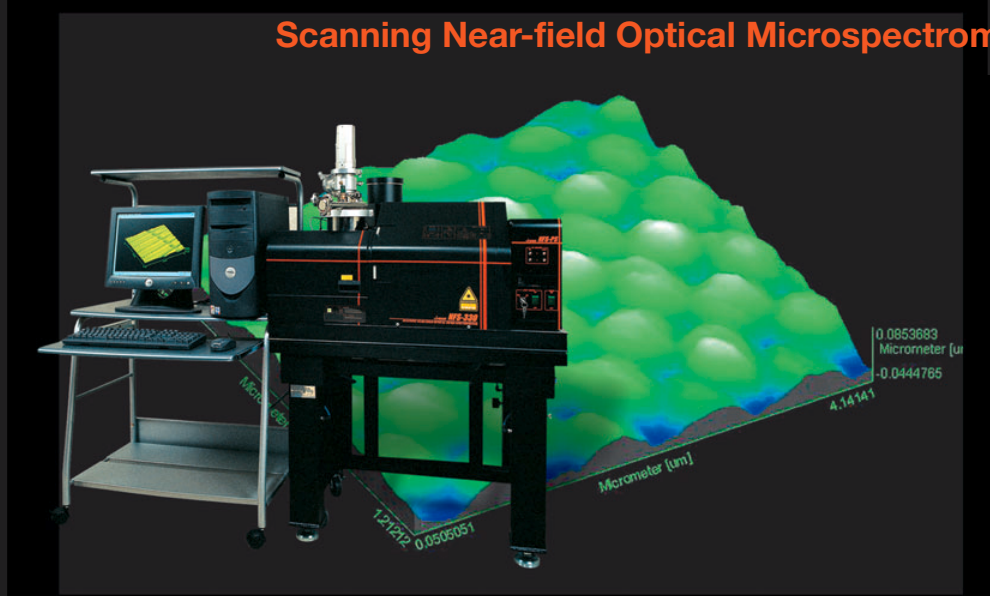


NFS series

Scanning Near-field Optical Microspectrometer



JASCO[®]



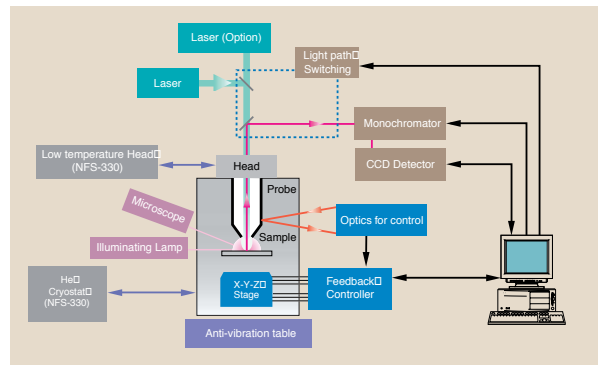
Scanning Near-Field Optical Microspectrometers

We perfected the NFS Series of scanning near-field optical microspectrometers as a new solution for nanotechnology. Traditionally, characterization methods at the nano level scale consist of topography observation using an electron microscope, elemental analysis using an x-ray microanalyzer, and topography observation using a scanning probe microscope. These analytical methods deliver images with high spatial resolution, but they cannot produce chemical information on a sample's surface. On the other hand, although FT-IR microspectroscopy, photoluminescence, Raman microspectroscopy and other techniques can produce chemical information from a surface, the data produced is confined to the micron scale. This is due to the diffraction limit of light, which means these techniques can only spatially resolve features on the order of the wavelengths being used.

Scanning near-field Microspectrometers have made possible characterization at the extreme nano level scale exceeding this diffraction limit. Introducing light into a fiber probe with an aperture of a hundred to several hundred nm produces near-field light of about the same size as the aperture near the tip.



NFS-330



NFS-230/330 System Diagram

	Microscope System	Cryostat	Built-in laser	External laser	Detector	FTIR Spectrometer
NFS-210	●					
NFS-310	●	●				
NFS-220	●		●	1 port		
NFS-320	●	●	●	1 port		
NFS-230	●		●	1 port	●	
NFS-330	●	●	●	1 port	●	
NFS-230C	●		●	NIR Laser	●	
NFS-220FT	●		●	1 port		● (NIR)
NFS-320FT	●	●	●	1 port		● (NIR)

NFS-210/310



The NFS-210/310 series is a near-field microscopy system incorporating a feedback mechanism for controlling the distance between the near-field probe and sample surface with a telescope for observation of the sample and probe interface. Laser excitation sources or detectors are not included but a variety of experimental systems can be built by using the access windows on the front and right side of the unit. In addition, direct access to the end of the optical fiber in the near-field probe allows greater flexibility for basic experiments using the near-field microscope system. The sample stage is controlled with exacting precision such that the probe tip remains at a fixed distance from the sample surface, the control movements providing accurate topographical information for the sample surface.

Features

- Integrated near-field microscope with high mechanical stability.
- Sample illumination and detection access from two sides (front and right).
- Direct access to optical fiber of the near-field probe.
- Topographic mapping of almost any sample; organic, inorganic, metal or biopolymer, etc.
- For low temperature experiments, the NFS-310 includes a He gas-flow cryostat for cooling to 10K or less.
- A compact footprint for an existing vibration isolation

Specifications

Spatial resolution:	Aperture diameter (or less) of near-field probe (1000 – 50 nm)
Stage range:	20 x 20 microns (room temp.), 5 x 5 microns (low temp)
Height:	8 microns (room temp.), 2 microns (low temp.)
Control PC:	Windows2000/XP OS
Communication:	16-bit ADC
Image acquisition:	Video capture
Software:	Feedback signal monitor and near-field mapping measurement software, 3D display software, CCD image display for probe observation, mapping analysis software, spectral analysis software
Sample cooling:	Gas-flow cryostat (NFS-310)
User access port:	2 ports (Front and right side)
Main unit size:	340 x 520 x 550 mm (W x D x H) (NFS-210) 340 x 520 x 750 mm (W x D x H) (NFS-310)
Power Supply:	335 x 450 x 140 mm (W x D x H)
Weight:	Main unit: 45 kg Power Supply: 15 kg
Power requirement:	100 V AC \pm 10%, 250 VA (Excluding PC and laser)

NFS-220/320



The NFS-220/320 series combines the precision of the NFS near-field microscope system with the additional excitation optics to expose samples to near-field light emitted from the tip of the near-field probe. In addition to topographical maps of the sample surface with a spatial resolution beyond a conventional microscope, the precise control of the distance between the probe tip and sample surface provides optimal illumination for optical nanofabrication applications.

Features

- Controlled illumination of samples with a spatial resolution of several hundred nm or less using the near-field probe.
- Topographic mapping of almost any sample; organic, inorganic, metal or biopolymer, etc.
- For low temperature experiments, the NFS-320 includes a He gas-flow cryostat for cooling to 10K or less.
- Parallel beam output port for light condensed by the near-field probe.
- Integrated laser source.
- Optional laser excitation with external laser port.
- The NFS-220T and -320T are bench-top models; the NFS-220V and -320V are supplied with a vibration isolation table.

Specifications

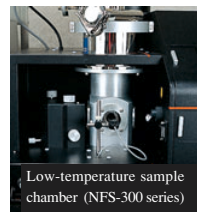
Measurement modes:	Illumination-collection, collection, and illumination (transmission)
Built-in laser:	532 nm source standard, or optional 632.8 nm excitation
External laser:	Capability for two excitation sources (including internal source)
Spatial resolution:	Aperture diameter (or less) of near-field probe (1000 – 50 nm)
Stage range:	20 x 20 microns (room temp.), 5 x 5 microns (low temp)
Height:	8 microns (room temp.), 2 microns (low temp.)
Control PC:	Windows2000/XP OS
Communication:	16-bit ADC
Image acquisition:	Video capture
Software:	Feedback signal monitor and near-field mapping measurement software, 3D display software, CCD image display for probe observation, mapping analysis software, spectral analysis software
Sample cooling:	Gas-flow cryostat (NFS-320)
Main unit size:	710 x 680 x 550 mm (W x D x H) (NFS-220) 710 x 680 x 750 mm (W x D x H) (NFS-320)
Power Supply:	335 x 450 x 140 mm (W x D x H)
Weight:	Main unit: 70 kg, Controller: 15 kg Vibration isolation table: 280 kg
Power requirement:	100 V AC \pm 10%, 250 VA (Excluding PC and laser)
Other requirements:	Nitrogen or air source for vibration isolation table, 0.3 to 0.8 MPa (50-100 psi).

NFS-230/330/230C



NFS-330

The NFS-230/330 series is an integrated near-field spectrometer system providing fluorescence and photoluminescence spectra with extremely high spatial resolution. The topographical mapping capabilities of near-field and precision control of the distance between the probe tip and sample surface can be used to provide controlled excitation of a submicroscopic region on the sample surface, providing fluorescence and photoluminescence data with a spatial resolution orders of magnitude greater than conventional microscopy.



Low-temperature sample chamber (NFS-300 series)



Room-temperature sample chamber (NFS-200 series)

Features

- An integrated near-field microspectrometer system.
- Measurement of fluorescence/photoluminescence spectra at high spatial resolutions from 50 to 1000 nm.
- Topographic mapping of almost any sample; organic, inorganic, metal or biopolymer, etc.
- For low temperature experiments, the NFS-330 includes a He gas-flow cryostat for cooling to 10K or less.
- Automated switching of illumination/collection modes, excitation sources and filters.
- The NFS-230T and -330T can be integrated onto an existing platform; the NFS-230V and -330V are supplied with a vibration isolation table.

Specifications

Measurement modes: Illumination-collection, collection, and illumination (transmission)

Internal laser source: 532 nm source standard, or optional 632.8 nm excitation

External laser port: Capability for two excitation sources (including internal source)

Spectrometer: Aberration-corrected Czerny-Turner spectrometer

Focal length: 300 mm

Diffraction gratings: Standard gratings of 1,800 lines/mm and 600 lines/mm

Wavelength resolution: 0.5 nm or greater

Wavelength range: 500 to 1,000 nm (Depends on probe used)

Detector: Thermoelectric or liquid nitrogen-cooled multichannel CCD detector

Spatial resolution: Aperture diameter (or less) of near-field probe (1000 – 50 nm)

Stage range: 20 x 20 microns (room temp.), 5 x 5 microns (cryostat)

Height: 8 microns (room temp.), 2 microns (cryostat)

Control PC: Windows 2000/XP OS

Communication: 16-bit ADC

Image acquisition: Video capture

Software: Feedback signal monitor and near-field mapping measurement software, 3D display software, CCD image display software for probe observation, mapping analysis software, spectral analysis software

Sample cooling: Gas-flow cryostat (NFS-330)

Main unit size: 710 x 680 x 550 mm (W x D x H) (NFS-230)

710 x 680 x 750 mm (W x D x H) (NFS-330)

Power Supply: 335 x 450 x 140 mm (W x D x H)

Weight: Main unit: 90 kg, Power Supply: 15 kg

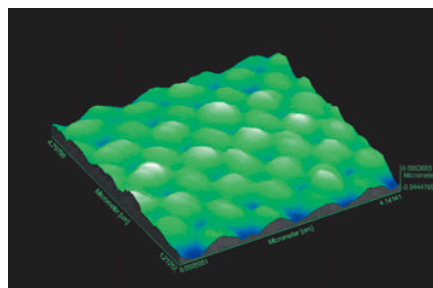
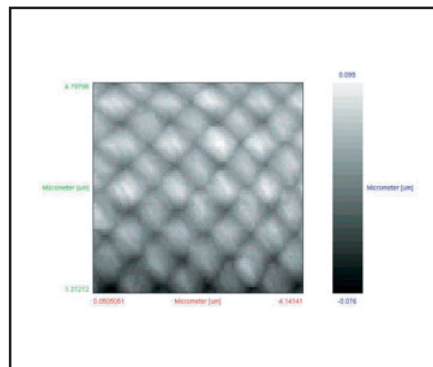
Vibration isolation table: 280 kg

Power requirement: 100 V AC $\pm 10\%$, 250 VA (Excluding PC and laser)

Other requirements: Nitrogen or air source for vibration isolation table, 0.3 to 0.8 MPa (50-100 psi).

Image Manager

Image Manager software provides a high resolution display of a wide variety of 3-dimensional NFS data including sample surface topography maps. Measurement results for peak intensity/intensity ratio distributions, peak area/area ratio distributions, and peak half-width values are used to provide incredibly realistic 3-D images of the spectral mapping data. Computation of distance and area measurements, cross-section analysis functions plus various image processing tools for high data volumes are used for efficient derivation of necessary information from the NFS system.



Electrical Panel

An even broader range of experimental systems can be devised and integrated with the NFS series via direct access to BNC connectors on the interface panel of the instrument power supply.

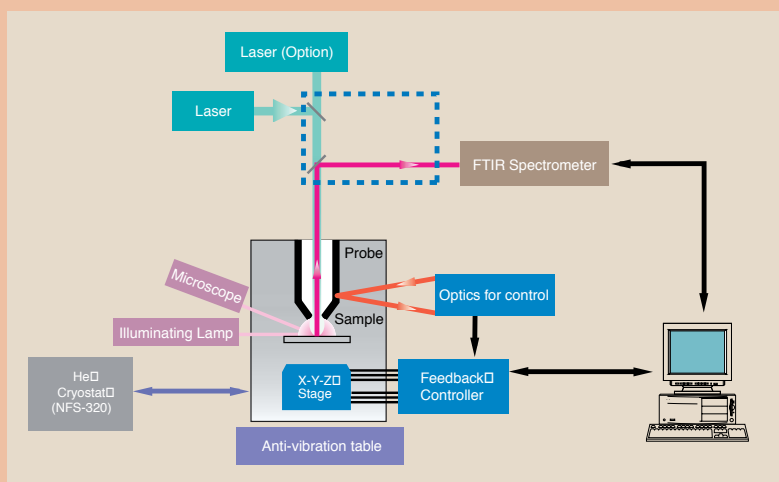
- Simultaneous mapping of two data channels.
- Synchronous control of near field spectrometer system and other external instruments using input and output triggers.
- External feedback control circuit provides switching between probe excitation and stage control signals.
- Synchronized control of probe excitation and data acquisition.

NFS-220FT/320FT



Rapid expansion of the Internet Telecommunications (IT) industry in recent years has promoted extensive research and development on optical elements for communication in the 1.3-1.5 micron wavelength range. Due to the nanoscale design of devices such as the highly efficient laser diodes that generate light at these wavelengths, the photo diodes that function as detectors, and the waveguides that form optical circuits, conventional spectral analysis methods are not able to analyze these items.

Using the Near-Field Near-infrared (NIR) Spectroscopy System, the spot size of near-field light generated from the near-field probe is dependent only upon the aperture size, not the wavelength. By using near-field light as the excitation source, samples can be examined in the near-infrared range with spatial resolutions at or below the source wavelengths utilizing a high sensitivity FT-NIR spectrometer.



Features

- Covers the near-infrared range used for the optical communications field.
- Combining near-field illumination with a high-sensitivity FT- NIR to provide luminescence spectroscopy in the near-infrared range.
- Topographic mapping of almost any sample; organic, inorganic, metal or biopolymer, etc.
- For low temperature experiments, the NFS-320FT includes a He gas-flow cryostat for cooling to 10K or less.

Specifications

Measurement modes: Illumination-collection, collection, external light introduction mode, and standard light source introduction mode for wavelength modification

Lasers: Maximum of 2 laser sources can be installed

Light path switching: Computer controlled

Standard Source: Green laser at 532 nm

External laser introduction: 1 port

Fourier Transform spectrometer:

Wavelength range: 850 - 1500 nm

Wavelength resolution: 1 nm (around 1 micron)

Detector: InGaAs

Interferometer: 90° Michelson interferometer

Beam splitter: Si on CaF2

Cryostat (NFS-320FT): He gas flow type – He gas introduced by transfer line

Stage range: 20 x 20 μm; Height: 8 μm

Control PC: Windows 2000/XP OS

Image acquisition: Video capture card

Software: Feedback signal monitor and near-field mapping measurement software, 3D display software, CCD image display software for probe observation, mapping analysis software, spectral analysis software

System size: 1600 x 750 x 1500 mm (W x D x H)

Weight: 80 kg (main unit), 76 kg, 300 kg (vibration isolation table)

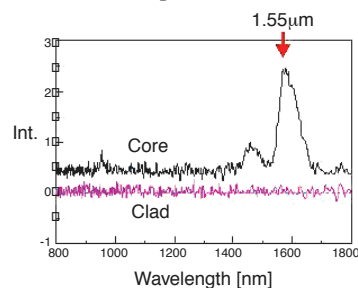
Power requirement: AC100 V ±10%, 250 VA (main unit), 130 VA (FTIR), 100VA (PC)

Other requirements: Nitrogen or air source for vibration-isolation table, 0.3 to 0.8 MPa (50-100 psi)

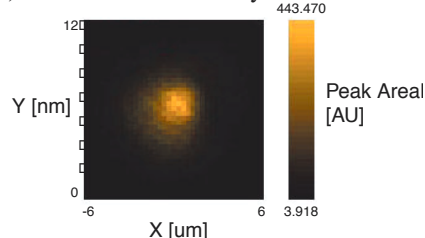
Applications

Combining a high sensitivity FT-NIR spectrometer with an InGaAs detector allows detection of wavelengths exceeding 1μm, beyond the range of a Si detector. The figures below outline the data collected by the NFS-220FT for the surface of an Er³⁺ (Erbium) doped fiber, the optical fiber used for optical signal amplifiers in the 1.55 micron band. 'A' illustrates the luminescence spectrum for the sample with a readily observable peak corresponding to the luminescence of Er³⁺ near the core. 'B' is a diagram of the luminescence intensity distribution, and 'C' displays the cross-section of the intensity distribution. The figures demonstrate that, even for the near-infrared range, spectral analysis can be done at spatial resolutions at or below the source wavelengths using near-field analysis methods.

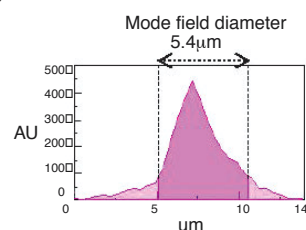
A) Luminescence spectrum



B) Luminescence intensity distribution

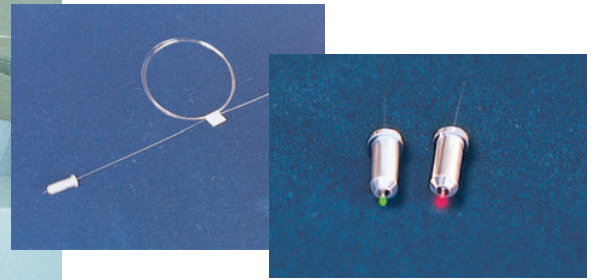


C) Cross Section



Near-field Probe

JASCO manufactures a variety of near-field probes with excellent transmission efficiency and a superior aperture control technology to enable high-precision near-field measurements.



Standard Near-Field Probe (Visible to Near Infrared)

NSP-30/50/100/200/300/400/500

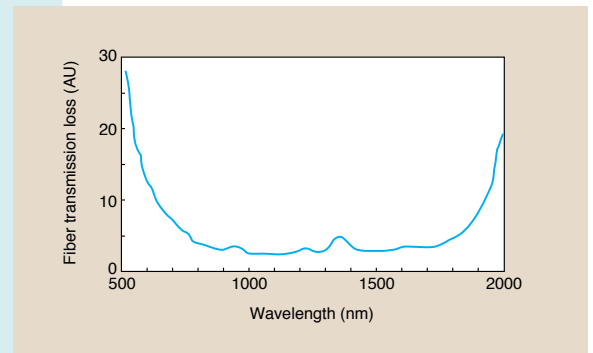
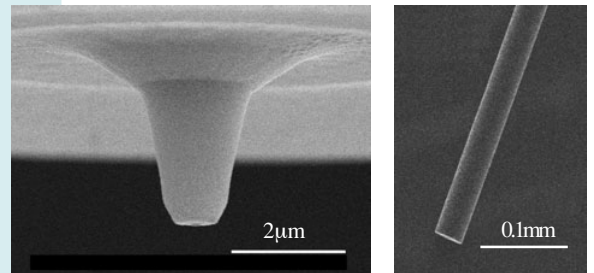
A near-field microscope probe featuring good transmission from the visible range to the near-infrared region. Standard near-field probes offer an aperture with a controlled spatial geometry, efficient transmission/condensation of near-field light, and with high resonance characteristics.

Features:

- Source transmission for a 100-nm aperture probe approaches 0.1%, ideal for spectral acquisition.
- Consistent wavelength transmission from 600 - 1800 nm.
- Highly uniform aperture diameter.
- Aperture diameters are specified from 100 - 500 nm in 100 nm increments, minimum aperture of 30 nm also supported.
- Excellent mechanical resonance frequency for optimized distance control between probe and sample.
- Probe documentation includes individual test results for probes including verification of probe diameter, aperture diameter, optical throughput, probe resonance frequency and visual inspection for defects/contamination.
- Scanning electron microscope (SEM) photographs for verification of probe aperture are available upon request.

Specifications

Aperture size:	+/-30nm for 30, 50nm +/-50nm for 100, 200, 300, 400, 500nm
Probe coating:	Gold
Coating thickness:	About 150nm
Resonance frequency:	20 to 50 kHz (with holder)
Fiber length:	0.5m standard (different lengths on request)
Cladding diameter:	125 μ m
Mode field diameter:	5 μ m ($\lambda=1550$ nm)
Core:	Ge doped
NA (numerical aperture):	0.32
Transmission loss:	Less than 0.45dB/km ($\lambda=1550$ nm)
Cut-off wavelength:	0.76 μ m



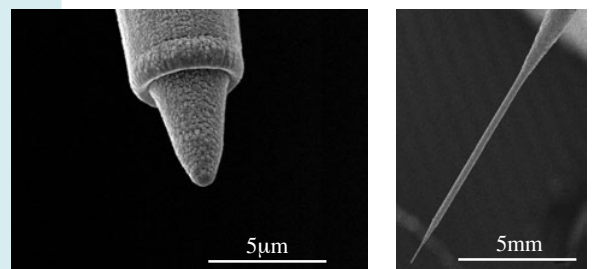
Near-Field Probe for Scattering Experiments

NPN-500

Light-scattering probe consisting of a sharpened fiber-optic probe with a metallic film surface coating. Perfect for scattering near-field microscope measurements. Gold coated surface has excellent scattering efficiency.

Specifications

Cone angle:	About 40°
Apex diameter:	About 500nm
Probe coating:	Cr + Gold
Coating thickness:	About 300nm
Resonance frequency:	20 to 50 kHz
Fiber handling area:	About 10cm



Near Field Probe for Short Wavelengths (Ultraviolet to Visible)

NPU-30/50/100/200/300/400/500

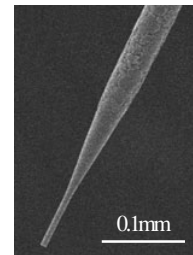
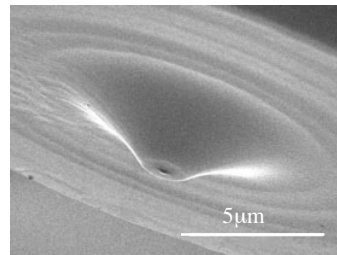
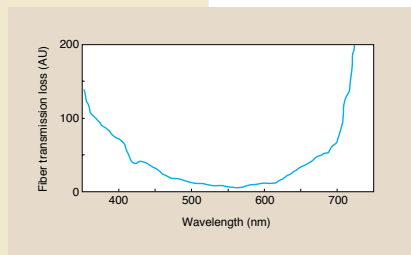
A near-field microscope probe featuring good transmission from the ultra-violet to visible wavelength region. Short wavelength near-field probes offer an aperture with a controlled spatial geometry, efficient transmission/condensation of near-field light, and with high mechanical resonance characteristics for optimized near-field measurements.

Features:

- Consistent wavelength transmission from 200 - 700 nm, more suited for short wavelength applications.
- Source transmission for a 100-nm aperture probe approaching 0.1%.
- Highly uniform aperture diameter.
- Aperture diameters are specified from 100 - 500 nm in 100 nm increments, minimum aperture of 30 nm also supported.
- Excellent mechanical resonance frequency for optimized distance control between probe and sample.
- Probe documentation includes individual test results for probes including verification of probe diameter, aperture diameter, optical throughput, probe resonance frequency and visual inspection for defects/contamination.
- Scanning electron microscope (SEM) photographs for verification of probe aperture are available upon request.

Specifications

Aperture size: +/-30nm for 30, 50nm
 +/-50nm for 100, 200, 300, 400, 500nm
 Probe coating: Gold
 Coating thickness: About 150nm
 Resonance frequency: 20 to 50 kHz (with holder)
 Fiber length: 0.5m
 Cladding diameter: 125 μ m
 Mode field diameter: 10 μ m ($\lambda=1550$ nm)
 Core: Quartz
 NA (numerical aperture): 0.1
 Transmission loss: less than 0.25dB/km ($\lambda=1550$ nm)
 Cut-off wavelength: 1.33 to 1.55 μ m



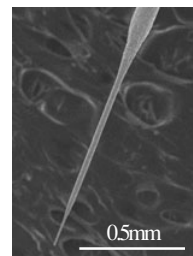
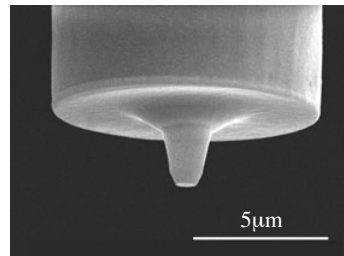
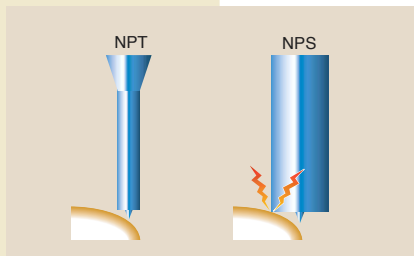
Resonance Stable Near-Field Probes (Visible to Near Infrared)

NPT-30/50/100/200/300/400/500

A near field spectral probe for visible light to near-infrared region manufactured for slanted or uneven samples by additional etching of the probe diameter.

Features:

- Additional etching of the probe diameter to reduce the opportunity for contact of the probe with the sample surface.
- The sample is not affected when detecting probe resonance.
- Other specifications conform to those for the NFS Standard Near-Field Probes.



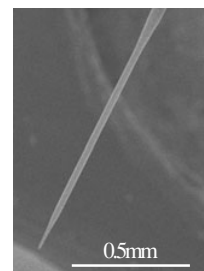
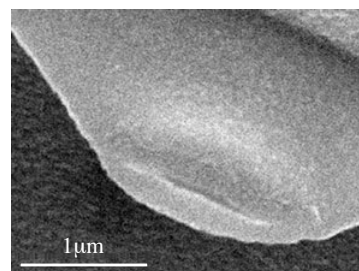
Polarized Near-Field Probe (Visible Light to Near Infrared)

NPP-50

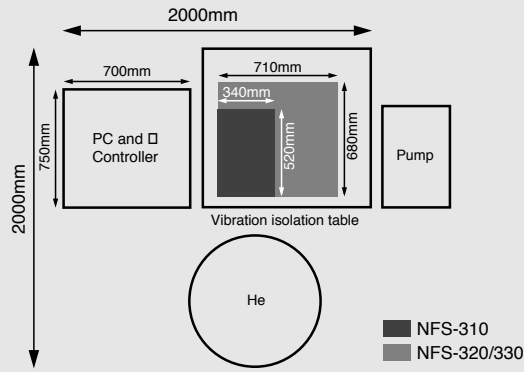
A near-field microscope probe that selectively generates or condenses linearly polarized light for wavelengths in the visible to near-infrared region. Depending on the electric field distribution generated by the slit-shaped aperture, linearly polarized light with a vertical electric field component on the slit aperture is either generated or condensed. Use of this probe allows measurement of near-field polarization.

Features:

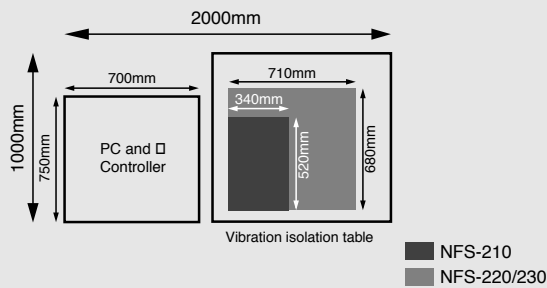
- Selectively generates or detects near-field linearly polarized light.
- Consistent wavelength transmission between 600 and 1,500 nm.
- Excellent mechanical resonance frequency for optimized distance control between probe and sample.
- Probe documentation includes individual test results for probes including verification of probe diameter, aperture diameter, optical throughput, probe resonance frequency and visual inspection for defects/contamination.
- Scanning electron microscope (SEM) photographs for verification of probe aperture are available upon request.



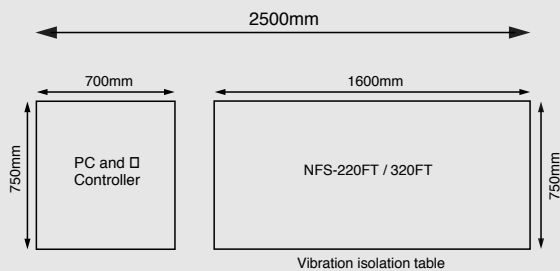
Low-temperature system



Room-temperature system



NFS-220FT / 320FT



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