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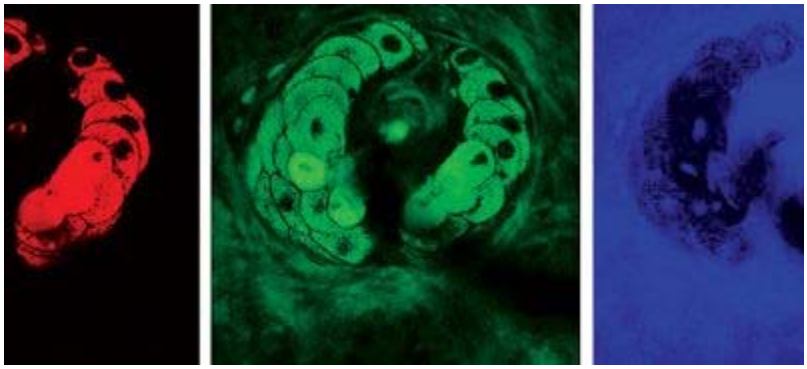
CELL BIOLOGY/RAMAN SPECTROSCOPY: Label-free, subcellular images captured at video rate

Culminating 11 years of work on medical applications of coherent Raman microscopy, Harvard University researchers have achieved stimulated Raman scattering (SRS) imaging on humans at video rate with epi detection.[1] (see video clip at http://bit.ly/g0Ze9W) Professor Sunney Xie was the volunteer subject for his students, whose accomplishment exceeded his expectations, he told *BioOptics World*.

Xie's group announced the development of SRS in late 2009. The bio-friendly, label-free approach provides important advantages (including superior contrast) over other imaging methods. "SRS imaging gives greater specificity and the ability to map a particular chemical species in the presence of an interfering species, such as cholesterol in the presence of lipids," says Marcos Dantus (of Michigan State University and BioPhotonic Solutions), who has since collaborated with the Harvard team to improve contrast through the use of shaped laser pulses.[2]



Video-rate stimulated Raman scattering (SRS) depicts the structural components of tissue—lipids (red), proteins (green), and water (blue)—in imaging the sebaceous glad wrapping around a hair in the epidermis of a mouse.

But the early SRS iteration captured only about one image per minute. By rearranging photodetectors to surround a small aperture through which a beam of light is directed at tissue, the Harvard researchers were able to collect and analyze almost 30 percent of the laser light directed at a biological sample—a 30-fold increase that enables far faster data collection. As a result, it is possible for the first time to

capture subcellular-level video of proteins, lipids and water within cells.

Thus, Xie foresees a role for SRS microscopy in surgery to remove tumors and other lesions because it can provide insights equivalent to histological analysis of excised tissue—an invasive and time-consuming process—through real-time scanning.

1. B. Saar et al., *Science* 330 (6009), 1368–1370 (2010)
2. C. W. Freudiger et al., *Nature Photonics* 5, 103–109 (2011)

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