Raman Scattering and Surface Enhanced Raman Spectroscopy

Figure 1: A typical representation of measurements taken using Raman Spectroscopy

Figure 2: Jablonski diagrams depicting the Stokes and Anti-Stokes shifts associated with Raman scattering.
5. Applications

Over the last 40 years SERS has grown to a broad field with a vast array of applications. Its true power lies in its ability to determine chemical existence at very small concentrations as well as structural information via non-destructive means. The list below is a small example of some of the fields SERS is used in today:

- Single Molecule Detection
- Imaging
- Biosensing
- Ultrahigh Vacuum Science
- Ultrafast Laser Science
- Materials Science
Two real-world applications of SERS technology are the development of an in vivo glucose sensor and the use of SERS to detect and identify explosive/toxic chemicals. These examples highlight the main benefit of SERS: identification of a specific molecule even at significantly low concentrations.

In the first example, a functionalized SERS substrate has been developed that is capable of accurately detecting glucose concentrations in blood. This substrate has been surgically implanted in rats and combined with the spatially offset Raman spectroscopy (SORS) technique, giving rise to surface enhanced SORS (SESORS). This technology allows for measuring the blood glucose concentration through the skin, eliminating the need to draw blood from the subject.

In the second example SERS has been used in the detection of explosives and toxic materials used in chemical warfare. This is done by combining a microfluidic SERS sensor with water soluble agents that convert the harmful chemicals from the gas phase to the liquid phase. In addition, the need to detect these compounds in the field has driven the development of small, portable Raman spectrometers such as those made by Thermo Scientific and Intavec Inc. Due to its ability to uniquely identify a molecule at low concentrations, SERS has been of significant interest to chemical species investigated by homeland security.

References

5. Mehmet Karhaman et all, *Fabrication and Characterization of Flexible and Tunable Plasmonic Nanostructures*, Scientific Reports,
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