Application Note: 006
Issue: 2

Applications for Surface Enhanced Raman in Forensic Science

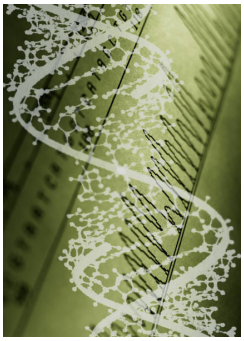
mesphotonics

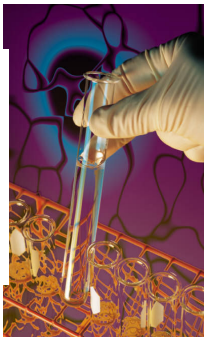
Key Words

- Detection
- Inks
- Evidence
- Raman
- SERS
- Forensics

Introduction

Spectroscopic techniques are widely used in identification and routine analysis in the forensic science laboratory. Raman spectroscopy is an attractive technique that supplies full chemical fingerprint information. It can be used for identification and comparison of unknown substances that are often present at an incident scene.





Raman spectrometers have benefited from years of steady improvement, which have lead to instrumentation which is portable, compact, affordable and is fully validatable to strict regulatory standards. As a result there is a renewed interest in employing Raman techniques in forensic science.

Raman spectroscopy

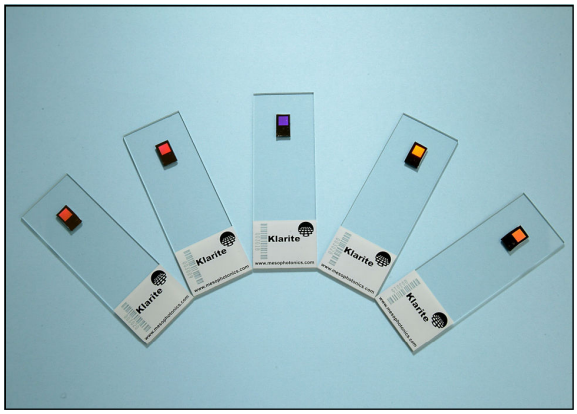
Raman spectroscopy is well suited to chemical analysis in forensic science. The Raman spectra provides unique molecular information which is characteristic of the molecules present. Raman measurements are fast, taking only a few seconds. Raman measurements are insensitive to water, making aqueous samples easily measured as water does not interfere with the measurement.

Surface enhanced Raman Spectroscopy (SERS)

One major hurdle to the analysis of forensic material with Raman is the relatively weak signal. This usually means that conventional Raman is only of use for bulk samples in high concentration. Surface enhanced Raman can enhance the weak Raman signal by a million times or more, and can extend the range of applications applicable to Raman spectroscopy. This enables materials to be analysed that are many orders of magnitude more dilute or in smaller quantities than with other techniques.

The technique which is due to the electronic interaction between the molecules and a specially textured surface, has largely been used for research purposes until the launch of Klarite SERS substrates. Simply, the substance to be analysed is deposited on the substrate and this is then analysed in the Raman instrument.

Many researchers have proven the use of SERS for detection of low concentration of materials that can be present at a crime scene. For example, detection of inks, bodily fluids, illicit drugs, explosives and lipstick amongst others have all been proven with the use of SERS.



Klarite test slides

Klarite SERS Substrates

Klarite disposable substrates, that are available in a variety of formats, can enable high sensitivity Raman tests to be done quickly and easily.

Using semiconductor processing techniques and our knowledge of photonic devices Mesophotonics have been able to produce highly reproducible SERS substrates in large volumes to enable this technique to now be used routinely.

Sample quantities can be in the range of microlitres to femtolitres allowing small quantities of chemicals to be analysed.

Applications for Surface Enhanced Raman in Forensic Science

Klarite Surface enhanced Raman spectroscopy can be used in the forensics industry for a variety of applications including;

- Trace level detection of crime scene chemicals
- Detection and identification of accelerants and explosives residues
- Detection of poisons in low concentrations
- Illicit drug analysis, human or scene samples
- Detection of cutting agents
- Analysis of inks
- Ability to analyse very small sample volumes

Klarite SERS substrates have been used successfully for detection of Cocane metabolite at and below biological levels. This is described in application note No.11. This demonstrates the superior detection ability of SERS. See fig 3.

Klarite SERS substrates are available in a variety of formats and customisation is available. These disposable substrates enable tests to be performed quickly and easily with the minimum of sample quantity.

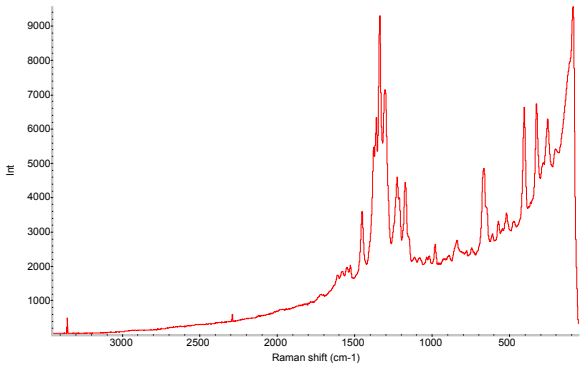
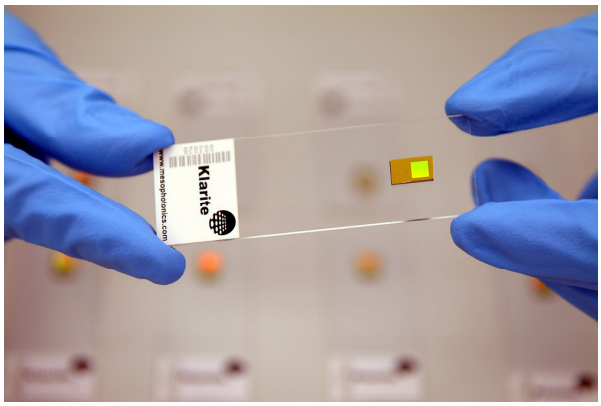


Fig 1. Raman signal of Inkjet printer ink extracted from paper



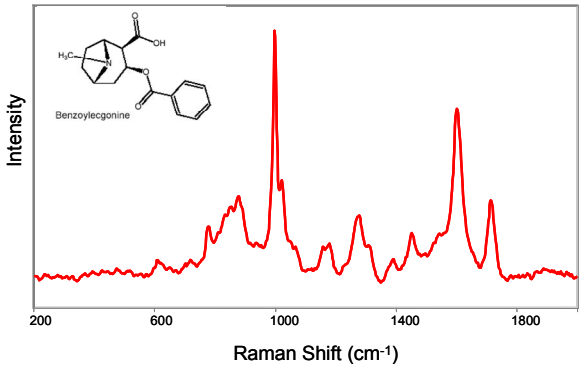


Fig 2. Trace spectra of 1 femtogram of cocaine metabolite benzoylecgonine recorded in 15 sec-

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