

# MICROSCOPY

## Tech Pulse



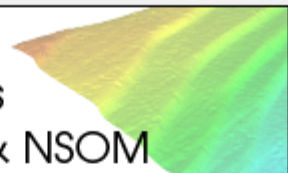
October 2019

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### Open-Source Photon Counting Advances Biological Research

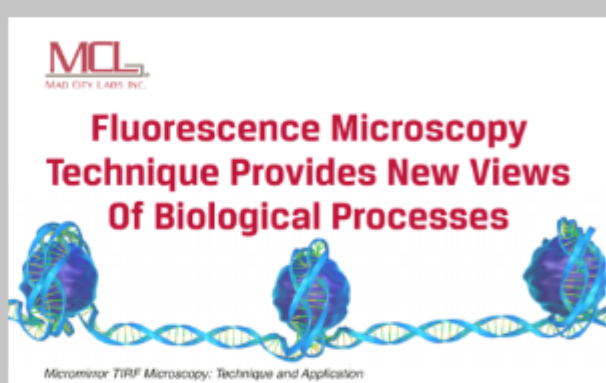
Functional imaging at the cellular level in the living brain is commonly achieved with two-photon laser-scanning microscopy (TPLSM), which enables researchers to face the challenges imposed by scattering of turbid media. Although TPLSM has become the gold standard for imaging under these challenging conditions, overcoming existing trade-offs inherent with this technique will expand the scope of the scientific questions that could be asked.



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### Fluorescence Microscopy Technique Provides New Views of Biological Processes

Introduction to the technique of MicroMirror TIRF (total internal reflection fluorescence) microscopy. The MicroMirror TIRF microscopy technique offers significant signal-to-noise ratio improvements compared to dichroic based TIRF microscopy when using multiple wavelength light sources. Short overview of the types of biological processes that can be studied via this method. Mad City Labs is the only commercial provider of a MicroMirror TIRF microscope.



Fluorescence microscopy has long been a powerful tool in biological research. As everyone knows, as total internal reflection fluorescence (TIRF) microscopy has more recently been used to watch biological processes unfold in real time. By taking advantage of the ability to label individual molecules with different colors of fluorescent tags, TIRF microscopy now allows scientists a view into the complex molecular assemblies that govern cellular processes. But TIRF microscopy can be limited by its signal-to-noise ratio. As scientists seek to understand ever more complex processes, they have to label more components with more colors, and this signal-to-noise problem worsens. Fortunately, a newer variant of TIRF microscopy that relies on micro-mirrors allows researchers to view their samples with unprecedented clarity, opening up new vistas in biological research.

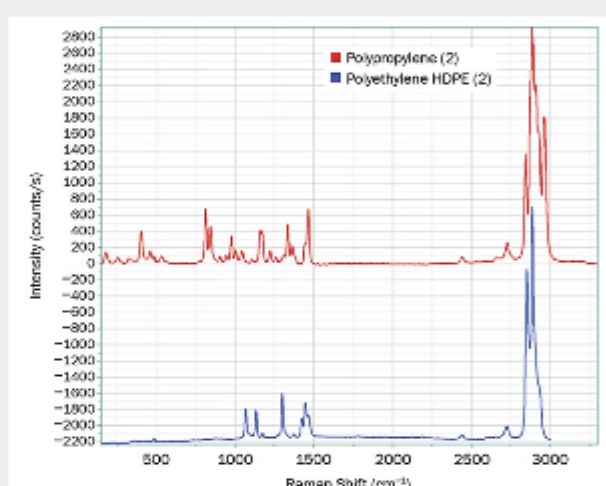
**Viewing Molecular Assembly**  
Almost all biological processes — DNA replication, RNA splicing, the opening and closing of ion channels that conduct neuronal signaling — are governed by so-called molecular machines. These machines are transient assemblies of molecular complexes often made up of many components, which come together, perform a task, and then break apart. How are these assemblies and disassemblies initiated and regulated? What happens when these processes go awry? Since these questions are central to an understanding of both normal and pathological cellular processes, scientists are hard at work seeking answers to them.

One way they do this is through a method known as catalyzed single-molecule spectroscopy (COSMOS). Imagine a particular molecular machine made up of four molecules — A, B, C, and D — and each can be labeled with a uniquely colored fluorescent tag. Researchers can anchor molecule A to a microscope slide and wait for the other molecules to join up with it — to catalyze, in other words. There are many ways the molecular machine could assemble. For instance, perhaps C and D have to bind together before they can bind to A, and only after all three are together does B join in. By watching the order in which the various components come together and seeing

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### Characterizing Microplastics with Raman Spectroscopy

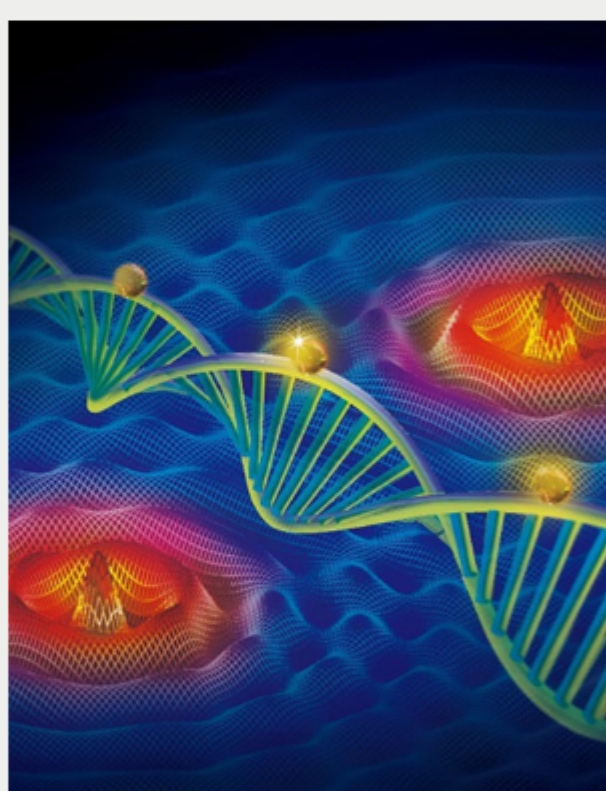
Raman microscopy combines Raman spectroscopy and optical microscopy, and is one of the most efficient and effective ways to identify polymers. It allows researchers to analyze microscopic pieces of plastics by focusing a laser beam onto a small spot to obtain Raman spectra.



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### Repetitive Optical Selective Exposure Could Improve Single-Molecule Localization Microscopy

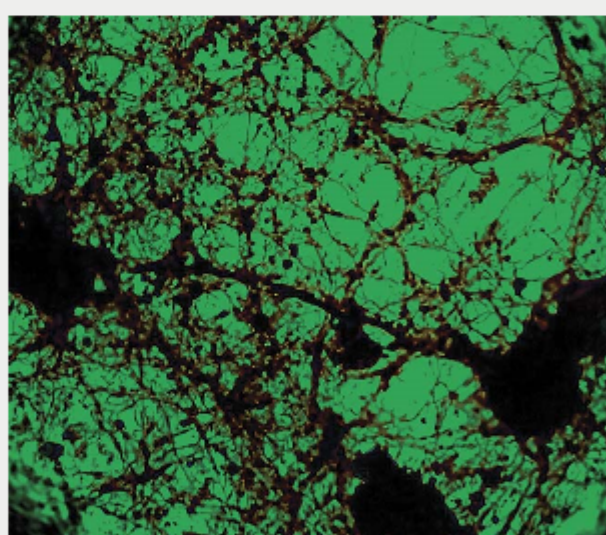
An interferometric, single-molecule localization method for superresolution fluorescence microscopy could significantly improve localization precision compared with conventional centroid fitting methods. The new approach is called Repetitive Optical Selective Exposure (ROSE).



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### Coherent Diffraction Imaging Expands Researcher Tool Set

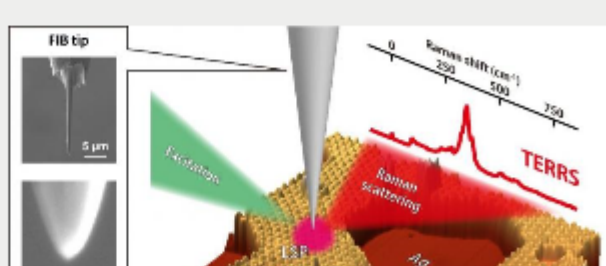
Nanoscale imaging with light in the intermediate range has been neglected, primarily because of a gap in available tools and techniques, so thus far the potential for progress has been relatively untapped. However, recent advancements in suitable lab-scale light sources as well as in computational imaging approaches now make it possible to measure structures and features at <15-nm resolution and with unique contrast sensitivity.



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### Tip-Enhanced Raman Spectroscopy Provides 1-nm Resolution

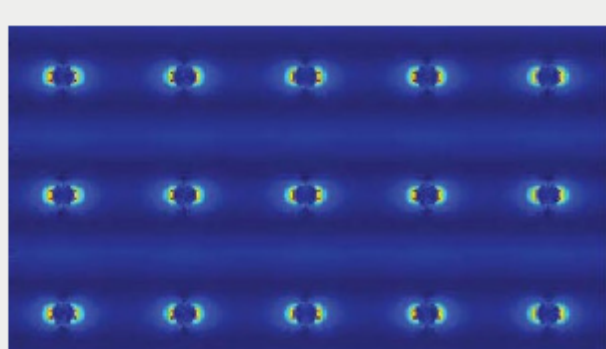
Tip-enhanced resonance Raman spectroscopy (TERRS) has been demonstrated by a research team at Fritz-Haber Institute, and the results suggest that TERRS could offer a new approach for the atomic-scale optical characterization of local electronic states.



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### Bio Nanolaser Proves Fully Functional in Living Tissue

Researchers at Northwestern University have created a nanolaser that can be used in living tissues without harming them. Developed in conjunction with a team from Columbia University, the nanolaser can be 50 nm to 150 nm thick, which allows it to fit and fully function inside living tissues.



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