NT-MDT
Spectrum Instruments

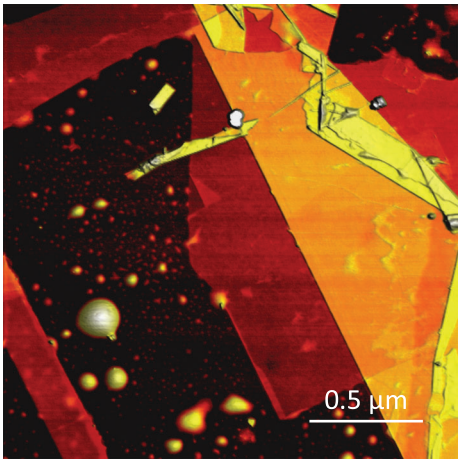
NT-MDT

NTEGRA Spectra II

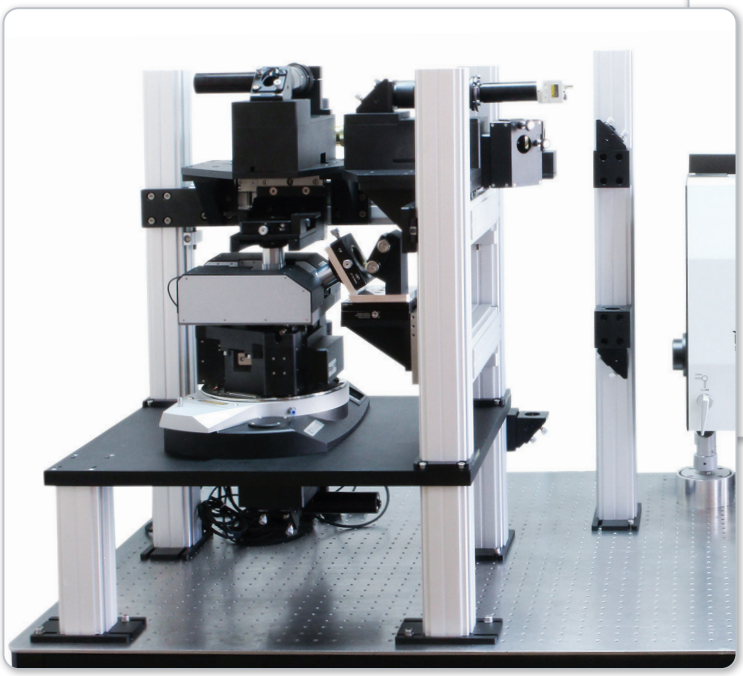
Physical and chemical characterization
at the nanoscale

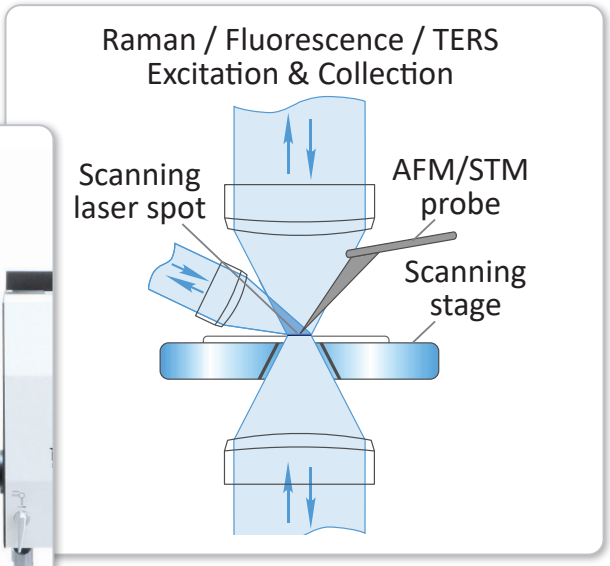
Atomic Force Microscopy
Confocal Raman / Fluorescence Microscopy
Tip Enhanced Raman Scattering
Scanning Near-field Optical Microscopy

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



Graphene flake on Si/SiO_2





www.ntmdt-si.com

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

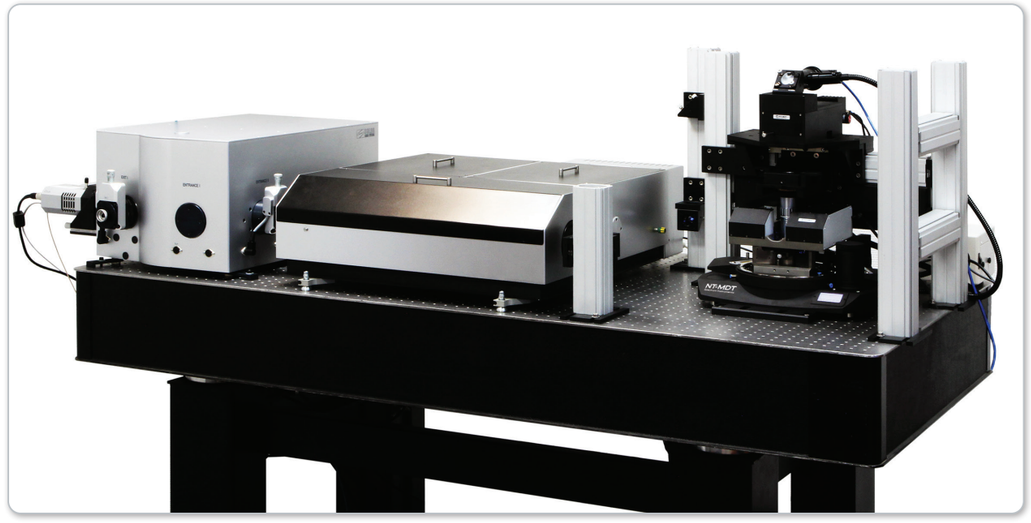
Integration

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

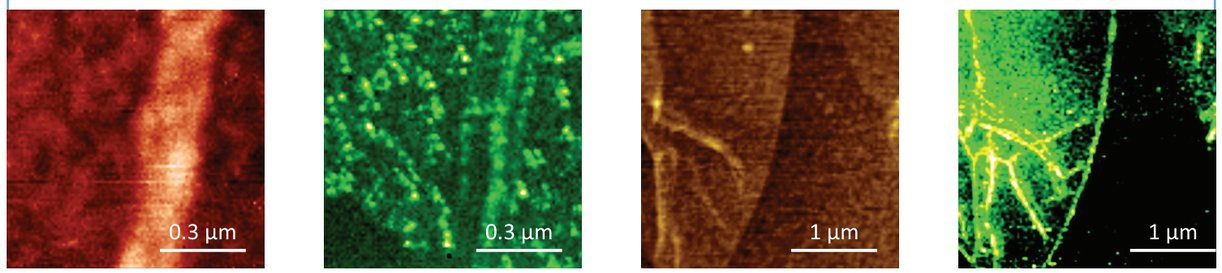
From topography to spectrum analysis, from electrical and mechanical properties to optical spatial resolution below the diffraction limit.

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.

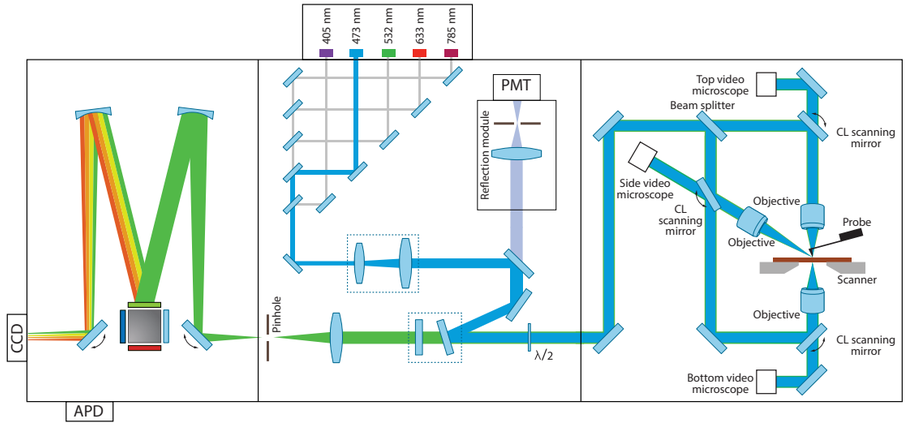
Thereby, HybriD Mode™ is a superior technique for cantilever-type TERS since it dramatically increases the tip lifetime, allows non-destructive studies, and besides enables Quantitative Nanomechanics.

Intelligent ScanT™

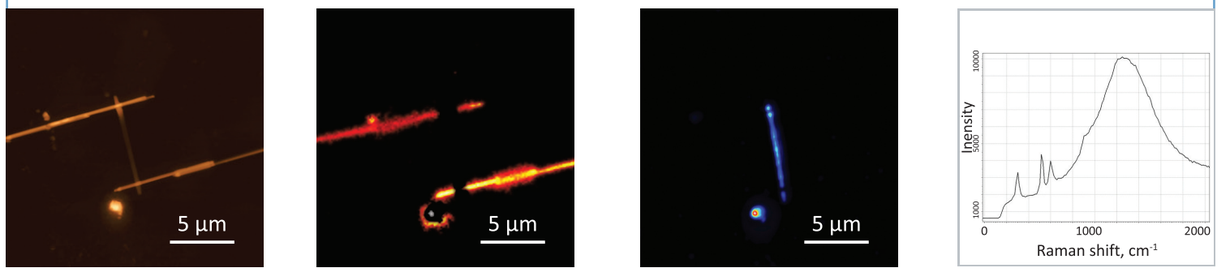
Program has been developed with the help of neural networks to provide auto-tuning of scanning parameters for imaging in AM-AFM.

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

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

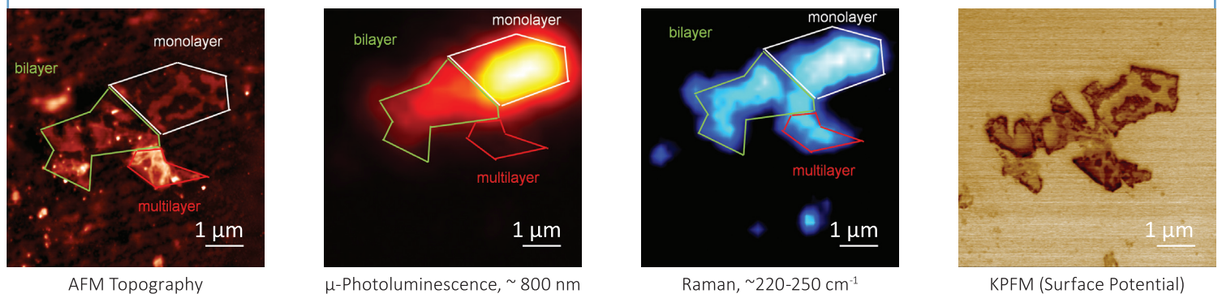


CdS nanowire. Courtesy: prof. R. Carpick, Penn State University



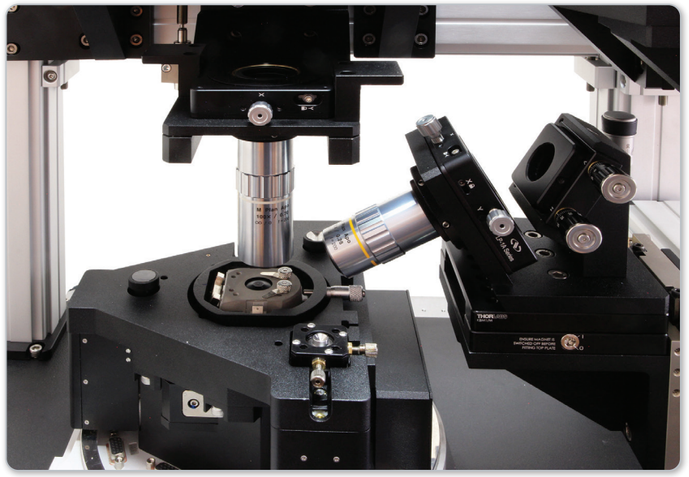
AFM topography | Raman map (conductive polymer nanowires) | Photoluminescence (CdS) | Raman and PL spectrum of CdS nanowire

$MoSe_2$ flakes. Courtesy: W. Mertin, G. Bacher, Universität Duisburg-Essen



AFM Topography | µ-Photoluminescence, ~ 800 nm | Raman, ~220-250 cm^{-1} | KPFM (Surface Potential)

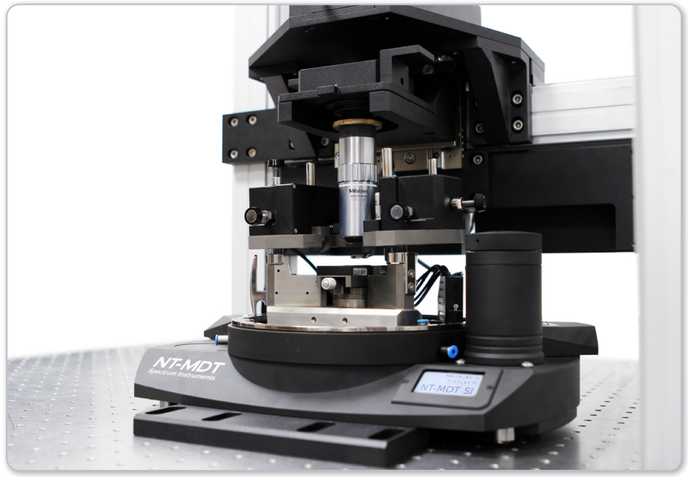
Light delivery system



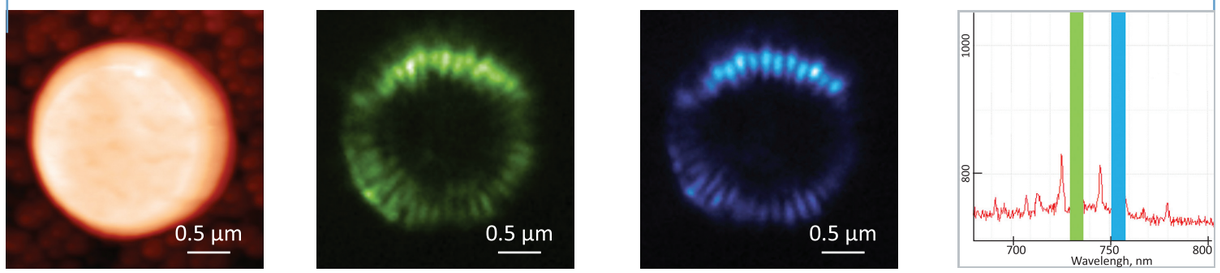
All existing TERS geometries: illumination & collection from bottom, from top or from side
Highest possible resolution optics is used simultaneously with AFM: up to 1.45 NA for Inverted, up to 0.7 NA for Upright, up to 0.7 NA for Side configurations
Exchangeable objectives with kinematic mounts: precision <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

Top-Grade Atomic Force Microscope

High-performance AFM: Z noise down to 15 pm
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

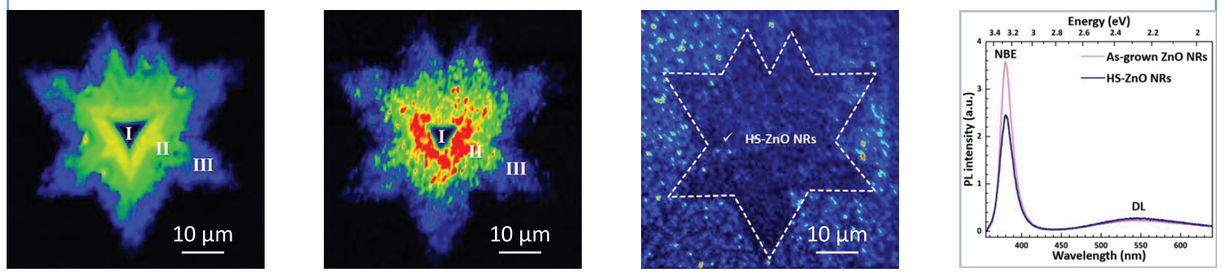


Whispering gallery light modes in microdisks with InP/GaInP self-organized quantum dots



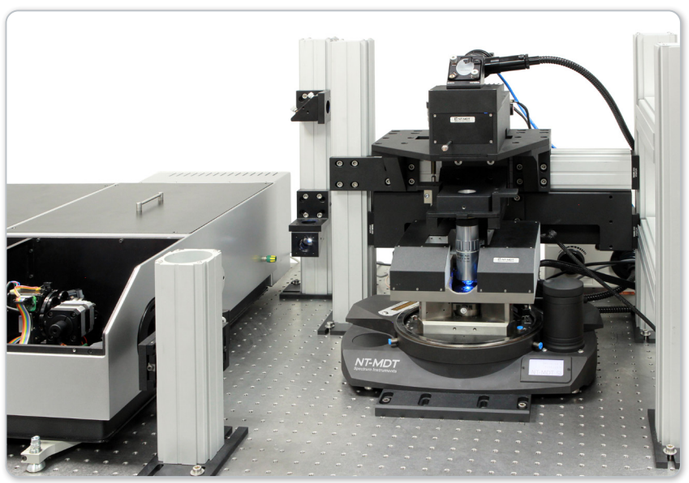
AFM topography | SNOM PL, 732-735 nm TE_{20} mode | SNOM PL, 753-757 nm TE_{18} mode | SNOM photoluminescence (PL) spectrum

Photoluminescence mapping of WSe_2 and HS-WSe_2.
Courtesy: Mun Seok Jeong et. al. ACS Appl. Mater. Interfaces 2019, 11



PL of pristine WSe_2 | PL of HS-WSe_2 | PL of as-grown ZnO NR | PL spectra

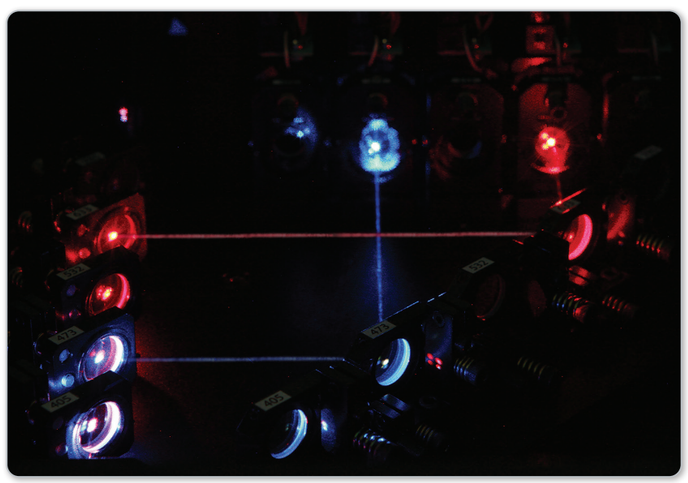
Confocal Raman & Fluorescence microscopy



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

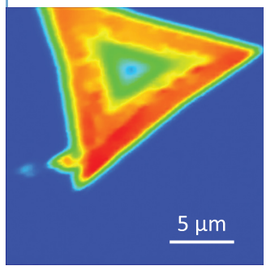
High efficiency 520 mm length spectrometer with 4 motorized gratings
Up to 5 lasers: from UV to IR range
Wavelength changes in a single click
Excitation wavelength range: 405 -1050 nm
Spectral resolution: down to 0.007 nm (0.1 cm^{-1})
4 different detectors can be installed: TE cooled CCD/EMCCD cameras, APD, PMT & FLIM detector
Low frequency Raman detection: less than 10 cm^{-1}
Detection of all SNOM signals: laser intensity, fluorescence intensity, spectroscopy



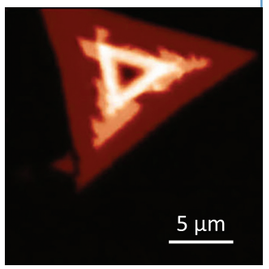
Applications

- 0D materials: Quantum dots
- 1D materials: Nanotubes, Nanowires
- 2D materials: Graphene, Graphene Oxide, $MoSe_2$, WS_2 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

MoS_2. Courtesy: Thi, Q.H. et al. npj 2D Mater Appl 2, 34 (2018)

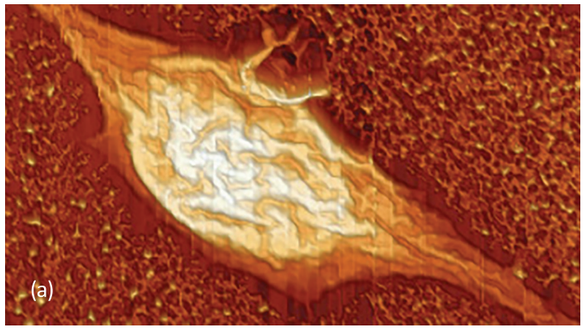


Photoluminescence

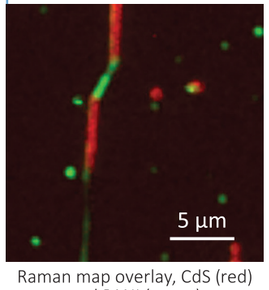


Raman map

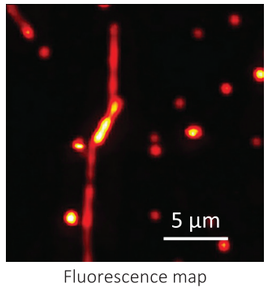
Cell with fluorophores of two different types. a) AFM topography. b) Confocal fluorescence map overlapped with topography (gray scale)



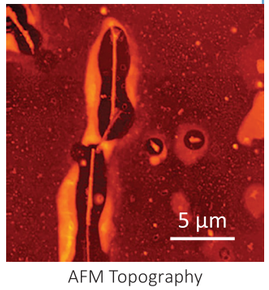
CdS-Polyaniline nanowires



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

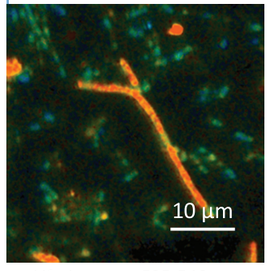


Fluorescence map

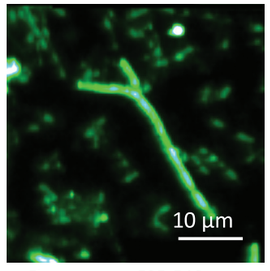


AFM Topography

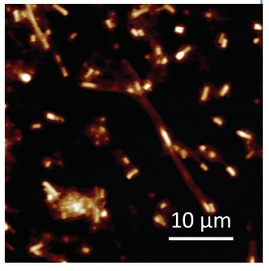
Topography and FILM image of e-coli



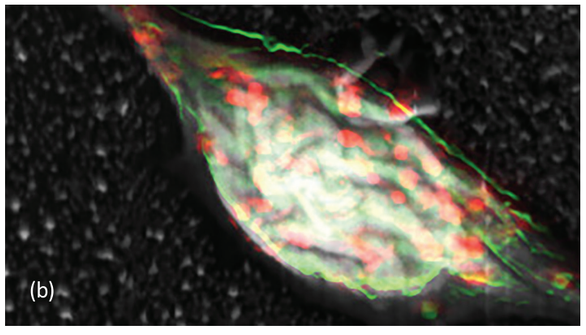
Lifetime map 525-540 nm



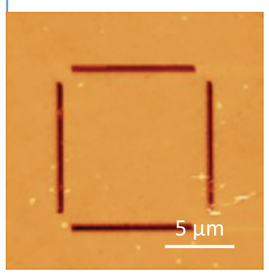
Fluorescence 525-540 nmn



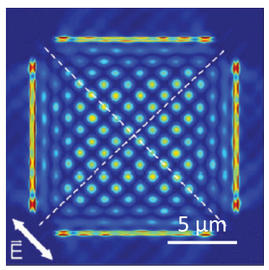
AFM Topography



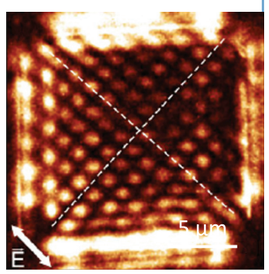
Surface plasmon polaritons interference in a square-like slit structure in Au film



AFM topography

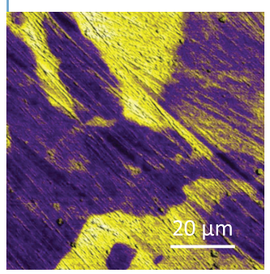


Numerical simulation

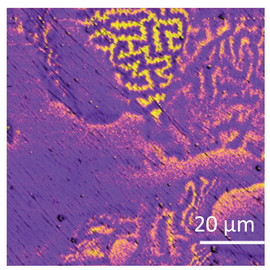


Experiment

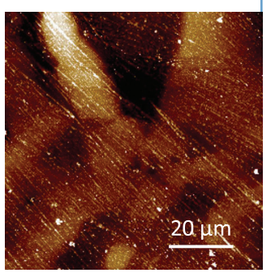
Stainless Steel



Kelvin Probe Force Microscopy

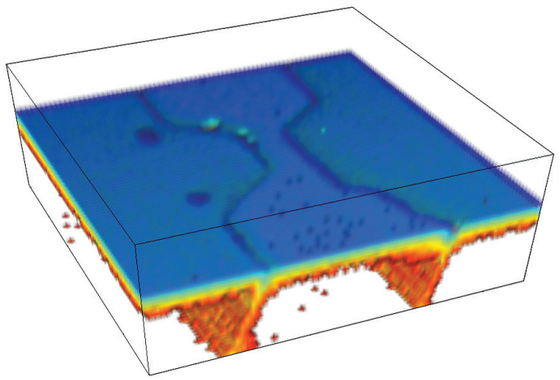


MFM

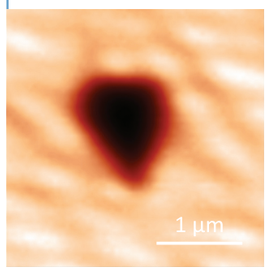


AFM topography

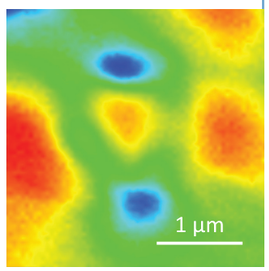
3D Raman Mapping of domain structure of $KTiOPO_4$, 660-740 cm^{-1}



Stress test on silicon wafer



AFM Topography



Raman map

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

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

NT-MDT
Spectrum Instruments

Leading the Way in Nanoscale Analysis

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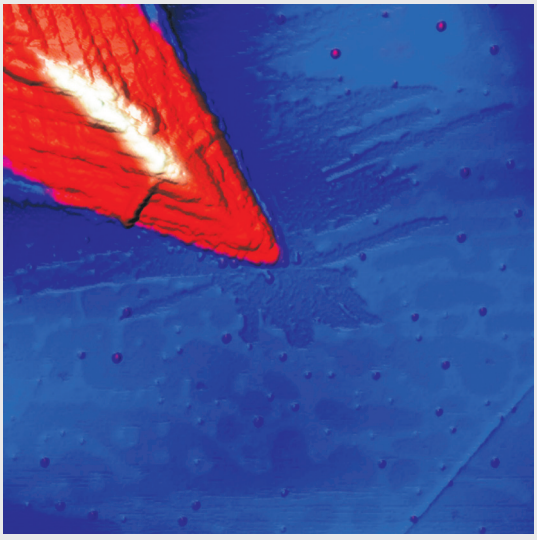
Follow Us

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.

HybriDMode™



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

NT-MDT®