

## RAMAN – A USEFUL CRIME FIGHTING TOOL IN FORENSIC LABORATORIES

V. Otieno-Alego

Forensic Services, Australian Federal Police, Canberra , ACT.

E-Mail: [Vincent.Otieno-Alego@afp.gov.au](mailto:Vincent.Otieno-Alego@afp.gov.au)

**Keywords:** *Raman microscopy, forensic science, trace evidence analysis, paints, explosives, drugs.*

**Abstract:** Raman microscopy satisfies most of the criteria for the forensic examination of common physical evidence. In this contribution, illustrative examples from casework are presented. Limitations of the technique, including the lack of data transferability, are also discussed.

Raman microscopy is now established as one of the analytical methods that satisfies most of the criteria for the forensic examination of common physical evidence such as contraband drugs, fibres, paints, explosive and propellant particles, chemical and biological warfare agents, plastics, inks as well as other miscellaneous forensic evidence. The technique is particularly well-suited for the analysis of potential evidence in that it combines the special analytical virtues of versatility, specificity, high spatial resolution, faster analysis times, with the forensic virtues of being non-destructive, non-invasive, requiring no sample preparation, and operable even through sealed transparent packaging. The non-invasive nature of this technique provides a real advantage to forensic laboratories such as Forensic Services, Australian Federal Police (AFP), who are involved in the analysis of unknown and potentially hazardous substances.

In most cases, a forensic examination of trace material such as paints, fibres, plastics and inks usually involves comparative analysis. The Raman technique can be used to rapidly identify or differentiate such items. Figure 1, for example, shows spectra of two architectural paints. The IR spectra of the known and questioned paints only show subtle differences and further tests would have to be conducted to differentiate them. In contrast, the Raman spectra of the two paints show the presence of two *different* phthalocyanine greens (pigment Green 7 in questioned paint and pigment Green 36 in reference paint) (1). Thus the two paints could not share a common origin. The ease of sample preparation means that the Raman technique can be used to rapidly discriminate between different paints or other materials. Multilayered paint chips, for example, can simply be supported on a microscope slide (using blue tack) to expose the different layers each of which can be targeted, analysed and discriminated especially on their pigment composition. Analysis of such paint by other techniques such as infrared would require that each layer be meticulously scraped and analysed. This is a time consuming exercise and the precious (possibly unique) sample is somewhat damaged. Similarly, seized illegal drugs can be rapidly screened to identify the active ingredients (Figure 2)(2).

Whilst most of the limitations that once plagued the Raman technique have been surmounted by modern instrumental advances, one main barrier to its routine use in forensic and kindred laboratories where quality control issues are paramount is the lack of data transferability and repeatability. The relative intensity (y-axis) of a Raman spectrum is affected by the wavelength-dependent response of the spectrometer (3). This lack of data transferability means that spectra recorded using different lasers cannot be *inter-compared* directly, a fact that also makes the commercial libraries less user friendly. Whilst standards exist for the calibration of the Raman shifts (ASTM E1848), it is only recently that procedures allowing the recording of instrument-independent Raman spectra have become available.

With the increased number of Raman instrument manufacturers, the cost of bench top Ramascopes as well as the portable versions have become attractive and we anticipate seeing them

in more forensic laboratories as well as front line field portable tools for the Crime Scene Examiner.

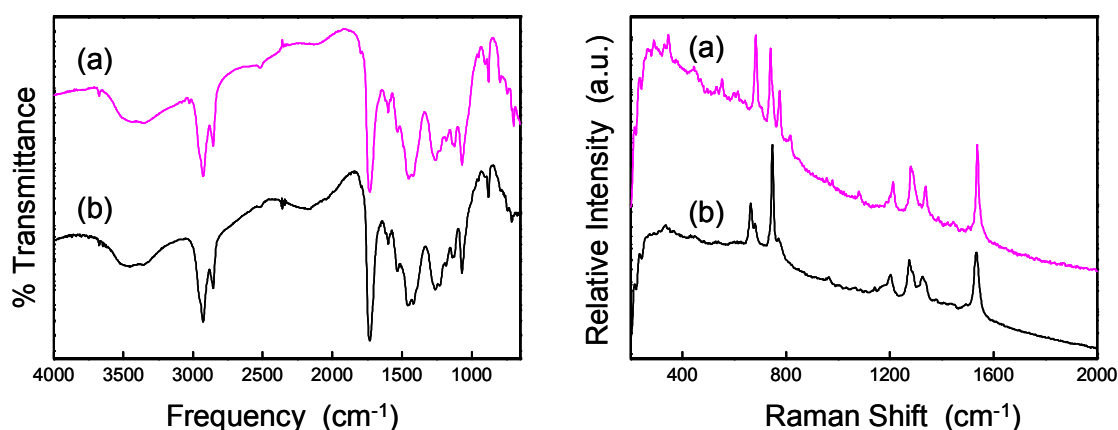


Figure 1. FTIR and Raman spectra of green architectural paint: (a) questioned paint and (b) reference paint.

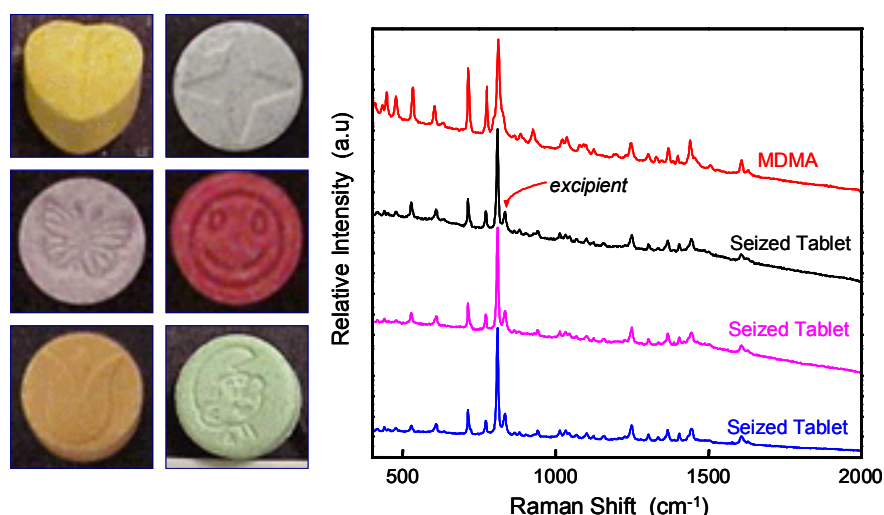


Figure 2 Seized ecstasy tablets and sample Raman spectra showing the presence of 3,4-methylenedioxymethylamphetamine (MDMA). Utilising the luminescent properties of MDMA(3), rapid recognition of active inclusions in the tablet matrix is aided with a monochromatic light source and filters. Crystals are then easily targeted and analysed with the Raman microscope.

## References

1. Otieno-Alego V., "75 Years on and Forensic Laboratories are Slowly but Surely Ramanising", The Forensic Bulletin, Australia and New Zealand Forensic Science Inc. Summer Issue, pp.20-23 (2004).
2. Hawke L., Otieno-Alego V., Dawson M., Armitage S., "An Evaluation of Raman Spectroscopy as a Screening Tool for Illicitly Manufactured Ecstasy Tablets. 16th International Symposium on the Forensic Sciences, Australia and New Zealand Forensic Science Society Inc., Canberra, March 2002.
3. Choquette S., Etz E. Hurst W. Blackburn D., "Relative Intensity Correction Standards for Raman Spectroscopy for Excitation with Several Common Laser Wavelengths", American Pharmaceutical Review, Summer Issue, April, 2003.