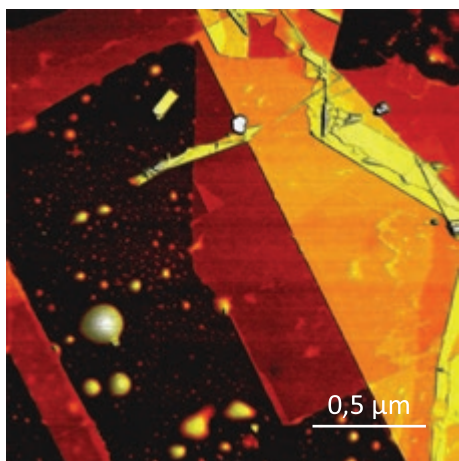


NTEGRA Spectra II

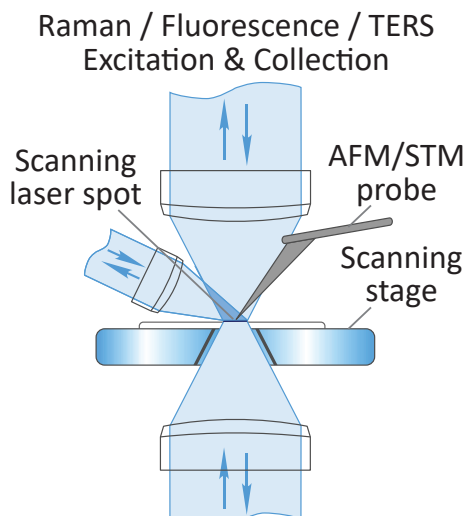
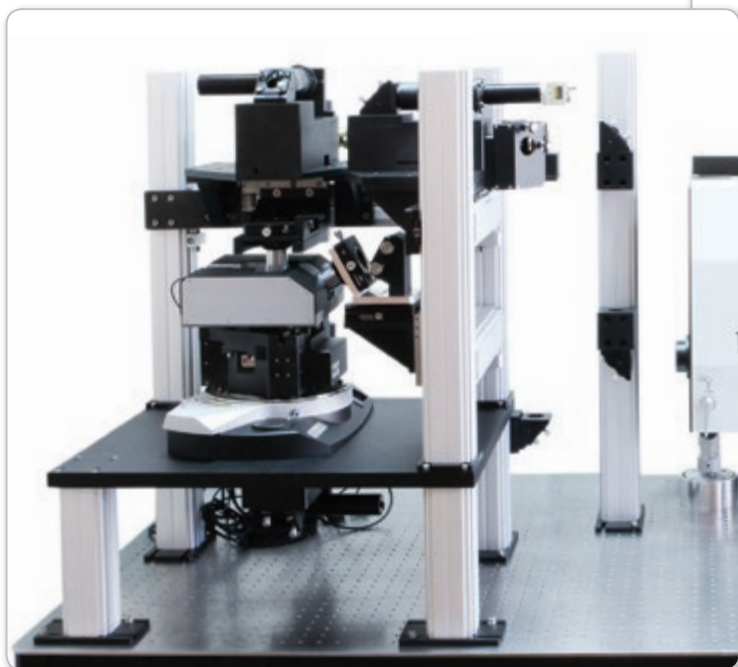


Graphene flake on Si/SiO₂

Physical and chemical characterization at the nanoscale

Atomic Force Microscopy
Confocal Raman / Fluorescence Microscopy
Tip Enhanced Raman Scattering
Scanning Near-field Optical Microscopy

Open architecture system
Automated AFM alignment
User-friendly software
Ergonomic design



NTEGRA Spectra II - Automatic AFM-Raman System

Optical access from top, side and bottom optimized for Raman, TERS and SNOM

Open design provides great opportunities in system customization

System accommodates up to 5 different lasers which are automatically interchangeable

AFM-Raman in air, controlled atmosphere, liquid, variable temperature

Full automation of the system simplifies customer's routine operations

Innovative HybriD Mode™ for real-time quantitative nanomechanics & Raman for chemical imaging

Integration

NTEGRA Spectra II is the first system on the market that seamlessly integrates the best of two worlds: AFM and Raman microscopy.

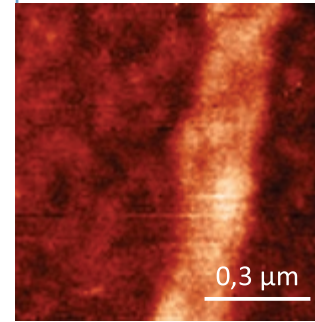
From topography to spectrum analysis, from electrical and mechanical properties to optical spatial resolution below the diffraction limit.

At the fingertips of scientists now is the capability to run a full surface analysis of a sample along with chemical study of the same area of interest.

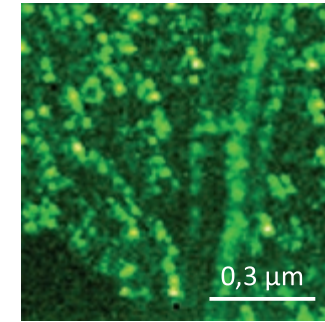
Researches now receive unlimited possibilities to extend their laboratory capacity.



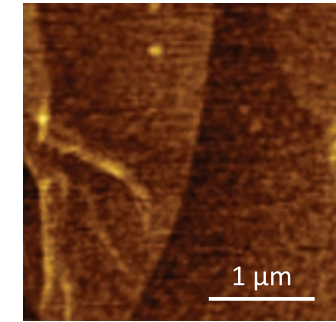
TERS + HybriD Mode™ of Graphene Oxide on Au substrate.
TERS resolution: 10 nm



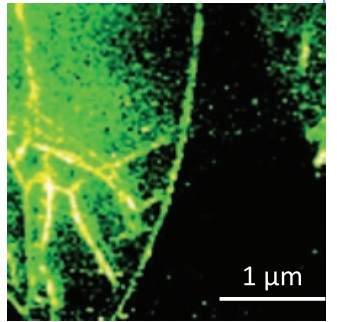
AFM topography



TERS (D band)



AFM topography



TERS (D band)

TERS by means of HybriD Mode™

Tip Enhanced Raman Scattering allows carrying out spectroscopy/microscopy with nanometer scale resolution.

TERS imaging requires prolonged tip-sample contact at each scanning point, but Contact AFM is destructive for both the tip and the sample.

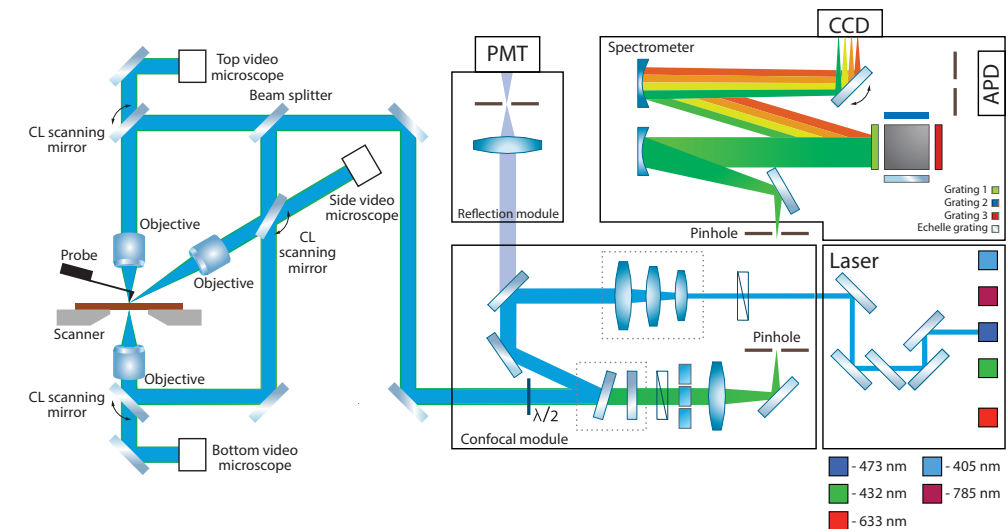
Thereby, HybriD Mode™ is a superior technique for cantilever-type TERS since it dramatically increases the tip lifetime, allows non-destructive studies, and besides enables Quantitative Nanomechanics.

Intelligent ScanT™

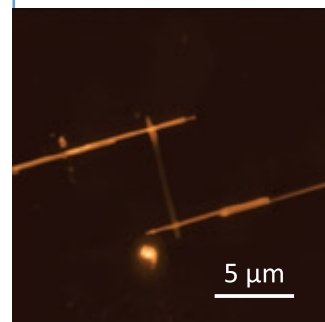
Program has been developed with the help of neural networks to provide auto-tuning of scanning parameters for imaging in AM-AFM.

Automatic maintenance of attractive (non-contact) & repulsive (intermittent-contact) regimes.

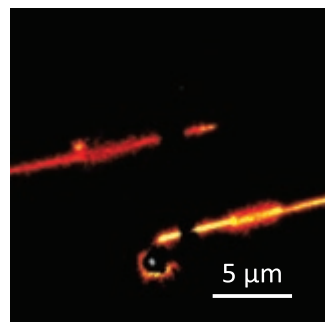
Artifact-free scanning without parachuting. Perfect performance at samples with any kind of morphology.



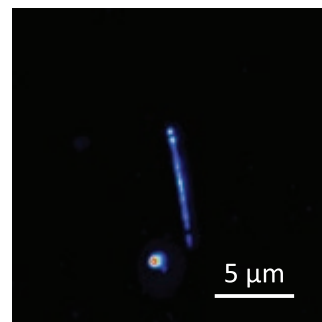
CdS nanowire. Courtesy: prof. R. Carpick, Penn State University



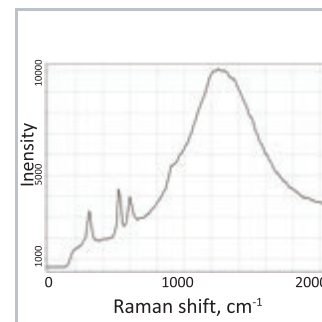
AFM topography



Raman map (conductive polymer nanowires)

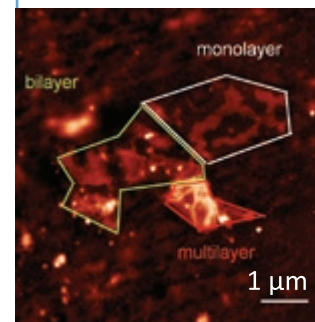


Photoluminescence (CdS)

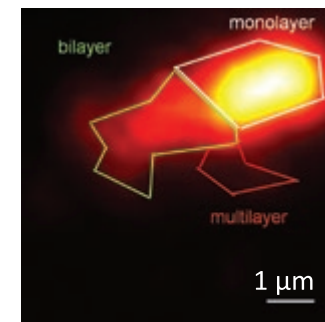


Raman and PL spectrum of CdS nanowire

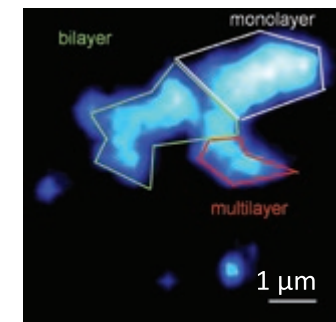
MoSe₂ flakes. Courtesy: W. Martin, G. Bacher, Universität Duisburg-Essen



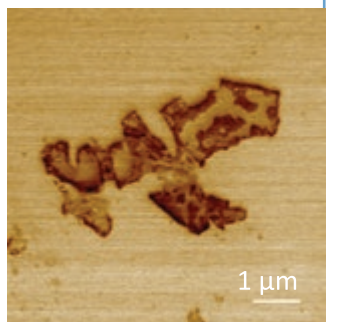
AFM Topography



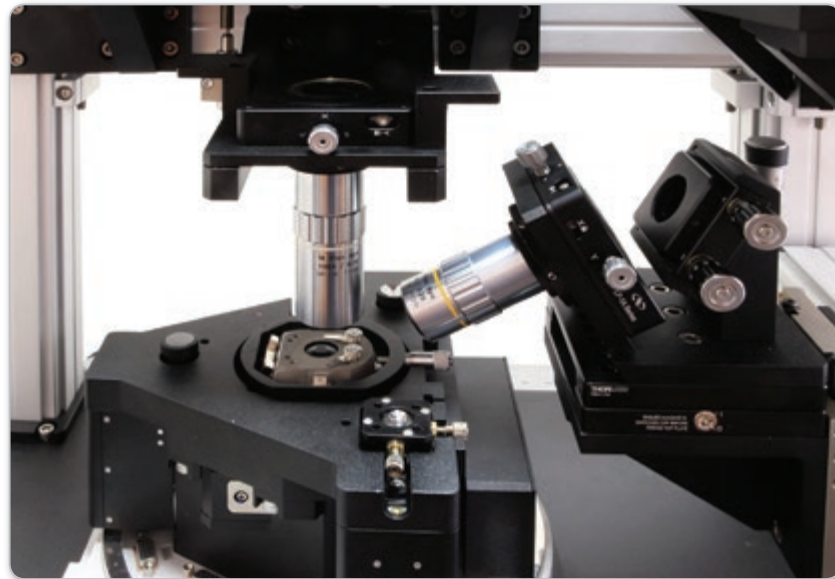
μ-Photoluminescence, ~800 nm



Raman, ~220-250 cm⁻¹



KPFM (Surface Potential)



All existing TERS geometries: illumination & collection from bottom, from top or from side

Highest possible resolution optics is used simultaneously with AFM: up to 1.45 NA for Inverted, up to 0.7 NA for Upright, up to 0.7 NA for Side configurations

Exchangeable objectives with kinematic mounts: precision <2 μm

Independent CL controlled scanning mirrors for precise laser spot positioning & hot-spot maintenance

Built-in optical periscope allows integration of Spectra II with any commercial or home-built confocal Raman spectrometer

High-performance AFM: Z noise down to 15 μm

Spatial resolution: down to 1 nm

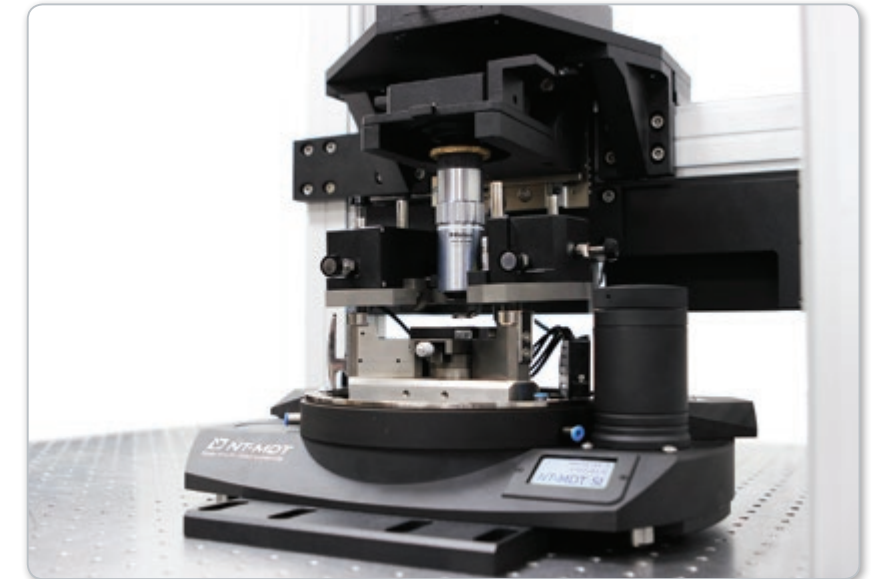
XYZ sample scanner: 100x100x10 μm

Automated AFM laser, probe and photodiode positioning and alignment

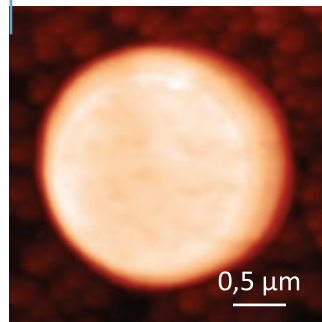
Simple exchange OBD registration system operational wavelength (670, 830, 1300 nm)

Different techniques and TERS probes can be used: STM, AFM cantilever, quartz tuning fork in tapping and shear force modes

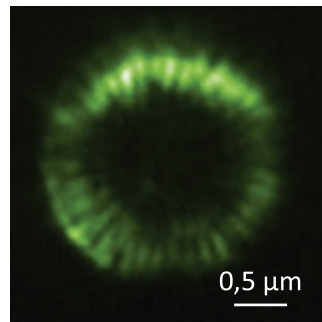
Hybrid Mode™ is a superior technique for cantilever-type TERS since it noticeably increases the tip lifetime and makes possible TERS imaging of soft, loose and fragile samples



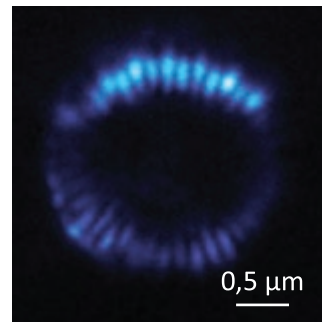
Whispering gallery light modes in microdisks with InP/GaInP self-organized quantum dots



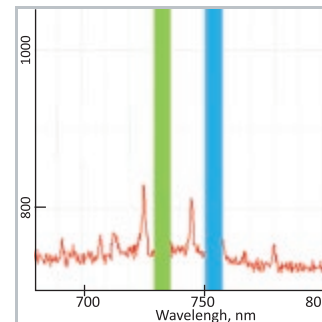
AFM topography



SNOM PL, 732-735 nm TE₂₀ mode

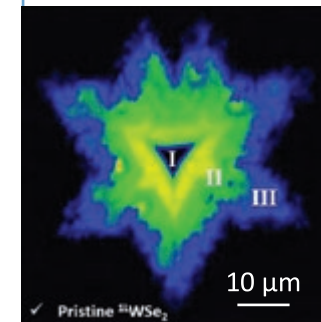


SNOM PL, 753-757 nm TE₁₈ mode

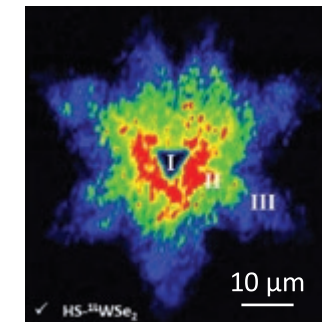


SNOM photoluminescence (PL) spectrum

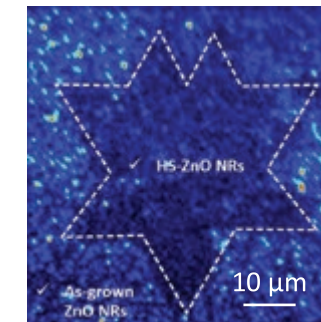
Photoluminescence mapping of WSe₂ and HS-WSe₂.
Courtesy: Mun Seok Jeong et. al. ACS Appl. Mater. Interfaces 2019, 11



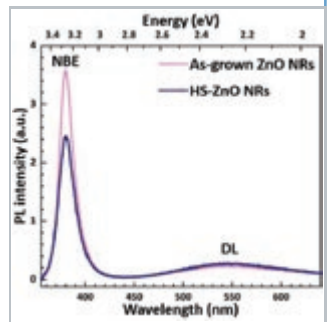
PL of pristine WSe₂



PL of HS-WSe₂

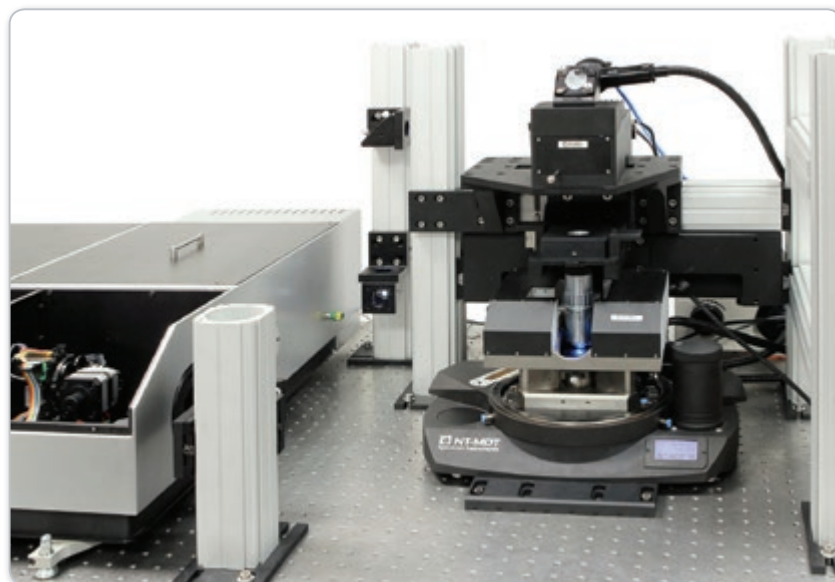


PL of as-grown ZnO NR



PL spectra

Confocal Raman & Fluorescence microscopy



Confocal Raman / Fluorescence / Rayleigh imaging runs simultaneously with AFM

Diffraction limited spatial resolution: <200 nm in XY, <500 nm in Z

Motorized confocal pinhole for optimal signal and confocality

Continuously variable ND filter with the range 1-0.001 for precise change of laser power

Motorized beam expander/collimator: adjusts diameter and collimation of the laser beam individually for each laser and each objective used

Full 3D (XYZ) confocal imaging with powerful image analysis

Spectroscopy

High efficiency 520 mm length spectrometer with 4 motorized gratings

Up to 5 lasers: from UV to IR range

Wavelength changes in a single click

Excitation wavelength range: 405 -1050 nm

Spectral resolution: down to 0.007 nm (0.1 cm^{-1})

4 different detectors can be installed: TE cooled CCD/EMCCD cameras, APD, PMT & FLIM detector

Low frequency Raman detection: less than 10 cm^{-1}

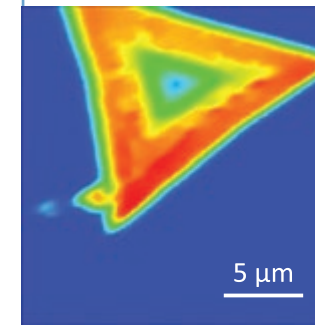
Detection of all SNOM signals: laser intensity, fluorescence intensity, spectroscopy



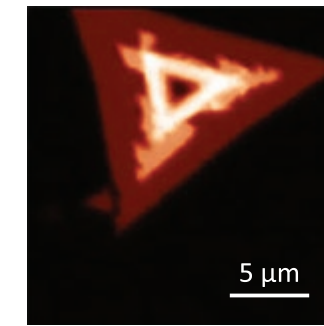
Applications

- 0D materials: Quantum dots
- 1D materials: Nanotubes, Nanowires
- 2D materials: Graphene, Graphene Oxide, MoSe₂, WS₂ etc.
- Piezoelectrics & Ferroelectrics
- Photonic crystals
- Surface plasmon polaritons
- Biological objects: cells, DNA, viruses.
- Amyloid fibrils, peptide nanotapes, lipid monolayers
- Polymers & Thin organic layers
- Chemical reaction control
- Optical device characterization: semiconductor lasers, optical fibers, waveguides, plasmonic devices

MoS₂. Courtesy: Thi, Q.H. et al. npj 2D Mater Appl 2, 34 (2018)

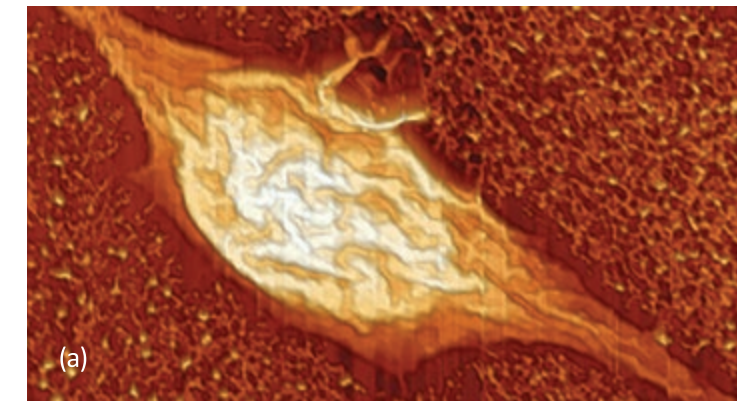


Photoluminescence

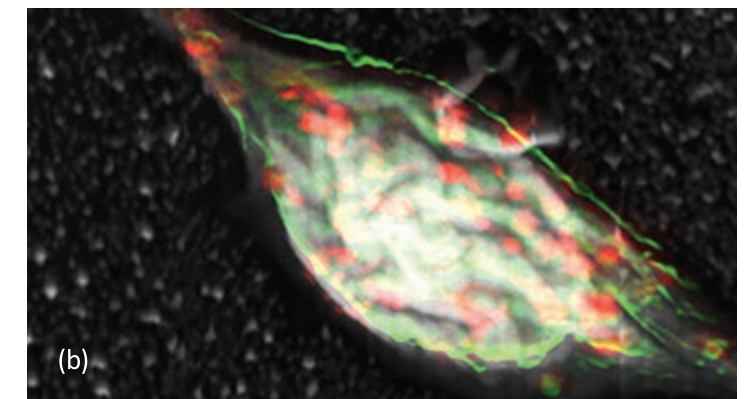


Raman map

Cell with fluorophores of two different types. a) AFM topography. b) Confocal fluorescence map overlapped with topography (gray scale)

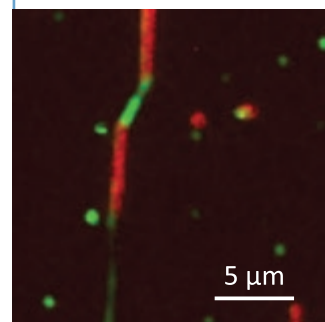


(a)

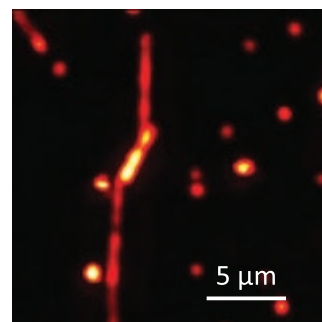


(b)

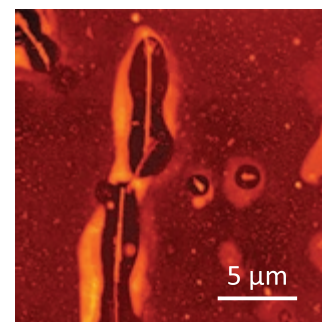
CdS-Polyaniline nanowires



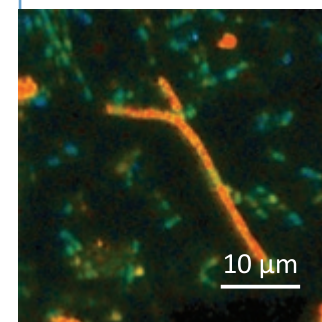
Raman map overlay, CdS (red) and PANI (green)



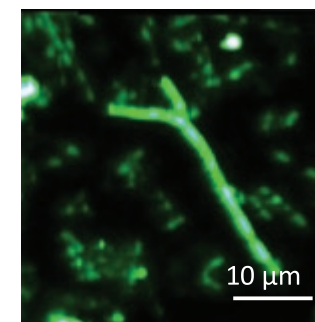
Fluorescence map



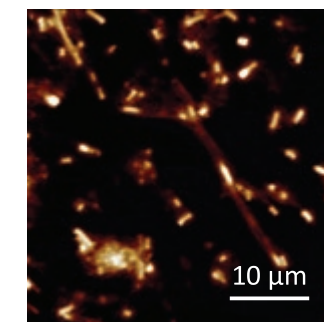
AFM Topography



Lifetime map 525-540 nm

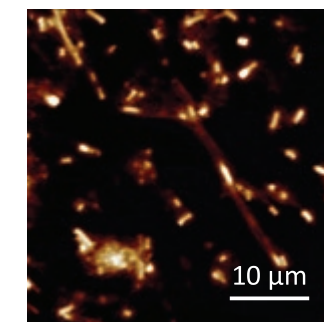
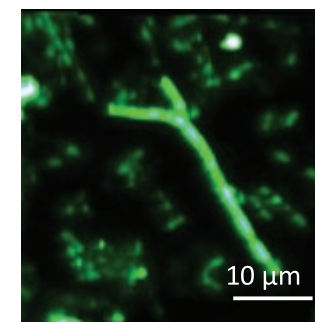
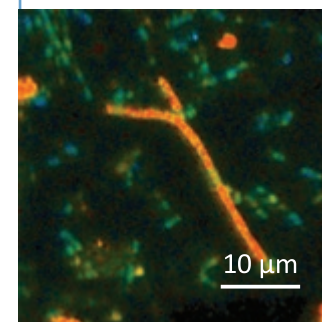


Fluorescence 525-540 nm

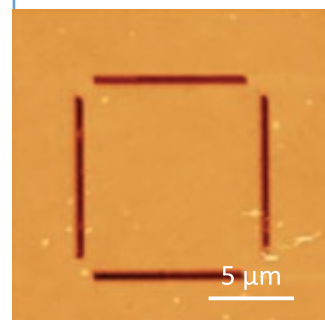


AFM Topography

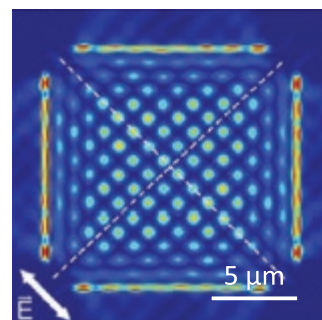
Topography and FILM image of e-coli



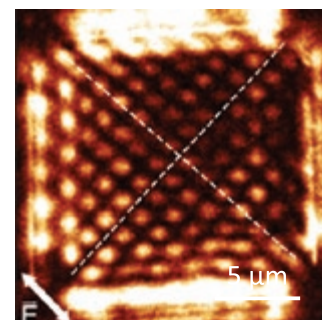
Surface plasmon polaritons interference in a square-like slit structure in Au film



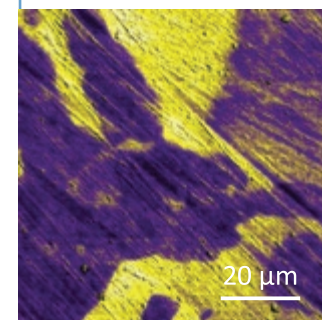
AFM topography



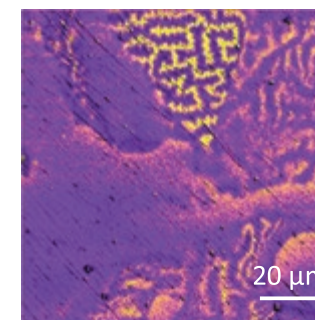
Numerical simulation



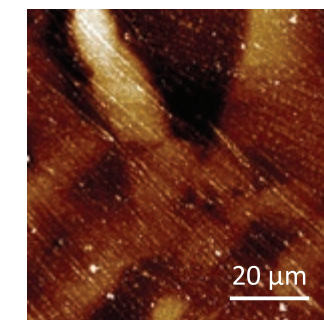
Experiment



Kelvin Probe Force Microscopy

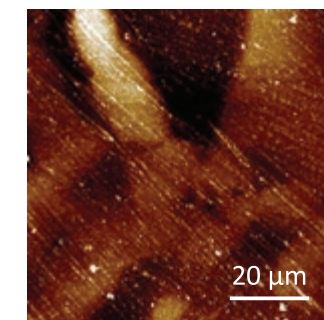
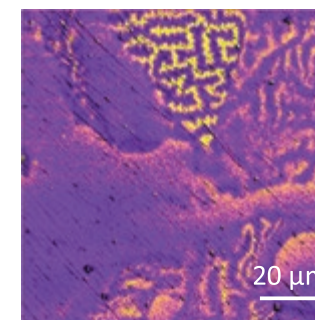
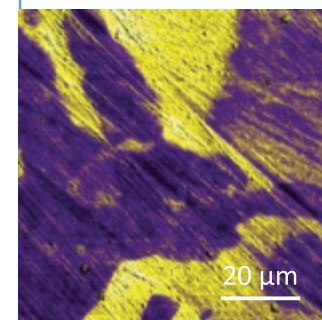


MFM



AFM topography

Stainless Steel



AFM Modes

Contact AFM: LFM, FMM, SRI, PFM

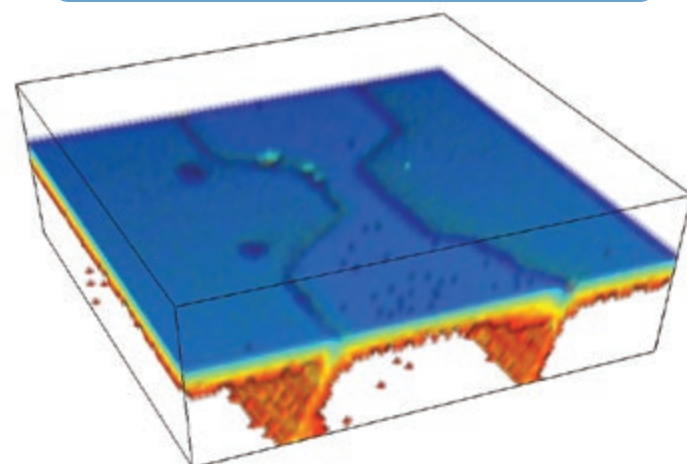
AM-AFM: MFM, EFM, SCFM, KPFM

HybriD Mode™: Young's modulus, Work of Adhesion, Current, Force Volume, PFM, KPFM, MFM, EFM

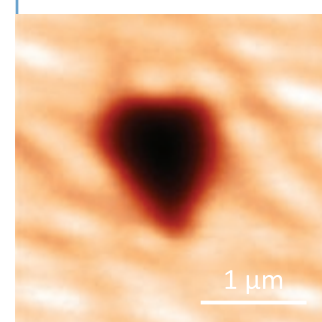
AFM spectroscopy, SS PFM

Nanolithography: Voltage, Current, Force Scanning Tunneling Microscopy

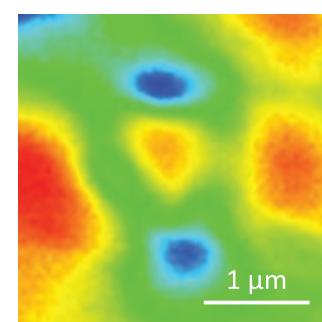
3D Raman Mapping of domain structure of KTiOPO₄, 660-740 cm⁻¹



Stress test on silicon wafer



AFM Topography



Raman map

Controlled Environment

Temperature
Humidity
Gases
Liquid
Electrochemical environment
External magnetic field

Optical Modes

White Light & Rayleigh Microscopy
Confocal Raman/Fluorescence Microscopy
SNOM: Transmission, Collection, Reflection, s-SNOM
Tip Enhanced Raman/Fluorescence Spectroscopy
SNOM & Laser nanolithography
Time-resolved spectroscopy, FLIM

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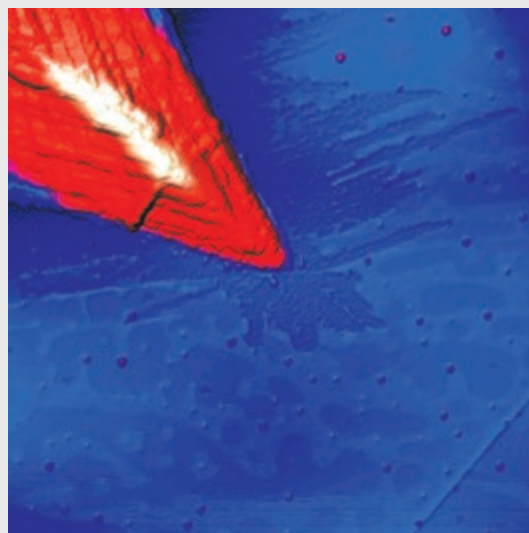
Mission:

NT-MDT is a trusted manufacturer of Atomic Force Microscopes (AFM) and integrated AFM systems with various ultrahigh resolution optical techniques for nanotechnology research. In every system we implement unique hardware and software solutions to meet and exceed the requirements of the scientific community regardless the research area.

Our team of talented engineers and scientists is committed to provide an excellent service to all of our customers in industry and academia worldwide. We cherish our stakeholders, work globally as a team to share ideas, technologies and talents, and constantly improve what we do.

Vision:

To be a second-to-none global manufacturer of microscopes for nanotechnology research, while upholding an unparalleled standard of excellence.



FM-AFM topography of $C_{242}H_{468}$ crystal.
Image Courtesy: Dr. Sergei Magonov

