

## Introduction: New Horizons in Research Imaging. Papers from the Eighth Omaha Imaging Symposium, April 2012

Since 2003, the annual Omaha Imaging Symposium has brought together experts in advanced biological imaging techniques for a one-day exposition of how advanced research imaging techniques foster progress in biological research. The eighth symposium in the series was held Friday, April 20, 2012, at the Harper Student Life Center of Creighton University, Omaha, Nebraska. This special section of *Microscopy and Microanalysis* consists of articles contributed by speakers at the symposium.

In the body, antigen-presenting cells are activated by pathogens or tissue damage and migrate to lymph nodes, but circulating immune cells such as these are blocked from entering the central nervous system by the blood-brain barrier. Alex Huang's laboratory at Case Western Reserve School of Medicine has exploited the power of two-photon laser scanning confocal imaging to observe the activity of immune cells deep within brain tissue in inflammation due to a variety of causes (Deborah S. Barkauskas et al., this issue). They report a surprising and previously unsuspected behavior of immune cells in the brain under these conditions. Their report vividly illustrates the power of direct observation to uncover new phenomena and extend our understanding of biological systems.

Surgery to remove cancers of the oropharyngeal cavity requires the removal of malignant tissue while sparing healthy tissue to preserve as much function as possible. The problem is that the extent of the malignancy is not always clear to the eye of the surgeon. Too little tissue removed and the malignancy may re-occur. Too much and vital function may be compromised. Laura Marcu's study (Yinghua Sun et al., this issue) demonstrates the application of fluorescence lifetime imaging to the determination of the demarcation of healthy and malignant tissue. The study demonstrates the viability of an endoscopic system capable of being used in an operative field such as the oropharyngeal cavity. They show that squamous cell carcinoma tissue can be distinguished from healthy tissue by its fluorescence intensity and lifetime. The work also brings us one step closer to a Star Trek-like device that can diagnose disease states by radiation alone.

Technical advances have in recent years made possible the direct observation of solitary fluorescent molecules. Protein molecules with attached fluorophores can be tracked with nanometer accuracy, and reactions can be observed at the single molecule level, revealing information about kinetics that would be unobtainable by ensemble methods. In another application of single molecule method imaging, the stoichiometry of association of fluorophore-coupled membrane proteins can be determined by continuously exposing single molecules to excitation and then counting the number of fluorophore bleaching steps required to reach background levels. In Richard Hallworth et al. (this issue), the authors use this approach to determine that the Slc26 family of trans-membrane anion transport proteins has maintained a common tetrameric stoichiometry throughout vertebrate evolution. This exciting result suggests the existence of common self-association motifs among the Slc26 proteins.

The symposium featured seven speakers in total. All agreed that the symposium had been a worthwhile and informative event. I hope you find the accompanying articles equally interesting.

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