SPECIAL SECTION GUEST EDITORIAL

Vibrational spectroscopy is emerging as a new and important contrast principle for biomedical microscopic imaging. The applications of infrared and Raman spectroscopy are familiar to chemists, physicists and materials scientists and increasingly to biomedical scientists. Infrared spectroscopic imaging combines Fourier transform infrared spectroscopy with recently developed cameras that operate in the mid-infrared. Raman spectroscopic imaging may exploit tunable filters that are themselves interferometers or may employ dispersive grating spectroscopy. Low-noise CCD cameras are the image recording devices. In general, specimen preparation protocols are similar to those of light microscopy, but stains are not necessary. Instrument vendors offer complete infrared and Raman imaging systems.

Vibrational spectra are good molecular fingerprints. Equally importantly, there are small but readily measured spectral changes that report local environmental changes. The spectra carry information about local structural properties as different as inorganic salt crystallite size and protein secondary structure and external parameters ranging from temperature to mechanical stress. The spectroscopic strengths are widely exploited by biomedical researchers, including laboratories where diagnostic applications are under study. These are the properties that have attracted imaging scientists to vibrational spectroscopy.

It is still too early to define the relative strengths and weakness of infrared and Raman spectroscopic imaging. Raman spectroscopic imaging offers spatial resolution equal to that of visible light microscopy because it is performed at visible or near-infrared wavelengths. Although spatial resolution is limited by the longer wavelengths, infrared imaging is easier to perform on large specimens and image acquisition is currently somewhat faster than for Raman imaging. Both techniques have similar information content, but neither has yet been demonstrated with the megapixel definition common in visible light microscopy.

The authors of the papers in this special section are researchers from government laboratories, medical and dental schools, and university chemistry and physics departments. They bring a wide range of expertise and outlooks to their work. Kidder et al. show how histopathology can benefit from unambiguous specimen characterization by infrared imaging, based on the readily measured parameter of lipid/protein ratios. This work has immediate clinical applications. Lemor et al. use Raman microspectroscopy and correlative visible light imaging to characterize the interface between dentin and dental adhesives. Mendelsohn, Paschalis, and Boskey use infrared imaging while Timlin et al. use Raman imaging to study bone, a tissue with highly variable mineral composition. Mineralized tissue may become an important applications area for vibrational spectroscopic imaging.

This journal special section contains the first collection of vibrational spectroscopic imaging papers to appear outside of the spectroscopy specialist literature. It is our hope that publication here will encourage biomedical scientists and engineers to enter this exciting new field.

Michael D. Morris

Special Section Guest Editor