MoScan-F

Near-Field Scanning Optical Microscope Platform

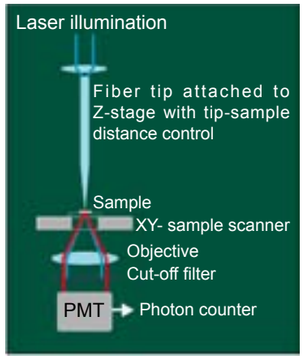
Just Place the Sample and Attach a Fiber Probe...

MoScan-F is a state-of-the-art device which gives a possibility to get the best up-to-dateavailable spatial optical resolution using nearfield scanning optical microscope (NSOM) principle. Although atomic force microscope (AFM) operation is also realized with the MoScan-F and AFM topographic images of a superior quality are recorded together with NSOM images, MoScan-F was designed as an optical device for users working mainly in optics and interested in best optical specifications and in variety of optical options available. Following NSOM principle of operation, we consider three main steps providing good optical images and success in near-field microscopy:

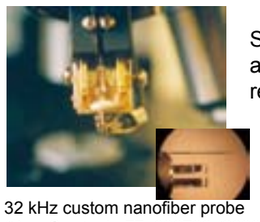
1. Sample preparation is a very important step for any microscopy technique. We supply the customer with test samples for calibration, educational and training purposes, but your success in microscopy depends on your sample preparation substantially.

2. Al-coated sharpened optical fiber tip with an aperture of less than 100 nm provides a superior spatial optical resolution, when it is almost in contact with the sample and illuminates the sample part under the aperture only. Quartz resonator attached to the tip by micro fabrication is an important part for tipsample distance (Z) control. The tip together with the resonator form NSOM probe, which is the key but consumable part in the near-field microscopy. We recommend several types of commercially available or custom made probes operating at 30 kHz - 100 kHz quartz resonance frequency.

3. Just place the sample and attach a fiber probe. The user friendly MoScan-F makes all the rest.



Schematic of a near-field microscope.



Standard 100 kHz fiber probe and fiber micro objective for the reflection mode operation.

32 kHz custom nanofiber probe
(Rev. Sci. Instr. 77, 033703 (2006)

Laser light propagates through a fiber tip with <100 nm aperture that is placed several nanometers from the sample. The sample is illuminated under the nano-aperture only. The objective collects transmitted laser light or laser induced fluorescence. XY scanning gives near-field optical image of the sample.

Fluorescence image of 100 nm - diameter TransFluoSpheres, received under excitation at 532 nm and detection around 600 nm.

Image size: 600 nm x 600 nm. MoScan-F “breaks the diffraction limit” and gives a lot of optical information inside l x l scan size, where l is the detection wavelength.

Key Features

- Near-field scanning optiacl microscope (NSOM) and atomic force microscope (AFM) modes of operation.
- NSOM images with laser and lamp illumination.
- Commercial and custom NSOM probes.
- Near-field optical and luminescence images in photon counying mode.
- Transmission and reflection NSOM configurations.
- 20 nm optical resolution (Raleigh criteria for spatial resolution).
- State-of-the-art optical microscope console: confocal configuration for simultaneous sample and tip observation with submicron resolution.
- Work with liquid samples.
- Femtosecond and UV excition.
- True single molecule detection.
- uScope data acquisition and FemtoScan image processing software.
- Ambient light protection with light-tight box

The FleaScan scanning stage (1) is the main part of the MoScan-F optical unit. The sample is placed on a completely computer controlled XY piezo stage for a fast sample travel and scanning. The fiber probe attachment is a very easy one-touch procedure, and the fiber probe holder is mounted on a piezo Z stage with an automatic probe approach option to avoid any risk of the fiber tip damage.

The FleaScan stage contains an objective of a high numerical aperture (2), for collection of the transmitted laser light or laser induced fluorescence when the sample is illuminated through the fiber probe (the illumination mode). The same objective is used for the sample illumination with a quartzhalogen lamp when the transmitted light is collected through the fiber probe (the collection mode).

Although we recommend a variety of laser sources for the sample illumination, a quartz–halogen lamp gives a better signal-to-noise ratio in many cases, because it is free of coherent effects like laser speckle structure. Another advantage of the lamp is that you can use different illumination wavelengths without the changing of the light source.

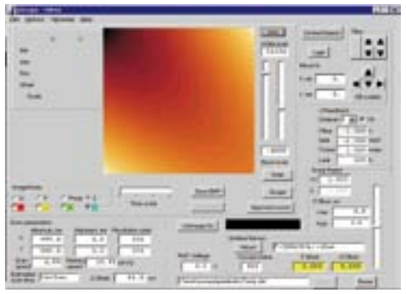
The FleaScan stage is placed on a vibrationally isolated breadboard (5) and its operation is controlled with MoScan-F electronic control unit and uScope data acquisition software. A specially designed optical microscope console (6) is mounted on a XYZ translation stage and installed on the breadboard separately. The console contains a binocular eyepiece tube (where CCD camera also can be placed) and a turret with long working distance infinity corrected objectives (7). We paid special attention to the console design for the best and simultaneous observation of the sample and the fiber tip.

The console forms a confocal microscope configuration for the observation of both transparent and opaque samples with submicron resolution. Together with the tip observation it gives a very comfortable way to find the best sample area for scanning comparing with other systems.

A long working distance objective is also used for the collection of light reflected from the sample under sample illumination through the fiber tip (NSOM reflection mode of operation). Reflection configuration can be realized also with a fiber micro objective placed near the fiber tip.

Optical signal is detected with the PMT (4) and photon counting system. Standard PMT is replaced by an avalanche photodiode for time-correlated single photon counting (TCSPC) fluorescence measurements under ultra short pulse excitation.

TSC
www.toptical.com.tw 02-2346-1510 toptical@ms17.hinet.net



Specifications

XY sample scanner
- 20 mm diameter central opening
- Maximum scan size: 40 ìm x 40 ìm
- Minimum scan step: 0.01 nm
- Maximum image size: 1024 x 1024 pixels
- Maximum XY sample travel: 10 mm x 10 mm (computer controlled)

Optical resolution
- 50 nm typical (depends on NSOM probe and sample under investigation)

Piezo-inertial Z stage with mounted NSOM probe
- Maximum Z-travel: 9 mm
- Z-scanning range: ±5 ìm

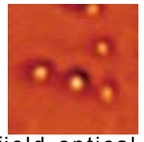
Electronic control unit
- XY stage electronics
- Z stage electronics
- Feedback (shear-force) electronics
- Photon counting electronics
- Lock-in amplifier
- Connected to a computer via PCI card

Photon counter
- Maximum photon counting rate: 5 x 107 cps
- Dark counts: < 10 cps
- Spectral response: 185 - 680 nm (185 nm - 850 nm optionally)

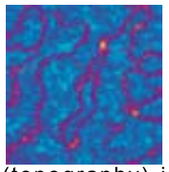
Standard illumination sources
- 150 W quartz - halogen lamp
- 670 nm (laser diode), 532 nm (solid state laser), 488 nm (Ar-ion laser), 400 nm (femtosecond laser)

Recommended NSOM probes
- 633 nm single mode, Al - coated (50 - 80 nm aperture), 100 kHz resonance
- 400 nm single mode, Al - coated (<100 nm aperture), 32 kHz resonance

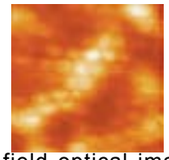
Dimensions
- Optical unit with light-tight box: 350 (W) x 460 (D) x 460 (H)
- Electronic control unit: 19” rack mountable or 170 (W) x 420 (D) x 200 (H)



Near-field optical image of 250 nm - diameter gold beads, deposited onto a glass slide.
Image size: 2 µm x 2 µm



AFM (topography) image of DNA (<3 nm thickness), deposited onto a glass slide



Near-field optical image of 100 nm - diameter polystyrene beads, deposited onto a glass slide