Rigaku Raman Technologies

# Application Note

## Hazardous Materials Identification Using a Handheld Raman Analyzer

Identification of Unknown Materials

FirstGuard™ Handheld Raman Analyzer

### Introduction

The safe and rapid identification of potentially dangerous substances is critical in homeland security and Hazmat situations.

Raman spectroscopy provides a compelling means to rapidly and accurately identify solid or liquid materials without the need to transfer or contact the sample. A Raman measurement involves illuminating an unknown material with a laser; light scattered back into the system rapidly provides a chemical signature of the material that is used for identification.

### Instrument and Measurement Conditions

The Rigaku Raman FirstGuard analyzer is a handheld system that is available with laser wavelengths of 532, 785, or 1064 nm - 1064 nm is the most useful sampling configuration in Homeland Security and HazMat applications. Raman scattered light is passed through a volume phase grating that disperses light onto an InGaAs (1064 nm) array detector. Measurements are analyzed using the on board, Windows-based PC incorporated into the handheld unit. The control software automatically optimizes the laser power and measurement time. The FirstGuard analyzer is supplied with a library of common hazardous materials that automatically provides a rapid and accurate identification of the material within seconds.

### Sample preparation

Raman spectroscopy offers the advantage of taking measurements directly on a sample with no

need to contact the sample or transfer the sample to another system. Measurements can be taken directly through transparent bottles and bags without opening the container holding the sample. This method is safer than other methods of molecular analysis that typically require contact with the sample.

### Raman Laser Wavelength

The use of a 1064 nm laser greatly reduces fluorescence and photodecomposition that can be observed when using a 785 nm laser for Raman measurements. Figure 1 shows the spectrum obtained from Composition B, a mixture of RDX and TNT, using 785 and 1064 nm excitation. The 785 nm Raman spectrum has a broad background that cannot be used for identification while the spectrum obtained using 1064 nm excitation has a number of Raman peaks that may be used to classify the material.

The use of a 1064 nm laser for Raman analysis is also safer for the analysis of explosive materials as excitation with this wavelength is less likely to cause a detonation event than a 785 nm laser.

# Application Note

## Hazardous Materials Identification Using a Handheld Raman Analyzer

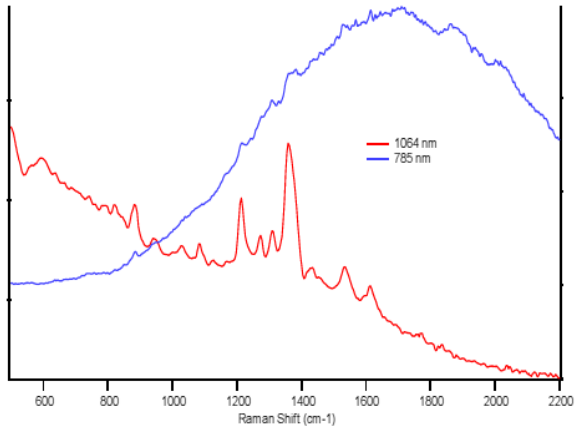


Figure 1. Raman spectrum of Composition B obtained using 785 nm (blue) and 1064 nm (red) excitation.

### Identification of Unknown Materials

Each Raman measurement results in a spectrum that rapidly identifies that material using the library of common hazardous materials that is supplied with the FirstGuard analyzer. The Raman spectrum of Composition B in Figure 1 (with 1064 nm excitation) has many peaks that can be used to identify the material with the on-board library. Advanced users have access to the raw data for more detailed analysis of the results.

### Simple User Interface

A simple user interface allows the operator to focus on safe operation of the Rigaku Raman FirstGuard analyzer. Figure 2 shows a typical screen shot that automatically appears after each measurement. The screen is dominated by a display showing the identity of the unknown material.


Figure 2. Typical screen shot from the Rigaku Raman FirstGuard analyzer after measurement of a potentially hazardous material.

### Conclusions

The Rigaku Raman FirstGuard analyzer provides the capability to rapidly and accurately identify a wide range of hazardous materials. The use of a 1064 nm laser for Raman measurements and a simple, easy to read user interface provides a safer means of obtaining Raman measurements on this class of materials.

### Keywords

Raman, handheld Raman, Homeland Security, HazMat