

Defect Review in the Photonics Revolution

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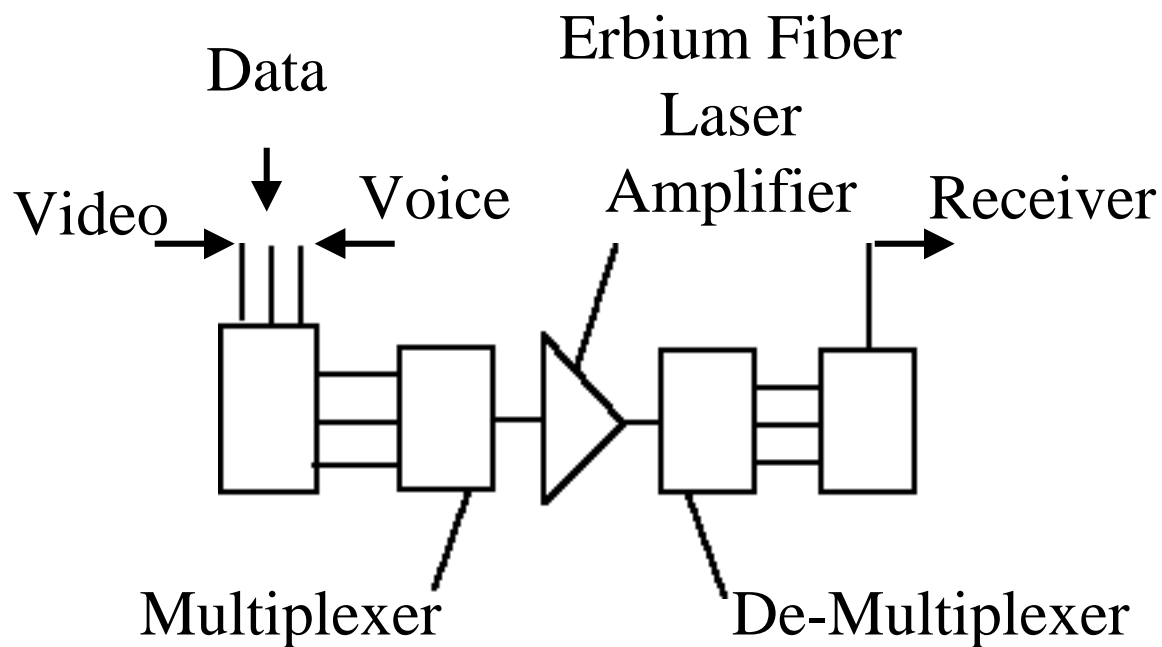
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Components of The DWDM Revolution



A New Direction for WDM Test & Measurement

- The Need - Decreasing Size and Increasing Integration
- The Technology - Near-field Optics
- 3. The level of Optical Resolution - 0.05 microns
- 4. New Correlations -
Light distribution

with simultaneous nanometer information on

Topography

Polarization

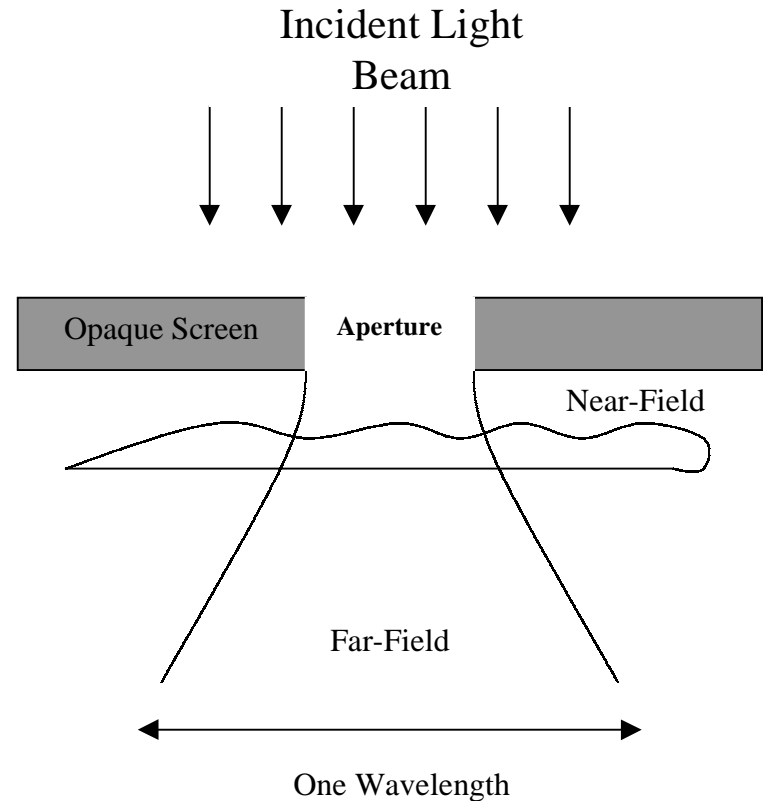
Electrical Characterization

Thermal Characterization

What is Near-Field Optics?

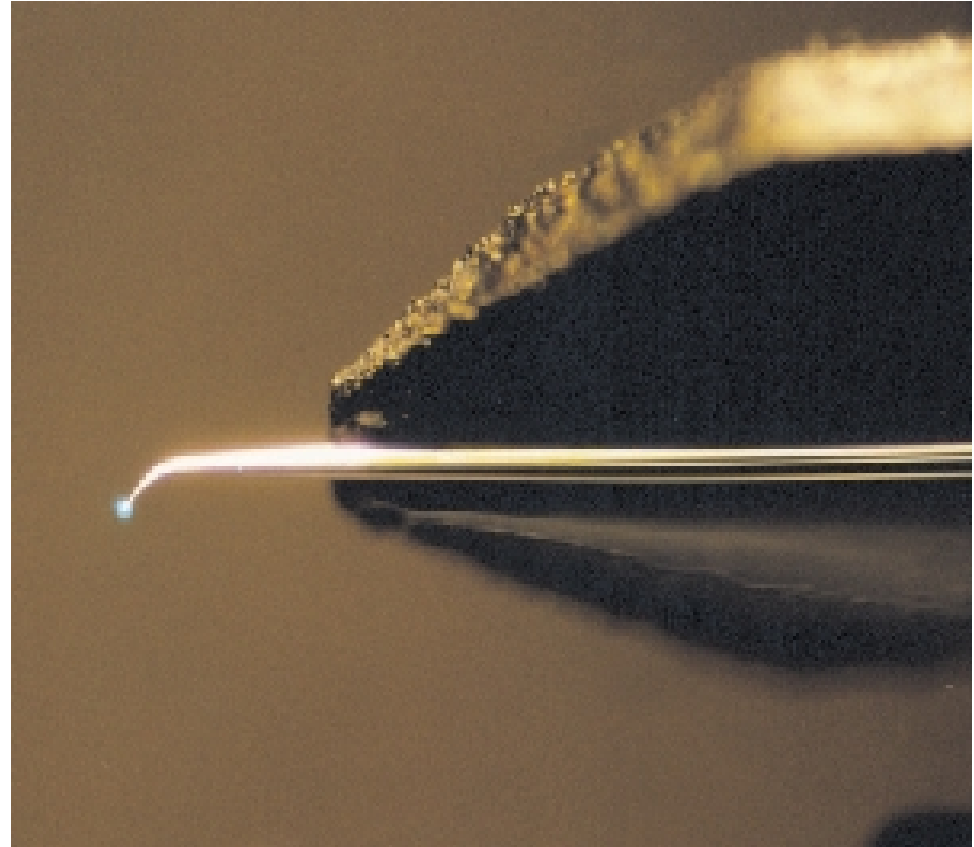
1. Collection or illumination of light through a sub-wavelength aperture

2. Scanning of sample or aperture relative to one another in the near-field

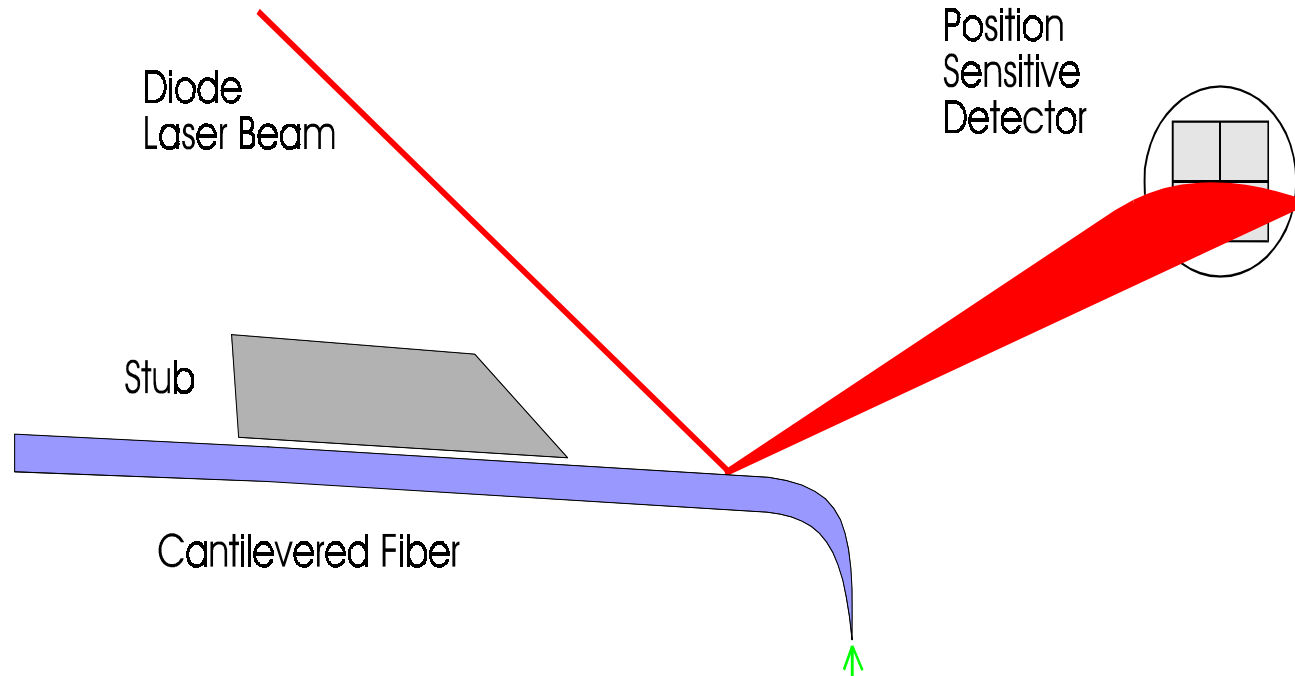


Near-field Optical Element

1. Tapered cantilevered metal-coated optical fiber probe
2. Simultaneous optical and topographical imaging
3. Simultaneous electrical [resistance, capacitance etc.] imaging



Deflection Force Sensing



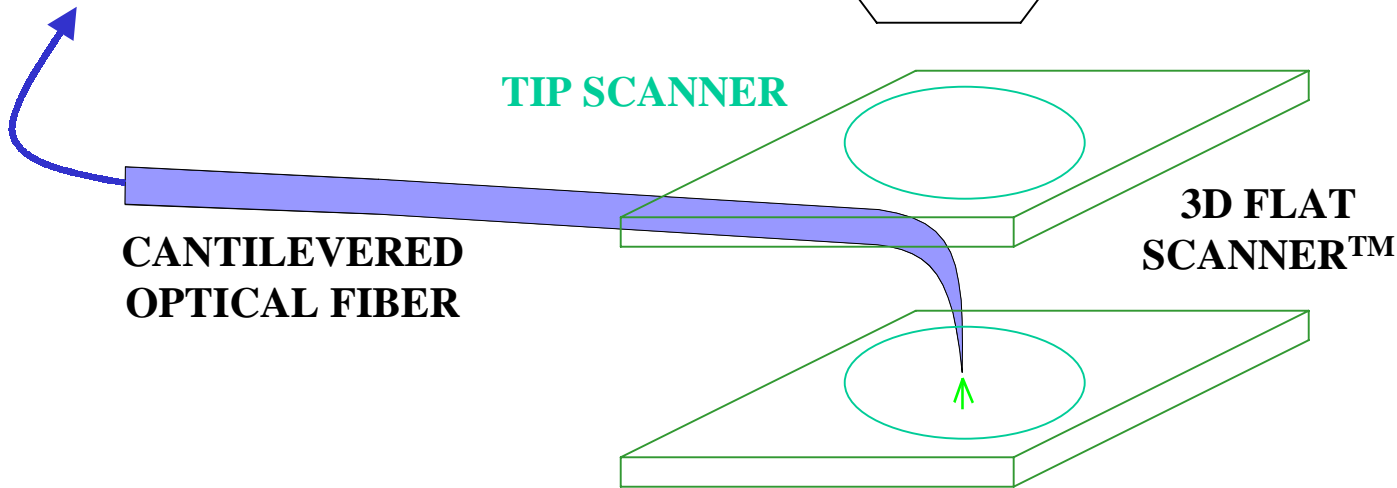
The standard optical method

1. Cantilevered optical fibers are excellent atomic force sensors that can operate to detect surface topography either in contact or by being close but not in physical contact with the surface
2. Nanonics also provides non-optical means of deflection sensing

Optical Spectrum Analysis
Time Domain Measurements
Electrical Measurements
Polarization Analysis
Thermal Measurements

CCD
CAMERA

LENS



SAMPLE SCANNER

LENS

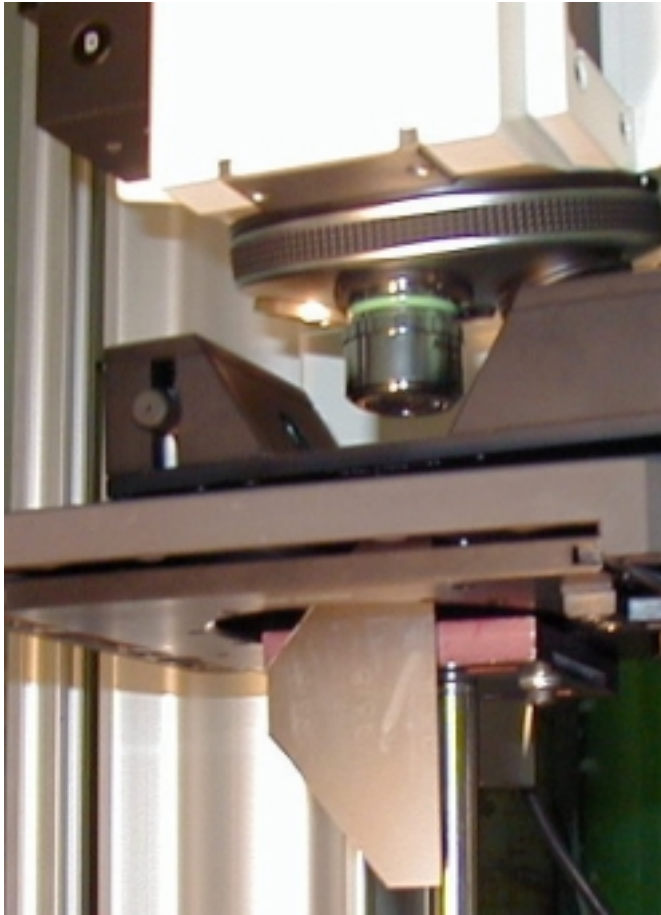
CCD
CAMERA

Nanonics

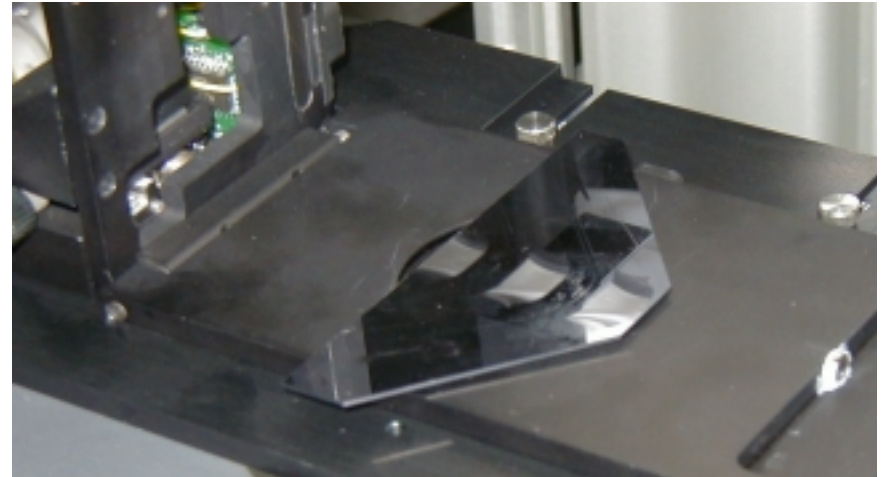
Near-field/Far-field

Defect Review Station

System Flexibility



Placement of waveguide
for high resolution
injection of light at the
edge of the guide



Placement of the waveguide
for imaging evanescent
fields

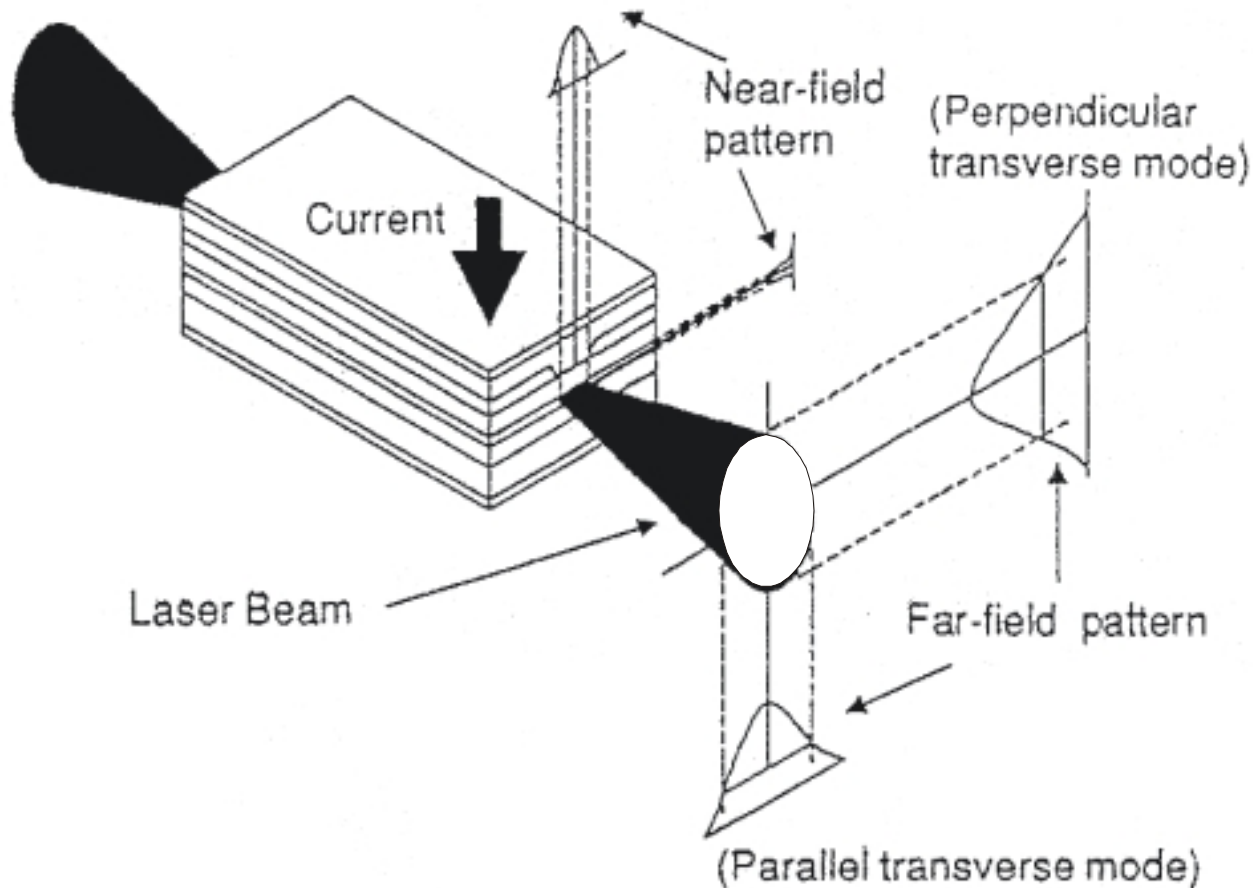


Near-Field Optics (NSOM) Plays A Bridging Role Between Conventional Optical Microscopy And Atomic Force Microscopy

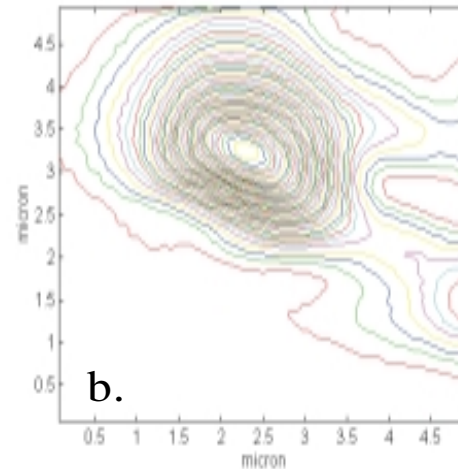
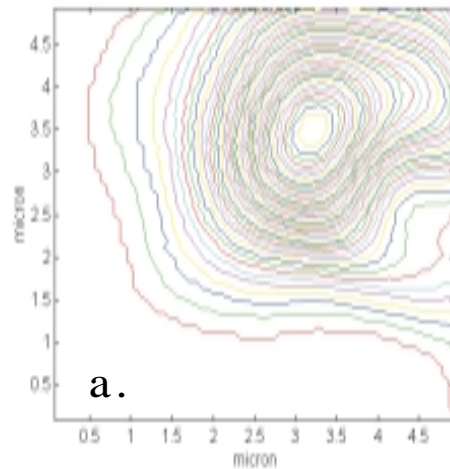
Demonstrating the uses of near-field optics

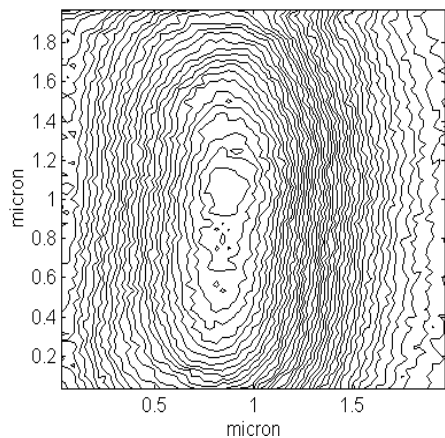
- Slab waveguide lasers
- V-Groove lasers
 - Correlating structure with light emission
 - Correlating mode structure with wavelength
 - Correlating mode structure with heat
- Optical waveguides
 - Optical fiber mode distribution with alterations in coupling
 - Polarization dependence of evanescent fields
 - Imaging the Tien effect
 - Imaging star couplers

Light distribution analysis with 0.05 micron spatial resolution of slab waveguide lasers emitting at 1.5 microns

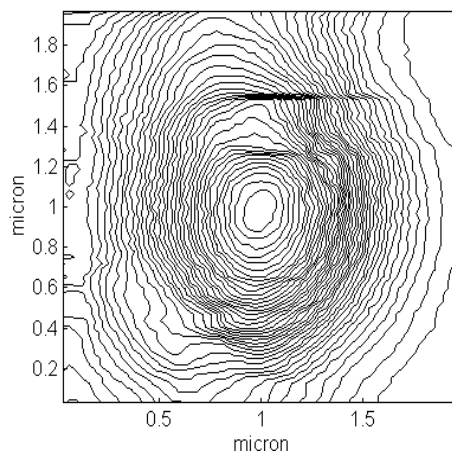


A comparison of the (a) far-field and (b) near-field light distribution

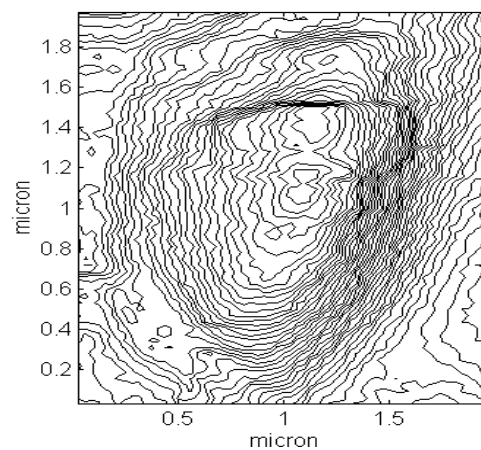




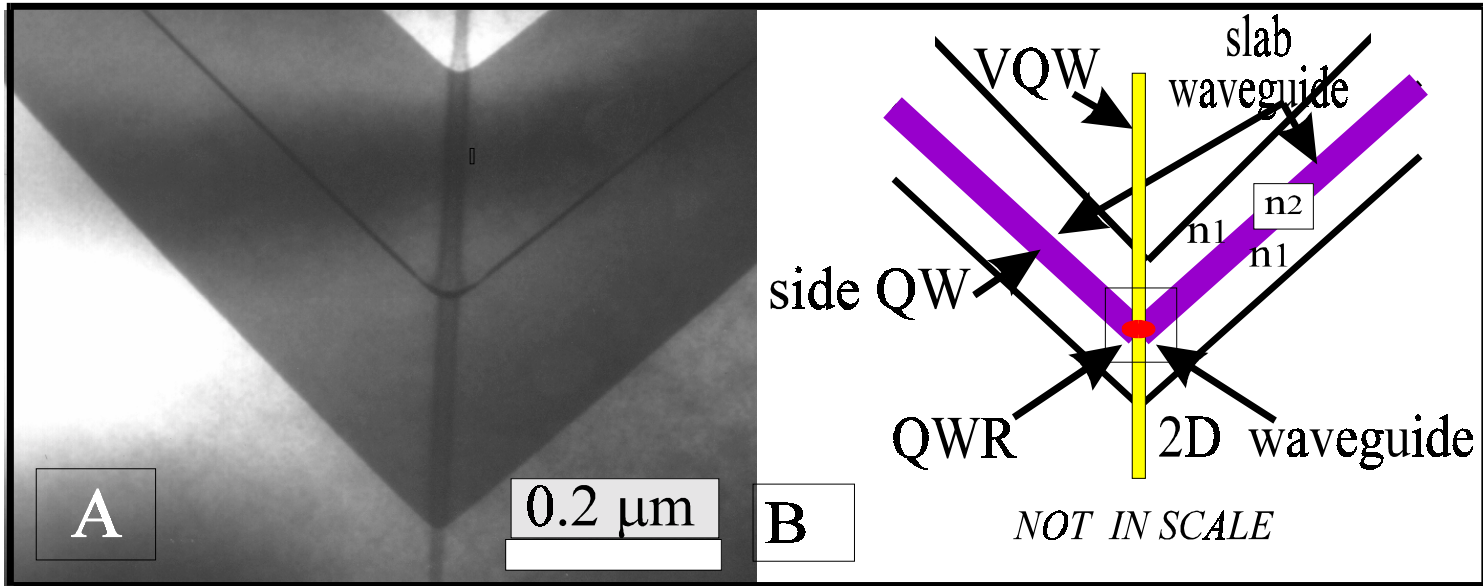
***NSOM Light
Distribution
From The Laser
Cavity With An
Injected Current
That Is Below
The Threshold
For Lasing
Action***



***NSOM Light
Distribution
From The Laser
Cavity With An
Injected Current
That Is Above
The Threshold
For Lasing
Action***

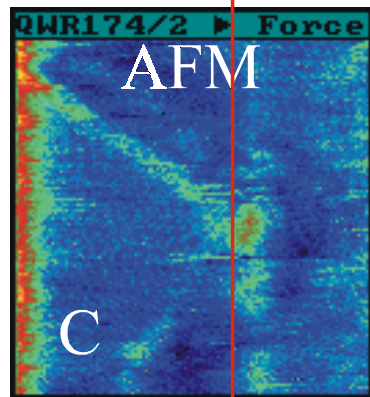
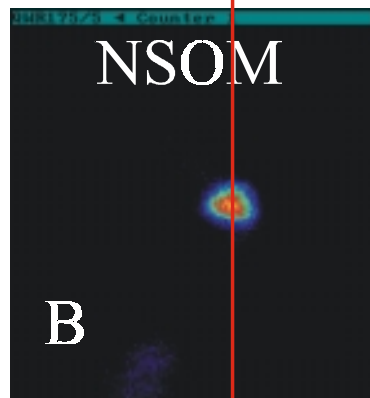
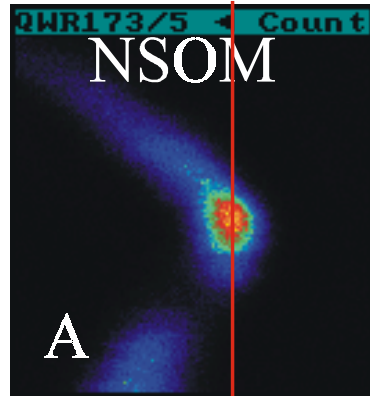


***Injected Charge
Distribution
Measured Using
the Simultaneous
Atomic Force
Capabilities With
an Injected
Current Above
the Threshold for
Lasing Action***

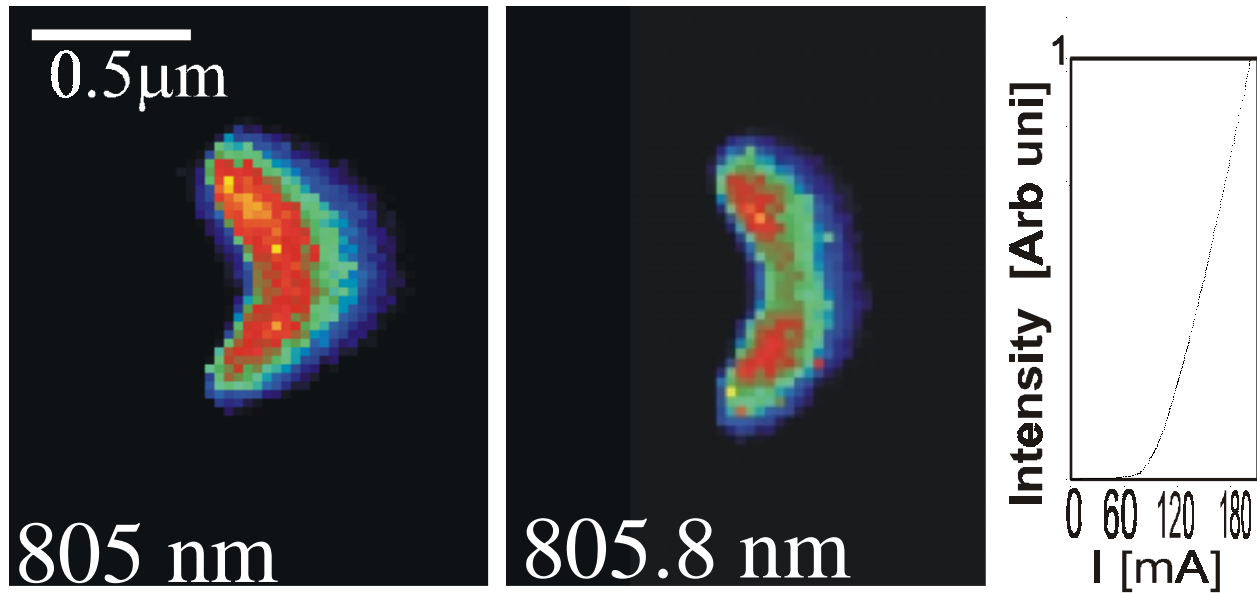


*An Electron
Micrograph
Of The V
Groove Laser
Structure*

*Diagrammatic
Representation Of
The Structure
(B).*

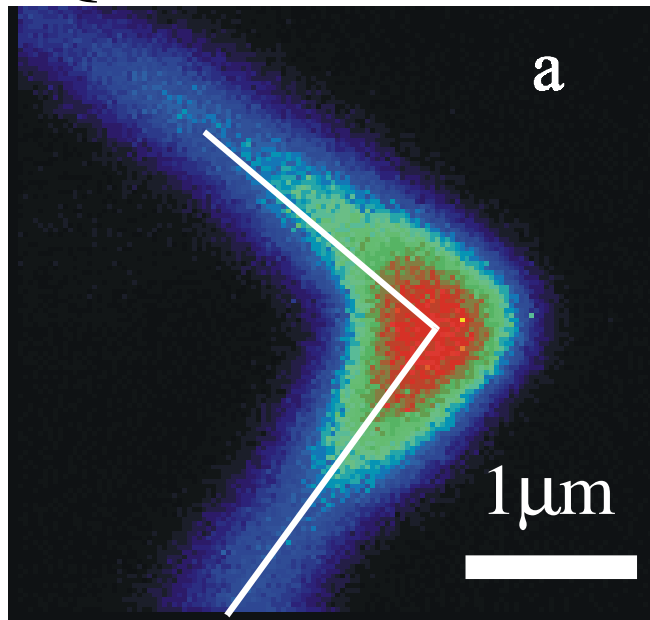


1. Correlation of the light distribution and geometric structure of the v groove laser
2. Notice the 150 nm offset

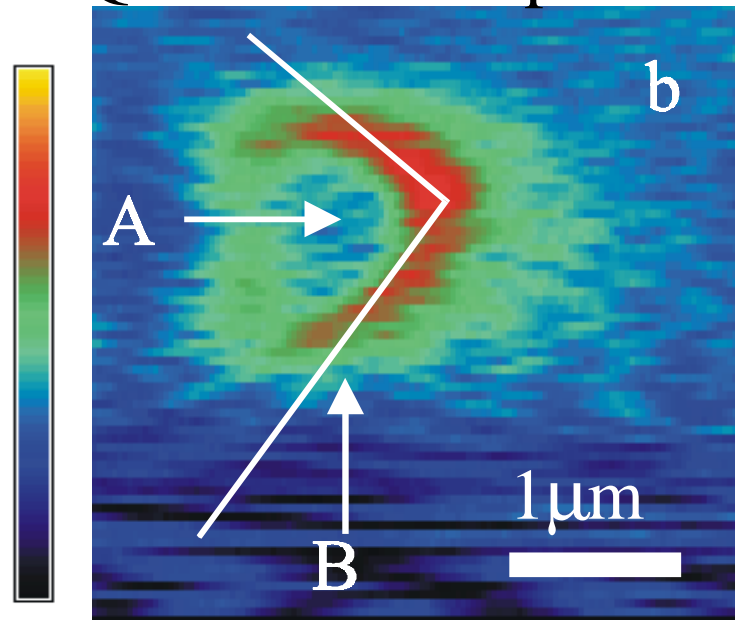


Correlation of mode structure with wavelength alteration

QWR293 -NSOM

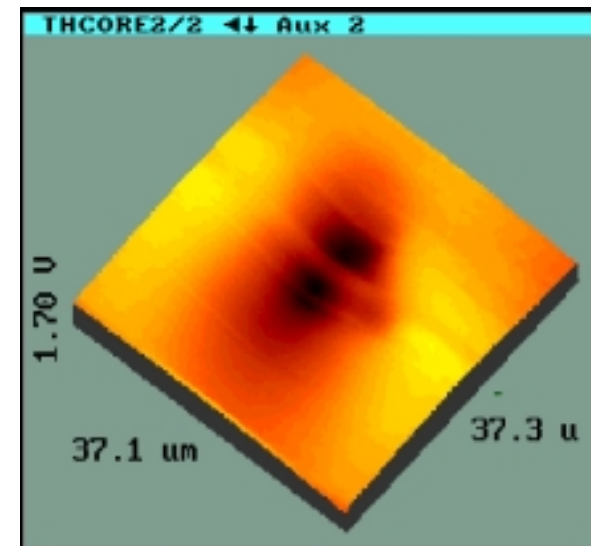
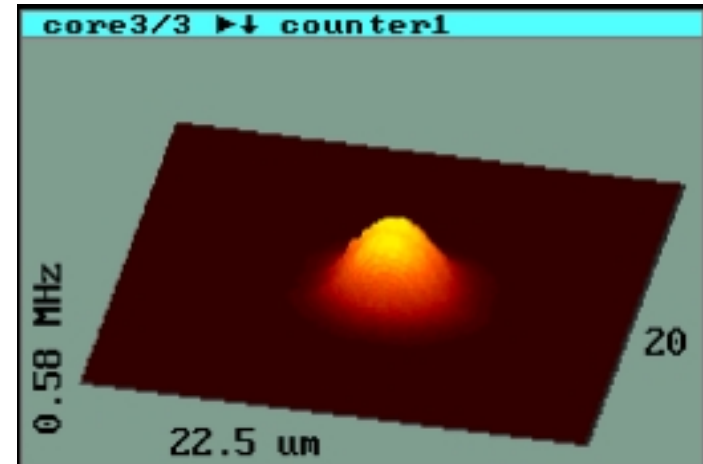
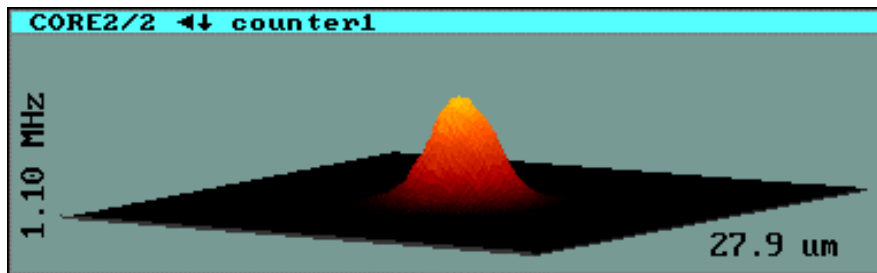
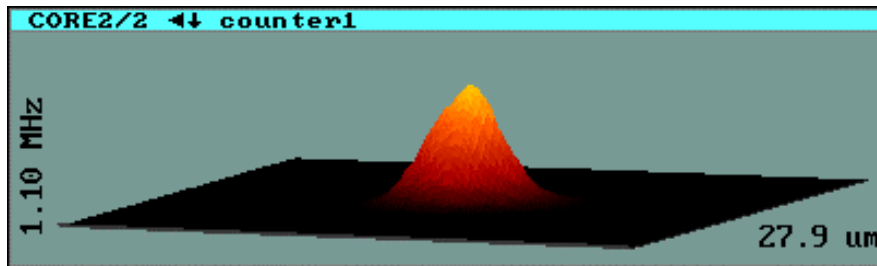
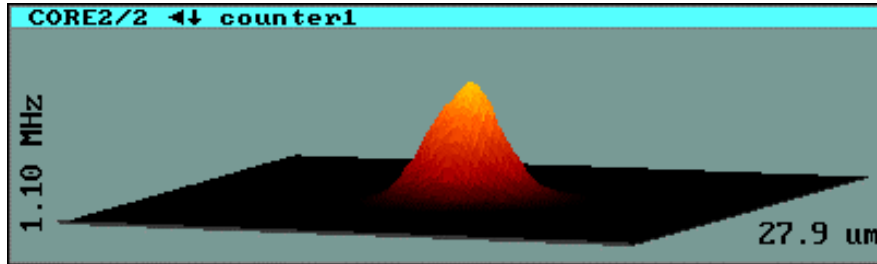


QWR294 -Temperature

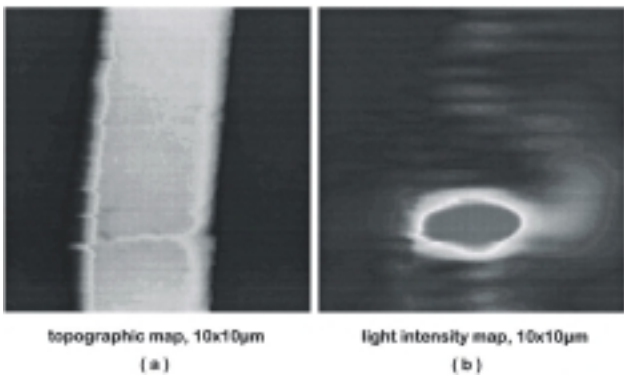


Correlation of light distribution with thermal characteristics

Optical Fiber Output Analysis

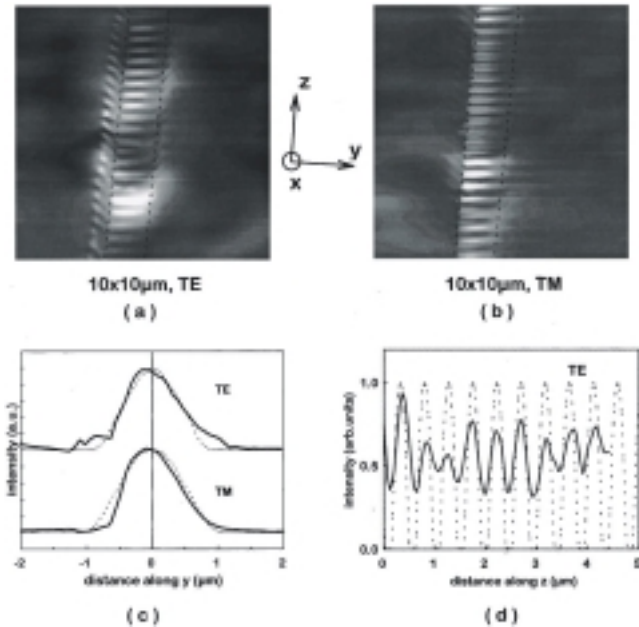


Correlation of light distribution with fiber coupling

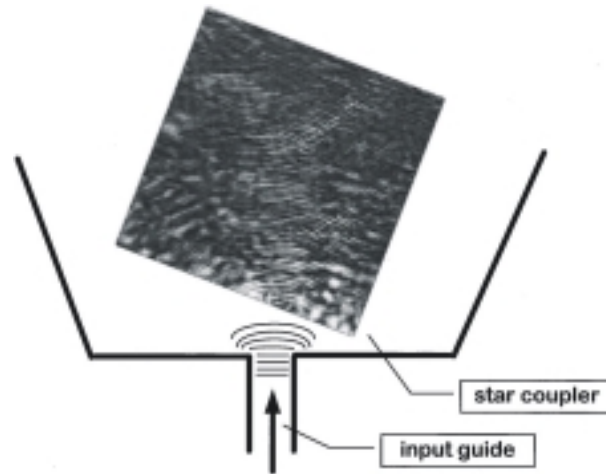


10 nm deep topographic alteration correlated with light leakage from a waveguide that corresponds to an ~ 0.05 dB guided power loss

Images taken from Applied Physics Letters Vol. 73, 1035-1037 (1998)



Near-field optical images of the evanescent field for TE and TM polarization of a semiconductor waveguide



Near-field optical image of the star coupler section of a phasor device

Summary

Near-field Optics

exceptional integrated information on today's components
with a resolution and an information content critical
for components in sight for tomorrow
and
being considered for tomorrow

[S. Shanhui, I. Appelbaum & J. D. Joannopoulos, "Near-field scanning optical microscopy as a simultaneous probe of fields and band structure of photonic crystals," Applied Physics Letters **75**, 3461 (1999)]

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