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Issue: 1

Homeland Security Applications for Surface Enhanced Raman Spectroscopy.

mesophotonics

Key Words

- Homeland secuirty
- Trace detection
- Sensitivity
- Selectivity
- Raman
- Surface enhanced

Introduction

Sensitivity and selectivity are vital for any early warning homeland security detection technology or forensics test no matter whether the applications is for portable or fixed use, people or cargo screening, civilian or military use.

Selectively identifying the composition of a sample requires a method of rapidly identifying any suspicious components, ideally at the most fundamental molecular scale. Over 100 years ago Nobel prize winner C.V.Raman discovered that the composition and structure of chemicals can be identified by the different colours in a very small rainbow of light they can be induced to emit. The unique finger print colour spectra of a sample can be compared to databases of known substances providing excellent detection selectivity. This enables a simple read out of probability of identification easily interpreted by a non-technical user against 1000's of potential threats.

Traditionally only concentrated samples could be identified with Raman technology as the amount of finger print light that is emitted is extremely small. This presents no problems where the pure sample is available, but does not enable trace or residual levels of a target to be detected. To identify trace levels, to provide the earliest possible warning, the identifiable Raman signals can be increased by more than a 1,000,000 fold using specially structured metal surfaces. Klarite technology from Mesophotonics makes this surface enhanced Raman technique reproducible and reliable enough to allow it to be used in a host of industrial applications including homeland security detection.

Application

In order to apply Klarite surface enhanced Raman detection, the sample must be placed in contact to the Klarite gold covered surface. This can be achieved by several means including depositing liquid samples, leaving the device in a potentially contaminated air space or dissolving components trapped in air filters. Once attached the finger print can be read out and compared to a database of known substances with a standard Raman instrument reader. Raman readers, including some ruggedised light weight (<2.5kg) first responder units are now available from many manufacturers most of which can be simply adapted to use Klarite enhancing chips.

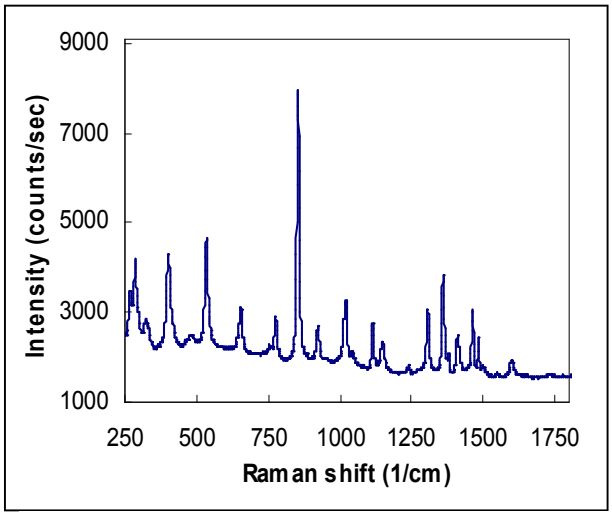

Figure 1: Typical Raman spectral finger print.

Figure2: Central laboratory based sample testing.

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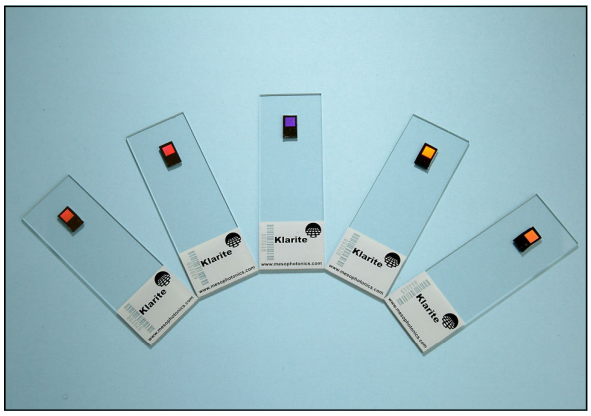
As Raman detects signatures of chemicals that depend on how the atoms in each compound vibrate it can be applied to the detection of a very broad range of chemical agents, explosives and forensic drugs. The high sensitivity of surface enhanced also means it can also be used for indirect detection of biological targets by sensing associated trace level chemical markers and precursors present in a sample [1].

Klarite is unique in applying the techniques of semiconductor fabrication to produce a surface that is structured to a specific design at the nanometre scale providing control over the surface enhanced Raman process. Leveraging the knowledge of the semiconductor industry means this surface can be made cost effectively in volume whilst maintaining consistent and reliable performance.

Reading of the Raman spectra from a sample deposited on Klarite typically takes less than one minute with identification possible with out any sample pre-processing enabling very rapid identification. This can be used not only to give early warning but also to trigger additionally detection elements for confirmation purposes. Recording Raman spectra is non- destructive and the readers sufficiently compact and economical it makes this technique ideal for being combined with other detection technologies for even greater reduction in false positive and false negatives.

Conclusion

Klarite chips enables trace level detection of chemical compounds and biomarkers for early detection applications in homeland security.



Klarite test slides

Raman spectroscopy has been available as a technique for almost 100 years but has been unable to detect trace levels of chemicals without some form of enhancement. Klarite surface enhanced Raman substrates from Mesophotonics reliably increase the intensity of the Raman finger print by over a 1,000,000 fold making it sensitive enough to see very small changes in trace level chemicals. As these measurements can be taken in water based and air samples with measurement times less than a minute it opens a new dimension in detection capabilities.

References

1- C.L. Haynes, C.R. Yonzon, X. Zhang and R.P. Van Duyne, "Surface-enhanced Raman sensors: early history and the development of sensors for quantitative biowarfare agent and glucose detection, Journal of Raman Spectroscopy 2005; 36: 471–484. Published online in Wiley InterScience (www.interscience.wiley.com). DOI: 10.1002/ jrs.1376

Partners are actively being sort by Mesophotonics Ltd to exploit the homeland security potential of Klarite.

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