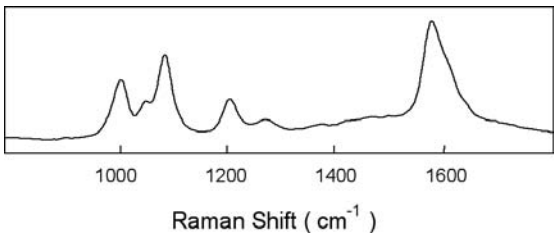
Nanoplex™ biomarker detection

A Primer on SERS

A new approach to optical detection in biological samples

The Raman Effect

When incident light encounters a molecule, most photons are elastically scattered. These scattered photons have the same frequency (energy) and wavelength as the incident photons. However, a small fraction of light (approximately 1 in 10^7 photons) is scattered at optical frequencies usually lower than the frequency of the incident photons. The process leading to this inelastic scatter is termed the Raman effect.



The difference in energy between the incident photon and the Raman scattered photon is equal to the energy of a vibration of the scattering molecule. A plot of intensity of scattered light versus energy difference is a Raman spectrum.

Surface Enhanced Raman Scattering (SERS)

In laser-based optical spectroscopy, Raman scattering generates a fingerprint-like vibrational spectrum for individual molecular species with features that are much narrower than fluorescence. Raman scattering can be generated using monochromatic far-red or near-IR light, photon energies too low to excite the inherent background fluorescence in biological samples. In addition, water is a very poor Raman scatterer, and combined with all the features described, makes Raman a useful tool in detecting molecular species in biological samples.

The limitations of Raman sensitivity are overcome by surface-enhanced Raman scattering. Molecules in very close proximity to roughened gold or silver nanoparticles give rise to million - to trillion - fold increases (known as enhancement factor) in scattering efficiency. SERS is an exquisitely sensitive technique allowing unique spectra to be acquired from a variety of adsorbed species, even down to the single-molecule level, but it is also non-specific in that the Raman signal from other molecules encountering the nanoparticle metal surface will also be enhanced. This has limited its impact in biological applications, until the advent of the Nanoplex™ biotag. While SERS allows Raman spectroscopy to become the single most sensitive optical detection technique available, it is not until the unique composition of the Nanoplex™ biotag, that the life science community can, for the first time, leverage the advantages of SERS-based detection in biological assays.

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