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scattering-Scanning Near-field Optical Microscopy – s-SNOM

RCMO group

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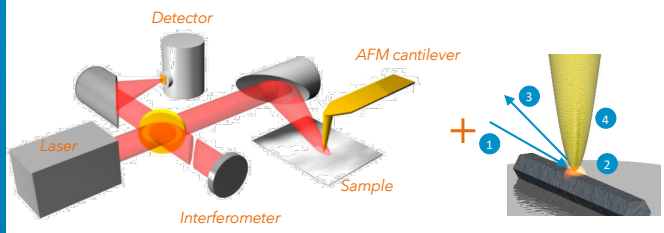
Abstract: SNOM has become an essential optical characterization tool at the nanoscale for nanophotonics research groups. This sub-wavelength microscope can beat the diffraction limit and achieve a spatial resolution down to 10 nm. When properly used and/or coupled to the proper illumination and detection, it can be involved in numerous applications. In particular, s-SNOM has a large flexibility and capabilities in imaging and spectroscopy over a large range of wavelengths. Indeed s-SNOM is based on AFM (i.e. free from fiber use) technique with the optical near field extracted from the scattering light resulting from the sample-tip interaction. Based on this detection scheme, the optical near-field detection enables visible, IR and THz (up to wavelengths of 300 mm) imaging and spectroscopy, keeping the high spatial resolution. The light detection path employs an interferometric system allowing recording both the amplitude and phase of the optical signal together with the topography and mechanical phase.

Principle

Uses a nanofocus for near-field measurements



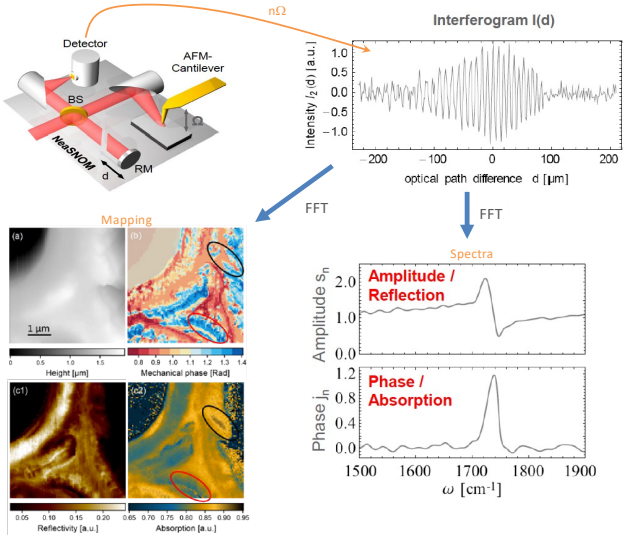
Combining far field optics with near-field optical microscopy
Wavelength independent 10 nm resolution

1. A focused laser-beam illuminates a commercially available AFM tip
2. The tip confines the incident light to a 10-20 nm-large nanofocus
3. The near-field interaction between the tip and the sample modifies the elastically-scattered light
4. By scanning the sample surface with the tip, an optical image with 10 nm spatial resolution is recorded

   Demodulation of scattering signal → background suppression (up to 5th harmonic)

Interferometric near-field detection

Amplitude and phase measurements

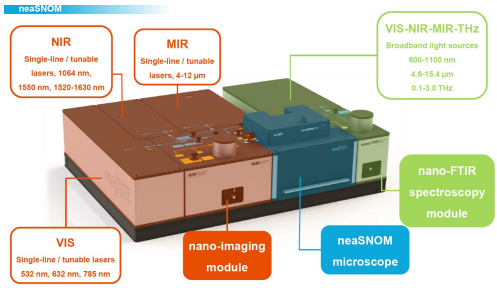


Topography, mechanical phase and optical reflection and absorption

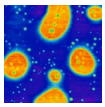
Reflection and absorption spectra, mappings or hyperspectral imaging

Suitable for a wide range of applications

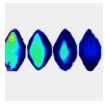
Modular system design with dual-beam path design of focusing unit

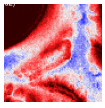


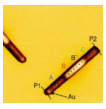
- Positioning sensors (resolution <10 nm)
- Patented parabolic mirror design prevents off-axis focusing aberrations
- Simultaneous focusing and detection of two independent light sources (imaging and spectroscopy modes)

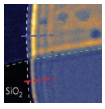

Polymers

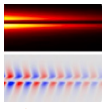

Life sciences

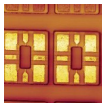

Mineralogy


Plant sciences


Nanoparticles

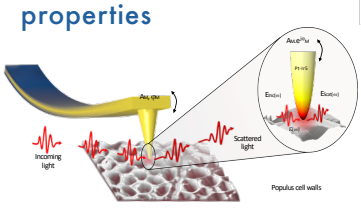

2D Materials

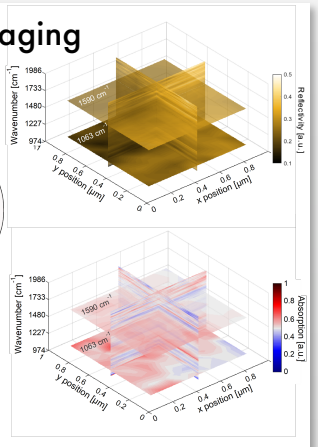

Plasmonics


Semiconductors

Local hyperspectral imaging

Revealing plant cell walls mechanical and optical properties





Mechanical phase → viscoelasticity properties

Optical reflection and absorption → n and k dispersion and mappings

References / Acknowledgments

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