Canadian Association of Physicists
Association canadienne des physiciens et physiciennes

Contribution ID: **4001** Type: **Oral (Non-Student) / Orale (non-étudiant(e))**

Sensing simple molecules to complex by their unique fingerprint with pulsed laser ablated nanostructured substrates

Wednesday 21 June 2023 14:45 (15 minutes)

We are well aware that every human can be identified by their unique fingerprint. Taking inspiration from natures'this wonder, there is an exclusive feature to identify different molecules/chemicals in materials science. We can find this attribute in the way molecules vibrate. Different molecules have different vibrational modes depending on their chemical constituents, bonding strength, structure, interaction and so on. Hence, we need sensitive instrumentation that can detect these vibrations, that is, Vibrational Spectroscopy (VS). VS is a powerful technique, which identifies the chemical-specific fingerprint of a molecule in its natural state without the need for labelling or sample preparation. This is a considerable advantage to chemists and biologists for the recognition and characterization of synthesized drugs, and chemicals, and assessing the purity of compounds compared to other techniques which are either invasive or/and require tagging of a molecule with a fluorophore to visualize them. VS encompasses two complementary techniques i.e. Raman and Infra-red (IR) spectroscopy forming a comprehensive system. They only differ in the selection rules for the different vibrational modes. That is, Raman detects those vibrational modes resulting from change in polarizability whereas, in IR, vibrations due to change in dipole moment are registered.
Although powerful as a technique, there are limitations to the concentrations of molecules that Raman can detect since it is a weak process. In order to alleviate this issue, tailored nanostructured particles are employed to create local enhancement effects known as hot spots. These nanostructures enhance the Raman signals even for ultra-low concentrations of molecules. In my talk, I will discuss the nanostructured devices used for surface enhanced Raman scattering with biological applications related to sensing.

Keyword-1

Surface enhanced Raman spectra

Keyword-2

Nanostructured substrates

Keyword-3

Pulsed laser ablation

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Session Classification: (DPMB) W2-3 Medical Physics | Physique médicale (DPMB)

Track Classification: Technical Sessions / Sessions techniques: Physics in Medicine and Biology / Physique en médecine et en biologie (DPMB-DPMB)