

# Raman analysis and identification of unknown materials for homeland security and crime scene investigation.

## Key Words

- Identification
- White Powders
- Substances
- Non-destructive
- Through Bag

## INTRODUCTION

In homeland security there is a need for rapid identification of unknown substances. The analysis of unknown white powders in particular is typically difficult, using methods that are time consuming and require specialist chemical knowledge.

However, the Avalon RamanMicro now provides the ideal solution for identifying a very wide range of explosives, biological and chemical weapons, and everyday materials used in hoax mailings etc, such as: sodium bicarbonate, starch, sugar, household detergent and flour.

The following information has been taken from two Real-life situations.

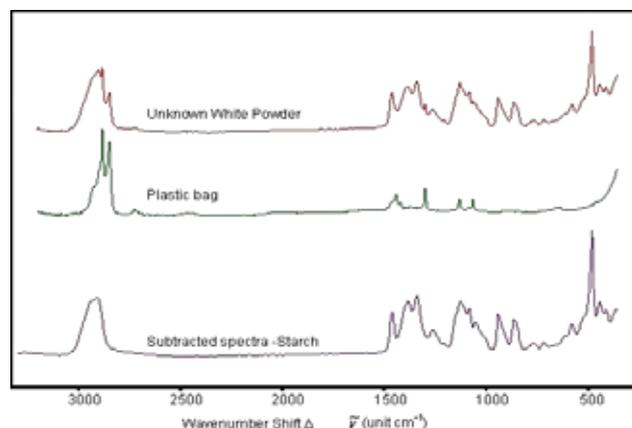


## CASE STUDY I

New York Subway Station: Unknown White Powder.

In the summer of 2003 an unclaimed bag was reported on the New York subway. Further examination revealed that it contained an unmarked plastic bag containing approximately 5lbs. of a white powder.

Due to the unknown nature of the substance it was not removed from the bag for analysis but instead the spectrum was recorded directly through the bag using a fibre optic probe. The "Auto subtract" software routine was used to remove the signals from the plastic bag from the spectra Figure 1. The built-in library searching of the spectral database identified the material was as starch. The entire process took less than 60 seconds (Figure 1).



**Figure 1 Identification of 'Unknown' white powder on the New York subway system.**

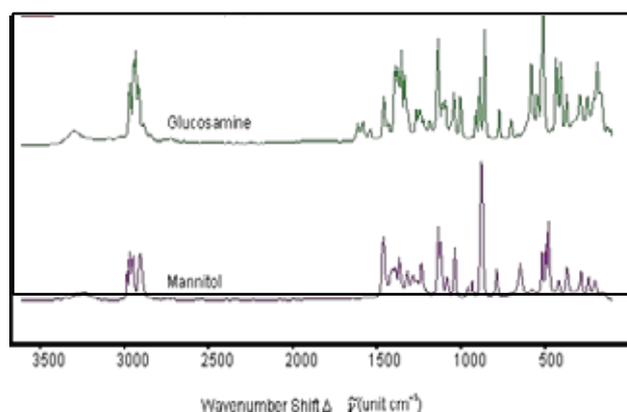
## CASE STUDY 2

JFK Airport: White Powder found in the Cockpit of a 747.

In the spring of 2004, airline ground crew found a small quantity of white powder on the floor of a Boeing 747 cockpit. It was assumed that the material was a dangerous agent such as an explosive or a biochemical agent. Upon visual inspection, using the Raman microscope's video camera it was noted that the sample was made up of three components, fluffy white crystals, needle shaped white crystals and what looked like a clear plastic material.

Raman Spectral analysis concluded that white crystalline materials were glucosamine and mannitol (Figure 2). Glucosamine is a standard medication for arthritis sufferers and mannitol a standard pharmaceutical filler.

The plastic material was identified as gelatine, which is commonly used to make pharmaceutical capsules. Visual analysis, spectral acquisition and spectral library searching was completed in a few minutes.



**Figure 2 Identification of an unknown powder at JFK airport**



## WMD & EXPLOSIVE IDENTIFICATION

Not only can Raman spectroscopy be used to identify unknown white powders rapidly, it can also be used to identify explosives (Figure 3), and other biochemical agents such as anthrax and mustard gas (Figure 4).

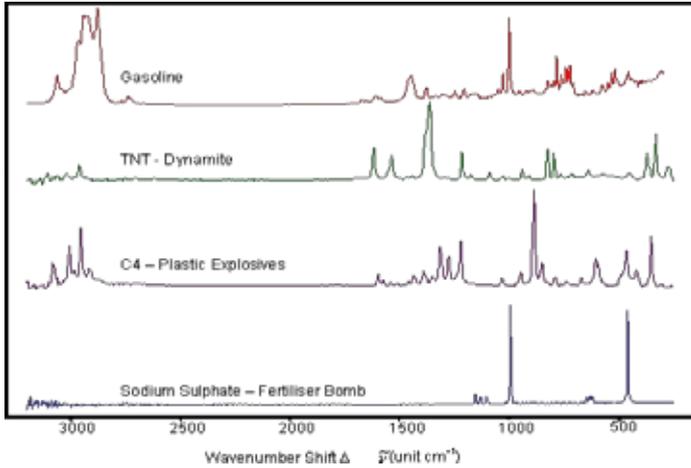


Figure 3 Spectral differences between common explosives.

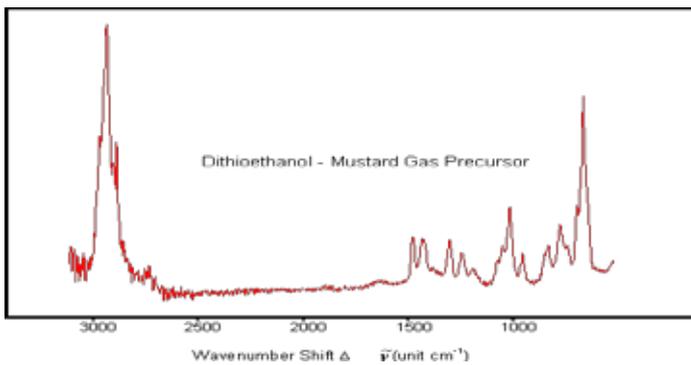


Figure 4 Raman spectrum of dithioethanol.

## THROUGH BAG ANALYSIS

Analysing unknown samples can be risky as the sample maybe harmful. However, Raman spectra can be acquired through a range of containers such as plastic bags and glass bottles. For example identifying unknowns sealed in plastic bags, Figure 1.

## PORTABLE AVALON SYSTEMS

Avalon instruments offers two portable systems, the RamanField (Figure 5a) and the RamanMicro-EZ (Figure 5b).

These systems are both high-end research-grade analysers, designed with ease of use ruggedness and reliability in mind.

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The RamanField is fiber probe based instrument ideal for in field work. The RamanMicro-EZ is ideal for use in a crime scene investigation lab or in a mobile laboratory.



Figure 5a Portable RamanField suitable for on-site.

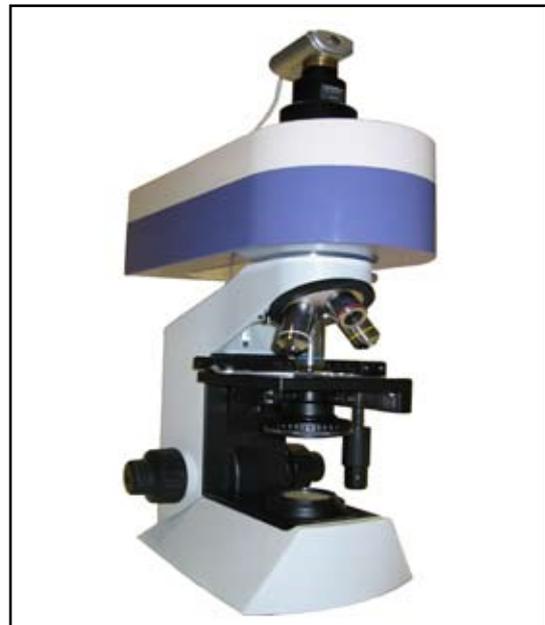


Figure 5b RamanMicro-EZ, Raman Microscope system.