Femtosecond NSOM

Ultrafast Nearfield Optical Microscope

Near-field Scanning Optical Microscope (NSOM) is a versatile tool for nano-characterization and nano-manufacturing. Conventional microscopes have fundamentally limited resolution due to diffraction, but there is no such restriction for near-field interactions, that is why near-field microscopy is becoming one of the most important techniques for nano-science.

Our system combines NT-MDT Solver NSOM scanning module and illumination module based on Del Mar Photonics Trestles laser. Possible applications of this tool are characterization of photonic nanodevices, bio photonics (investigation of cells, viruses, DNA molecules), nano-chemistry (chemical reactions control), nanoscale photolithography (processing of photosensitive polymers).

This technique provides simultaneous measurements of topography and optical field distribution, these two images can be correlated and bring better understanding of the samples under investigation. With different modifications a lot of additional parameters can be mapped. For example by introducing optical interference techniques phase of optical field can be measured. Phase delay of AFM signal gives information about mechanical properties of the surface under investigation. Additional module to measure spectral optical response is available.

Topography feedback is provided by shear force AFM technique, and optical configuration allows using NSOM in reflection and transmission modes. Temporal resolution provided by femtosecond laser opens wide range of new possibilities such as: transport dynamics studies of nanostructured materials, pump-probe experiments, ultra fast coherent and Raman spectroscopy. Spatial optical resolution of the tool is better than 100 nm and temporal resolution in the pulse operation mode is better than 100 fs. Tunable CW operation for spectral measurements is also available, wavelength range in this case is 710-950 nm.

Open architecture of the system allows using different wavelength lasers available at Del Mar Photonics. Different detectors and spectroscopic modules optimal for specific configuration can be used. Easy to use and flexible data acquisition and image processing software is supplied with every NSOM system.

Features:

- Shear force topography feedback
- Nano-resolution optical imaging
- Reflection and transmission mode of operation
- Femtosecond pulses or wavelength tunable CW illumination
- Spectrometry module (optional)

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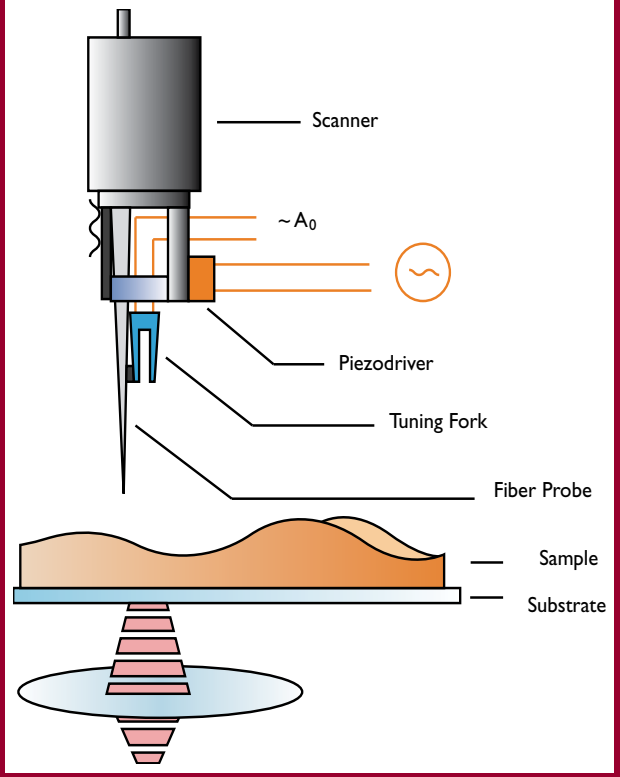


Optical schematic of Near-field Scanning Opticall Microscopy

Modes of Operation:

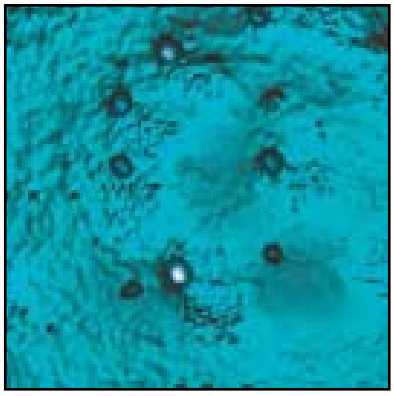
• Reflection NSOM allows images of the intensity of light reflected from the sample to be obtained. The sample is illuminated via a probe aperture during the scanning and reflected light is directed by a mirror system through the objective of the inverted microscope to the PMT (photomultiplier tube).

• Luminescence NSOM allows images of local luminescence intensity to be obtained. The sample is illuminated during scanning via a probe aperture and transmitted light is directed to the PMT through an inverted microscope objective and notch filter.

• Transmission NSOM allows images of the intensity of the light transimitted through the transparent sample to be obtained. The sample is illuminated via a probe aperture during the scanning and transmitted light is collected by an inverted optical microscope and directed to PMT.

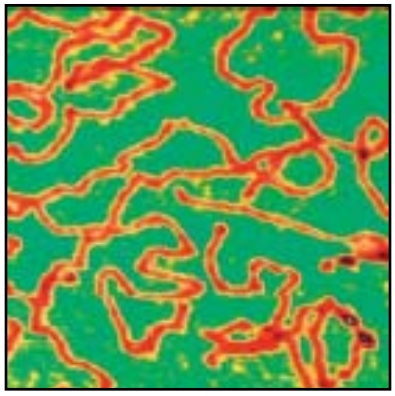
Different Laser Wavelegnth Options	
Laser Option	Wavelength
Trestles 20/50/100	700-950 nm
Mavericks-65	1240-1270 nm
Tamarak-Er	1540-1560 nm

Scan type by sample; by probe (optional)	
Measuring head scan range	80x80x3.5 µm (±10%)
Min scanning step	0.009 nm
X,Y sample positioning	5x5 mm
Positioning resolution	5 µm
Sample size	up to Ø100x10mm
X,Y Closed-loop stage	
X,Y range	100x100 µm
Residual non-linearity	Better than 0.2%
Resolution	2 nm
Repeatability	30 nm (typically), less than 0.2% from the full range
Max. normal load	2 kg
Illumination laser	
Pulse length	<50 fs
Output power	>100 mW
Repetition rate	> 80 MHz
Wavelength range	740-950 nm



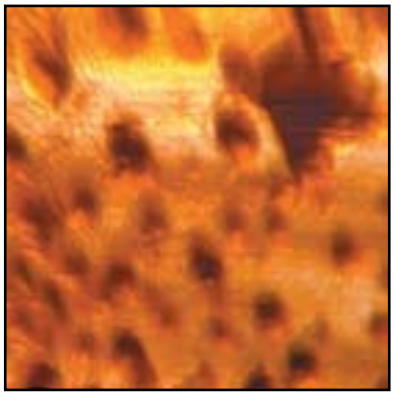
NSOM lithography on positive photoresist made with 488nm Ar laser. Time of exposure for different spots 0.1-0.5s. The result of the lithography is measured in Shear Force Mode.

Scan size: 3.7x3.7um.



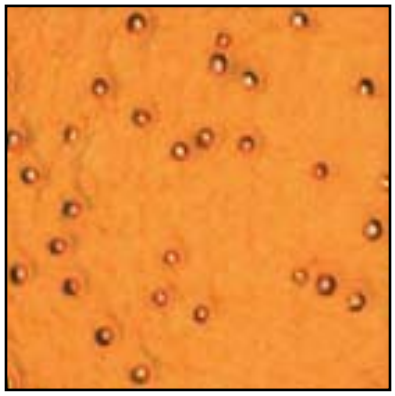
Linearized DNA plasmid on mica. Shear Force image mode.

Scan size 1250x1250x1.2nm.



Gold particles deposited on glass. Transmission NSOM image.

Scan size: 27x27 µm.



GaAs quantum dots. Reflection NSOM image made with 442 He-Cd laser.

Scan size: 7x7 µm.

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4119 Twilight Ridge | San Diego, CA 92130 | Tel::(858) 876-3133 Fax::(858) 630-2376
E-mail::sales@dmphotonics.com URL::www.dmphotonics.com