Tuesday, March 16, 2021

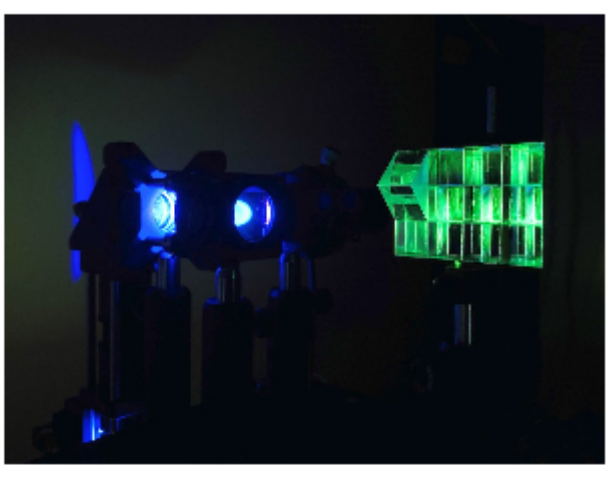
MICROSCOPY Tech Pulse

March 2021

Microscopy Tech Pulse is a special edition newsletter from Photonics Media and Mad City Labs Inc. covering key developments in microscopy technology. Manage your Photonics Media membership at Photonics.com/subscribe.

Microscopy Advancement Expands Camera-based 3D Imaging

Researchers at Boston University introduced a multifocus optical microscopy technique for simultaneously acquiring images at differing depths. The method can be added to existing camera-based microscopy techniques, such as fluorescent, phase contrast, and dark-field imaging.



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PROMOTED CONTENT

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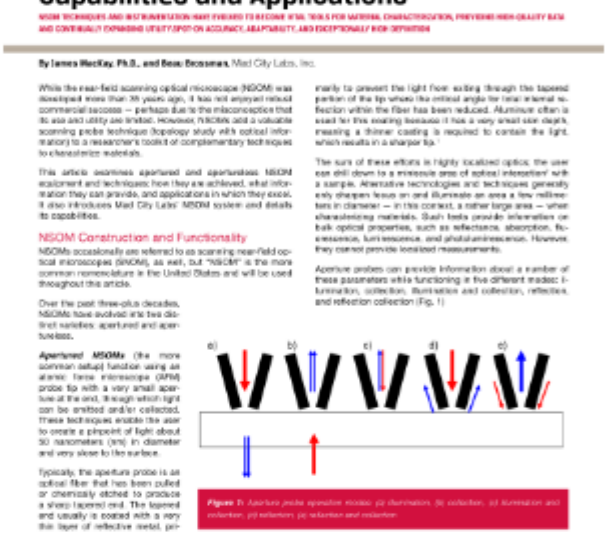
Near-Field Scanning Optical Microscopes: Capabilities and Applications

NSOM techniques and instrumentation have evolved to become vital tools for material characterization, providing high-quality data and continually expanding utility, spot-on accuracy, adaptability, and exceptionally high definition. This article examines apertured and apertureless NSOM equipment and techniques: how they are achieved, what information they can provide, and applications in which they excel.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Near-Field Scanning Optical Microscopes:
Capabilities and Applications

By James MacKay, Ph.D., and Beau Bessonen, Mad City Labs, Inc.

While the near-field scanning optical microscope (NSOM) was developed more than 30 years ago, it has not enjoyed robust commercial success — perhaps due to the misconception that its use and utility are limited. However, NSOMs add a valuable scanning probe technique (topology study with optical information) to a researcher's toolkit of complementary techniques to characterize materials.

This article examines apertured and apertureless NSOM equipment and techniques: how they are achieved, what information they can provide, and applications in which they excel. It also introduces Mad City Labs' NSOM system and details its capabilities.

NSOM Construction and Functionality

NSOMs occasionally are referred to as scanning near-field optical microscopes (SNOM), as well, but "NSOM" is the more common nomenclature in the United States and will be used throughout this article.

Over the past three-plus decades, NSOMs have evolved into two distinct varieties: apertured and apertureless.

Apertured NSOMs (the more common setup) function using an atomic force microscope (AFM) probe tip with a very small aperture at the end, through which light can be emitted and/or collected. These techniques enable the user to create a pinpoint of light about 50 nanometers (nm) in diameter and very close to the surface.

Typically, the aperture probe is an optical fiber that has been pulled or chemically etched to produce a sharp (tapered) end. The tapered end usually is coated with a very thin layer of reflective metal, primarily to prevent the light from exiting through the tapered portion of the tip where the critical angle for total internal reflection within the fiber has been reduced. Aluminum often is used for this coating because it has a very small skin depth, meaning a thinner coating is required to contain the light, which results in a sharper tip.

The sum of these efforts is highly localized optics: the user can drill down to a minuscule area of optical interaction with a sample. Alternative technologies and techniques generally only sharpen focus on and illuminate an area a few millimeters in diameter — in this context, a rather large area — when characterizing materials. Such tools provide information on bulk optical properties, such as reflectance, absorption, fluorescence, luminescence, and photoluminescence. However, they cannot provide localized measurements.

Aperture probes can provide information about a number of these parameters while functioning in five different modes: illumination, collection, illumination and collection, reflection, and reflection collection (Fig. 1).

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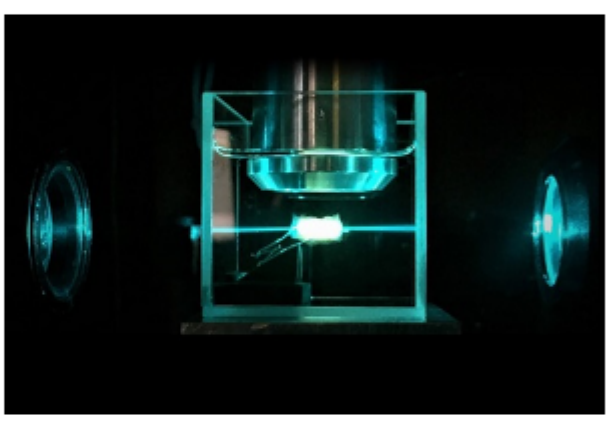
Light-Sheet Microscopy Method Improves Cancer Diagnostics

A microscopy technique developed by researchers at TU Wien (Austria) in collaboration with TU Munich could lead to more reliable cancer diagnostics. The technique allows a tumor to be analyzed after surgery in 3D without cutting the tumor into sections.



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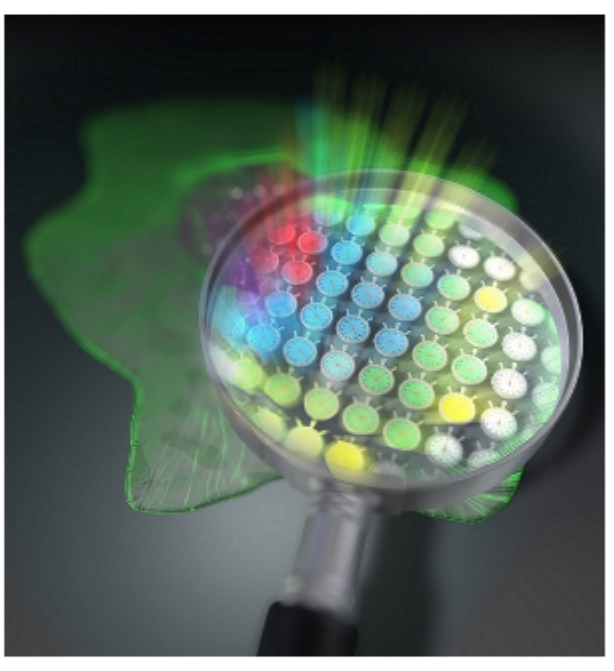
Technique Enhances Effect of Fluorescence Lifetime Microscopy

Researchers from Tokushima University have developed a method of fluorescence lifetime microscopy that does not require mechanical scanning. The technique drastically increases the effectiveness of fluorescence lifetime microscopy (FLIM).



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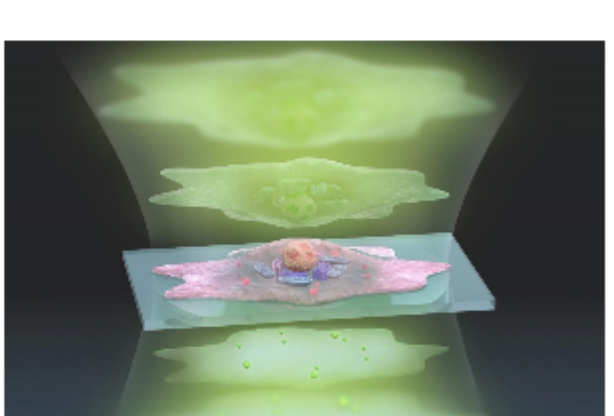
Microscopy Method More Sensitive for Viewing Live Cells

Researchers from the University of Tokyo have developed a way to increase the extent and types of information they are able to ascertain about the insides of living cells by using existing microscopy techniques. Their method does not require staining or fluorescent dyes.



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Imaging Without Limit, on Demand

A team at Columbia University has introduced a way to program a layered crystal in such a way that it is able to open doors to imaging capabilities beyond common limits, on demand. The technique exerts control over nanolight — light that is able to access the nanoscale — providing insight into the field of optical quantum information processing.

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Diagnostic Solution, Powered by Microfluidic Chip, Leads to Inexpensive Hemoglobin Measurements

SigTuple Technologies and the Indian Institute of Science demonstrated an AI-powered, imaging-based tool for the estimation of hemoglobin levels. The setup combines a microfluidic chip and an AI-enabled microscope designed for deriving the total, as well as differential counts, of blood cells. The method uses a microfluidic chip and reagent, costing less than $0.14, as well as a detector in the form of a conventional microscopy camera.

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