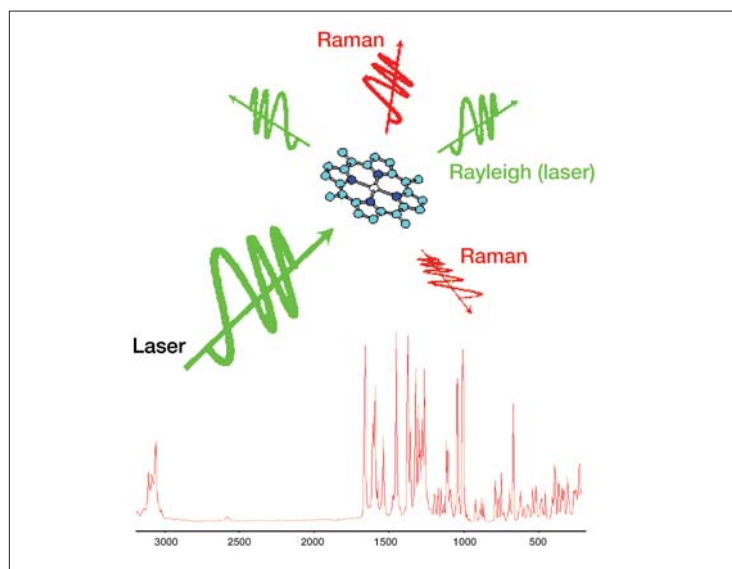


# What is Raman Spectroscopy?



Raman is a technique for identification and analysis of molecular species. It is similar to FT-IR spectroscopy, however it has several distinct advantages. For example, Raman can be used to study solids, liquids, powders, gels, slurries and aqueous solutions. It does not require any special sample preparation, thus many studies may be performed in situ. An example of this is in the analysis of mixed pharmaceutical tablets sealed in a blister pack. Tablets can be identified directly through the sealed blister pack, without destroying the sample and the relative concentration of the substances in the tablet can be determined.

Raman spectroscopy is based on the detection of scattered light. In general, when light interacts with a substance it can do so in one of three main ways:

- The light may be absorbed
- The light may be transmitted

Or

- The light may be scattered

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Raman spectroscopy is a result of the scattering of light. The radiation may be scattered elastically, that is without any change in its wavelength, and this is known as Rayleigh scattering. Conversely, the radiation may be scattered inelastically resulting in the Raman Effect.

There are two types of Raman transitions: upon collision with a molecule a photon may lose some of its energy (this is known as Stokes radiation) or the photon may gain some energy (this is known as anti-Stokes radiation).

When viewed with a spectrometer, it can be seen that both the Stokes and anti-Stokes radiation are composed of lines which correspond to molecular vibrations of the substance under investigation. Each compound has its own unique Raman spectrum which can be used as a fingerprint for identification.

Using IR spectroscopy on aqueous samples results in a large proportion of the vibrational spectrum being masked by the intense water signals. With Raman spectroscopic techniques, aqueous samples can be analyzed with ease as Raman signals from the water molecule are relatively weak.

Using Raman spectroscopy, spectra of samples in transparent containers, such as glass or plastic, can easily be obtained. Modern Raman Instruments can easily obtain spectra in seconds with no sample preparation and recent advances in software allow for real time sample identification and quantification.

## Advanced Raman

There are several advanced Raman techniques, these include Resonance Raman, SERS, High Throughput Raman and Chemical Imaging.

## Resonance Raman

Resonance Raman techniques require no extra equipment and occur when the photon energy of the exciting laser beam matches that of an electronic transition of a chromophoric group within the system under study. Under these conditions bands belonging to the chromophore are selectively enhanced by factors of  $10^3$  to  $10^5$ .

## Surface-enhanced Raman

In 1974, it was discovered that pyridine molecules that were absorbed onto an electrochemically roughen surface yielded many times more intense Raman signals than they normally would. This effect was later named Surface Enhanced Raman Spectroscopy (SERS). The theoretical understanding of SERS is not clear, but the technique has found application in many areas of physics, chemistry and biology, yielding information on how molecules interact with surfaces while allowing detection of very low concentrations of various analytes.

## High-throughput Raman

Modern instrumental developments, reducing the complexity of instruments and increasing instrument reliability, allows for automated analysis of hundreds or thousands of samples, in real time with little or no user interaction. PerkinElmer is a world leader in high throughput Raman. Please visit our Raman section of our website at [www.perkinelmer.com/raman](http://www.perkinelmer.com/raman) to learn more.

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