Raman spectroscopy for broader medical research

LONDON: Scientists have modulated Indian Nobel laureate C V Raman's spectroscopy signals, opening the door to wider biomedical and clinical applications such as real-time assessment of tissues during surgery.

Researchers 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.

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.

"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," Corresponding author Christoph Krafft of the Institute of Photonic Technology, Jena, Germany said.

"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," he said in a statement.

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. The inelastic scattering of light from any sample is called the Raman effect, named after the Indian scientists and Nobel prize-winner C V Raman, according to the study published in Biomedical Spectroscopy and Imaging.

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.

"This work represents a significant step beyond current Raman microscopy that breaks completely new ground," Editor-in-Chief of Biomedical Spectroscopy and Imaging, Parvez Haris added.

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