Microscopy TODAY

Coming Events

Due to COVID-19, please check to see if the listed events have been postponed or cancelled.

2020

APT&M 2020 – Atom Probe Tomography & Microscopy
July 7–10, 2020
Oxford, England
https://aptm2020.web.ox.ac.uk

Microscopy & Microanalysis 2020
August 2–6, 2020
Milwaukee, WI
www.microscopy.org

16th International Congress of Histochemistry and Cytochemistry (ICHC)
August 30–September 2, 2020
Prague, Czech Republic
http://ichc2020.com

Neuroscience 2020
October 24–28, 2020
Washington, DC
www.sfn.org/meetings/neuroscience-2020

2020 MRS Fall Meeting & Exhibit
November 29–December 4, 2020
Boston, MA
www.mrs.org/fall2020

ASCB 2020 Annual Meeting
December 5–9, 2020
Philadelphia, PA
www.ascb.org/meetings-events/future-ascb-meetings

2021

Microscopy & Microanalysis 2021
August 1–5, 2021
Pittsburgh, PA
www.microscopy.org

2022

Microscopy & Microanalysis 2022
July 31–August 4, 2022
Portland, OR
www.microscopy.org

2023

Microscopy & Microanalysis 2023
July 24–28, 2023
Minneapolis, MN
www.microscopy.org

2024

Microscopy & Microanalysis 2024
July 28–August 1, 2024
Cleveland, OH
www.microscopy.org

Carmichael's Concise Review

Visualizing Vesicles as Biomarkers in Cancer

Stephen W. Carmichael
Mayo Clinic, Rochester, MN 55905

carmichael.stephen@mayo.edu

Advances in optical imaging technologies have a way of revealing structures in new ways, seeing things in a new light, and providing new information about fundamental biological processes such as carcinogenesis. Two of the factors driving these technologies are new laser sources and new ways of pulse-shaping or manipulating light to enhance nonlinear optical imaging processes in tissues. Recent work has focused on using lower repetition-rate ultrafast lasers to pump photonic crystal fibers to generate stable, low-noise, widely coherent supercontinuum that can then be used to excite multiple nonlinear processes in tissues. Simultaneous label-free autofluorescence multi-harmonic (SLAM) microscopy was recently demonstrated to generate two- and three-photon autofluorescence and second- and third-harmonic generation imaging channels simultaneously, enabling structural, molecular, and metabolic imaging in

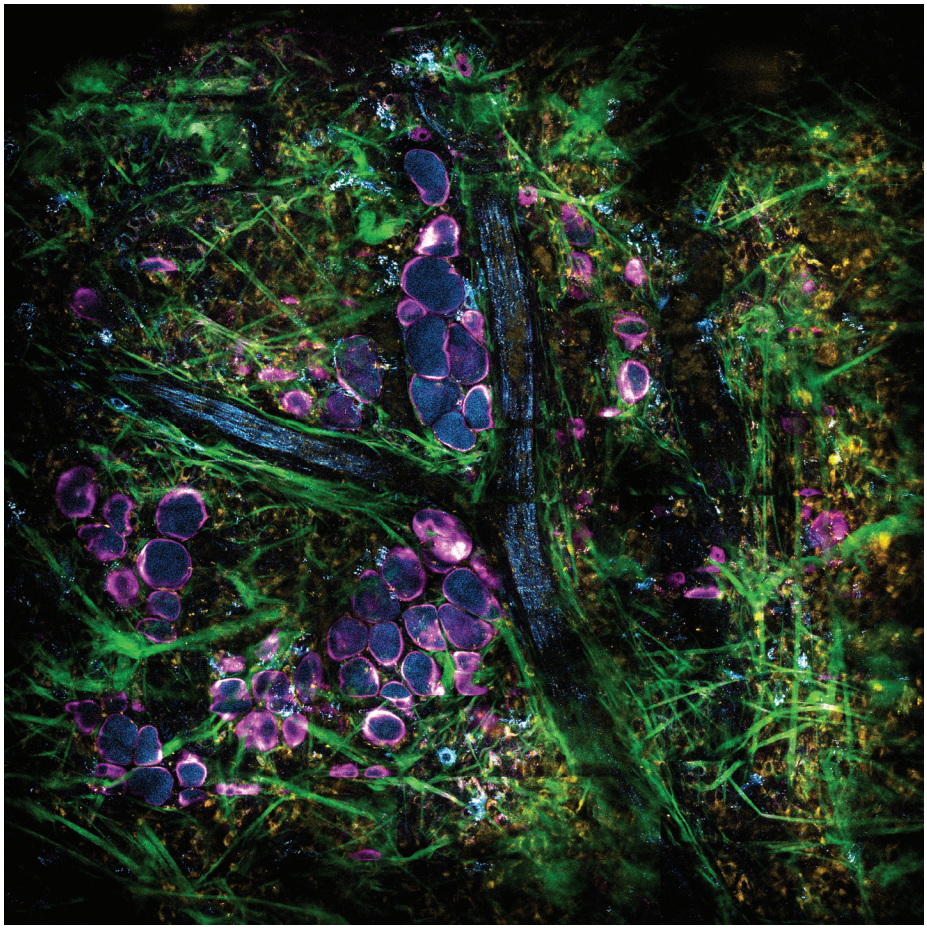


Figure 1: Label-free SLAM microscopy image of a mammary tumor. The multimodal color channels include: Green – Second Harmonic Generation from collagen; Magenta – Third Harmonic Generation from interfaces, such as between lipid/aqueous compartments; Yellow – Two-Photon Excited Autofluorescence from FAD; Blue – Three-Photon Excited Autofluorescence from NAD(P)H. Extracellular vesicles appear primarily as blue/magenta single-pixel objects due to their NAD(P)H content and size.

doi:10.1017/S1551929520001054

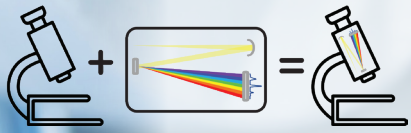
https://doi.org/10.1017/S1551929520001054 Published online by Cambridge University Press

https://doi.org/10.1017/S1551929520001054 Published online by Cambridge University Press

HORIBA Scientific

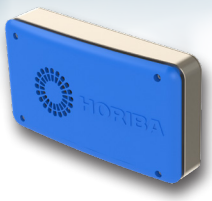
2 NEW Innovative Microscopy Products from HORIBA

Applications like FLIM, TRPL, photoluminescence, Raman and electroluminescence require more capabilities than your microscope can provide. HORIBA has two new products to help you multitask your microscope.



NEW Standard Microscope Systems

Add various spectroscopies to ANY STANDARD Microscope without sacrificing performance of either one!



NEW SPAD FLIMera Camera

Fluorescence lifetime images from 25K simultaneous pixel measurements at a video rate of 30 frames per second!

ELEMENTAL ANALYSIS
FLUORESCENCE
GRATINGS & OEM SPECTROMETERS
OPTICAL COMPONENTS
FORENSICS
PARTICLE CHARACTERIZATION
RAMAN / AFM-RAMAN / TERS
SPECTROSCOPIC ELLIPSOMETRY
SPR IMAGING

JOBIN YVON Technology

Find out more at: horiba.com/microscopy

https://doi.org/10.1017/S1551929520001054 Published online by Cambridge University Press

real time. Importantly, this is label-free, as labels may alter the biology. SLAM microscopy was recognized as one of the recipients of the *Microscopy Today* Innovation Awards for 2019.

Historically, advances in imaging have enabled investigators to visualize things in a novel manner, and therefore ask new questions that were previously not conceivable. Recently the group headed by Stephen Boppart, the same group that developed SLAM microscopy, has taken the technology a step futher. In a publication by Sixian You, Stephen Boppart and others showed that it was possible to visualize extracellular vesicles (EVs) in tissues and *in vivo* without the use of dyes, probes, or other labels [1]. The most exciting part is that this may have clinical applications. EVs is a collective term for exosomes, microvesicles, and apoptotic bodies. These cell-derived particles have generated extensive interest as we learn more about how cells use them for intercellular communication in states of health and disease, particularly in cancer. It is known that cancer cells rapidly increase the production of EVs early in the disease, well before solid tumors appear. Therefore, it is thought that these EVs are important in the progression and spread of cancer. It is hypothesized that EVs released from cancer cells circulate throughout the body early in carcinogenesis, are taken up by normal cells, and direct them to upregulate their metabolism. This could facilitate the body to host the growing and spreading tumor.

Whereas much remains to be elucidated about EVs, it is exciting that SLAM microscopy is able to detect and visualize the presence and spatial distribution of EVs in tissue specimens and *in vivo*. The recent paper by You et al., with their multimodal optical imaging approach, identified unique optical signatures in breast cancer. They also showed that these signatures of EVs can be used to differentiate tumor-associated EVs from normal EVs and also indicate the aggressiveness of the tumor (Figure 1). They think that the autofluorescence generated by nicotinamide adenine dinucleotide phosphate (NADPH) within the EVs, as well as the size and structural composition of the EV membrane, in turn generates a strong third-harmonic signal between lipid-aqueous interfaces. You et al. showed that these signatures from the EVs coming from various breast cancer (and normal) cell lines from rat mammary tumors and from human breast cancer specimens indicate the tumor when imaging during surgery. They also found signatures for normal EVs in breast tissues from normal patients.

Whereas SLAM microscopy has generated stunning and data-rich images, there also exists the potential for using these unique multi-modal optical signatures as biomarkers for both clinical diagnosis and for screening. Ongoing efforts by this team may lead to a way of detecting cancer in urine samples [2]. This potentially will shed new light on liquid biopsies for cancer!

References

[1] S You et al., *Proc Nat Acad Sci* 116(48) (2019) 24012–18, www.pnas.org/cgi/doi/10.1073/pnas.1909243116.
[2] S Boppart, personal communication.
[3] The author gratefully acknowledges Dr. Stephen Boppart for extensive assistance with this article.

MT

Rely on Evactron® Plasma Cleaning to Keep Contamination Under Control

During the current extended shutdowns, hydrocarbon contamination can build up in your microscope. XEI Scientific's R&D team designed these dependable Evactron systems for efficient cleaning with:

- Oxygen radical etch plus UV active desorption
- External hollow cathode plasma radical source
- "POP™" ignition at high vacuum—no venting
- No sputter etch damage or debris
- Fast, reliable high-performance operation
- Set cleaning time, cycle cleaning and power levels

Evactron®
By XEI Scientific

Need clean sample and chamber surfaces?
Let us show you the
"fastest way to pristine"™!

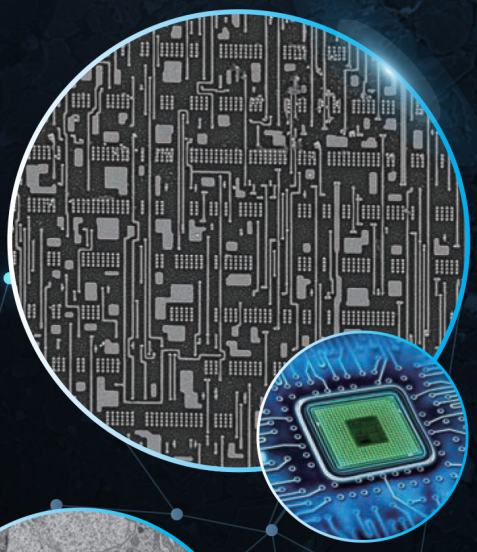
WWW.EVACTRON.COM 1-650-369-0133

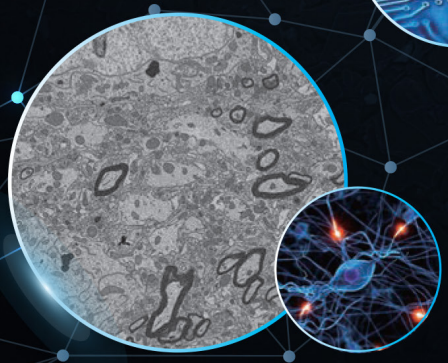
FBT

First
HIGH THROUGHPUT SEM System

Navigator-100

- 10 times faster than conventional FE SEMs
- Direct electron detection technology and Dual channel imaging (SE&BSE)
- Intelligent atlas and cross-scale material characterization
- Big data intelligent analysis and AI computing





FBT Navigator SEM X10

Conventional FE SEM

ACCSI2018 Award

BCEIA2019 Gold Award

CE

ISO 9001

CHINA
FOCUS EBEAM TECHNOLOGY(BEIJING) CO. ,LTD
Tel: +86 010 67832505 ext 813

SINGAPORE
FOCUS EBEAM TECHNOLOGY PTE.LTD
Tel: +65 6349 8868 ext 8921

www.focus-ebeam.com contact@focus-ebeam.com

https://doi.org/10.1017/S1551929520001054 Published online by Cambridge University Press