Breakthrough study opens door to broader biomedical applications for Raman spectroscopy

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Raman spectroscopy has enabled incredible advances in numerous scientific fields and is a powerful tool for tissue classification and disease recognition, although there have been considerable challenges to using the method in a clinical setting. Scientists have now demonstrated the advantages of wavelength-modulated Raman spectroscopy, opening the door to wider biomedical and clinical applications such as real-time assessment of tissues during surgery. This study is published in *Biomedical Spectroscopy and Imaging*.

The inelastic scattering of light from any sample is called the Raman effect, named for the Nobel prize-winner C.V. Raman. It yields a molecular fingerprint related to the intrinsic composition of the sample. With the advent of lasers for excitation, this analytical technique has been applied in many disciplines from mineral investigations to protein structure determination and single cell studies. The technique enables cancerous lesions, which are accompanied by changes in chemical composition compared to normal tissue, to be detected as a vibrational spectroscopic fingerprint. However, there are considerable challenges to using the method in a clinical setting because factors such as ambient light, background fluorescence, and 'etaloning' (a phenomenon that degrades the performance of thinned, back-illuminated charge-coupled devices) can hinder the interpretation of images. Pre-processing the data is prone to introduce artefacts and seriously hamper a classification.

Scientists from St. Andrews (UK) and Jena (Germany) have now demonstrated that wavelength-modulated Raman spectroscopy, an alternative to standard Raman spectroscopy with monochromatic excitation, overcomes these key problems. In this study they describe how to record Raman signals against a high auto-fluorescence background by studying liver tissue and record spectra of Paracetamol tablets in ambient light.

Corresponding author Christoph Krafft, PhD, of the Institute of Photonic Technology, Jena, Germany explains: 'The principle of our implementation of wavelength-modulated Raman spectroscopy is that fluorescence emission, ambient light, and system transmission function do not significantly vary, whereas the Raman signals do vary upon multiple wavelength excitation with small wavelength shifts. In turn this leads us to 'cleanly' extract the Raman signature even in the presence of such factors. In the current work, we developed a hardware-based approach to suppress confounding factors in Raman spectra that requires a minimum of pre-processing and offers further unsurpassed advantages."

Editor-in-Chief of *Biomedical Spectroscopy and Imaging*, Parvez Haris, CChem, FRSC, FRSPH, adds: "This work represents a significant step beyond current Raman microscopy that breaks completely new ground. Raman analysis for biomedicine is at a crucial juncture where there is worldwide recognition that it is on the verge of potential acceptance by the wider community and clinical practice if key issues, such as the ones the authors have raised, can be overcome.

"The straightforward nature of the technique means that biologists and researchers at the life sciences interface can benefit immediately from the advantages of the novel method," he concludes.

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