

## Application Note

### Keywords

- Pharmaceutical ingredients
- Excipients
- Paracetamol
- Carbamazepine

### Techniques

- Raman
- Fluorescence
- Chemometrics

### Applications

- Raw materials inspection
- Pharmaceuticals QC

# Raman Analysis of Pharmaceutical Ingredients

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A range of options is available for Raman analysis, including systems suitable for handheld, laboratory and educational applications. Systems typically include a spectrometer, laser, operating software and sampling accessories, while modular options are available for users to configure their own Raman systems. Setups are available for various wavelength ranges and resolution requirements.

## Introduction

Raman spectroscopy offers a number of benefits for testing and characterization. It is rapid and non-destructive, requires only limited sample preparation and allows for sample volumes in the microliter range. In addition, Raman can be used to measure aqueous samples or samples with high moisture content, and allows researchers to capture data from a sample contained in plastic or other materials that are optically transparent to the wavelengths of interest.



Raman is particularly useful for pharmaceutical applications. For example, Raman techniques are used to discern characteristics of pharmaceutical raw materials, including active ingredients, binders, fillers, lubricants and other excipients. Raman is also useful for through-container measurements of pharmaceutical blister packs, pill bottles and vials.

## Experimental Conditions

To illustrate the capabilities of our Raman systems we analyzed paracetamol (acetaminophen) and carbamazepine, which are pharmaceutical active ingredients, and the excipients alpha and beta lactose. The samples studied consisted of simple organic compounds contained in standard, clear borosilicate scintillation vials. No additional preparation was necessary.

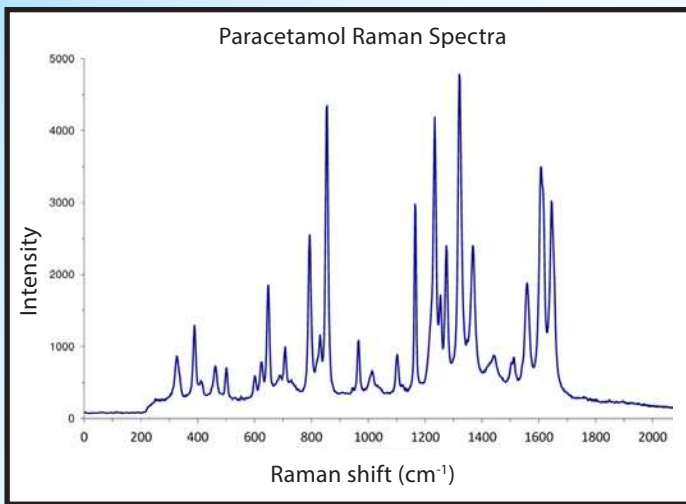


Figure 1: A modular Raman setup can be configured to measure paracetamol, an analgesic more commonly known as acetaminophen.

Samples were analyzed using a modular Raman setup comprising a QE series spectrometer, a 785 nm laser with 500 mW output and a fiber optic probe. The spectrometer was set from ~780-940 nm and configured with a 50  $\mu\text{m}$  slit for good optical resolution. High reflectivity optical bench mirrors were added to increase spectrometer sensitivity.

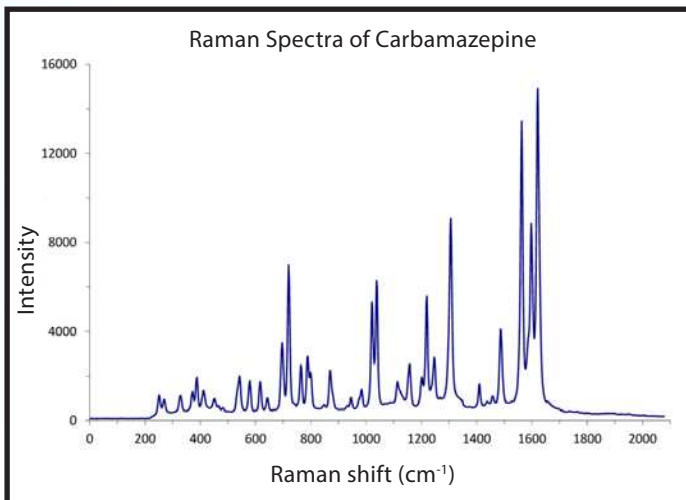


Figure 2: Spectral features of pharmaceutical ingredients such as carbamazepine are clearly discernible using Raman spectroscopy.

To collect signal, we placed the tip of the probe at the bottom of three glass vials containing the samples. We measured the samples at an integration time of 8 seconds and averaged three spectra.

## Results

Our measurements confirmed that this Raman configuration can differentiate pharmaceutical

active materials such as paracetamol (Figure 1) and carbamazepine (Figure 2) based on their spectral fingerprints. Also, the experiment helped demonstrate that, with proper method development and application of chemometric analysis, our Raman setups can be used to obtain semi-quantitative data of active ingredients in a pharmaceutical mixture.

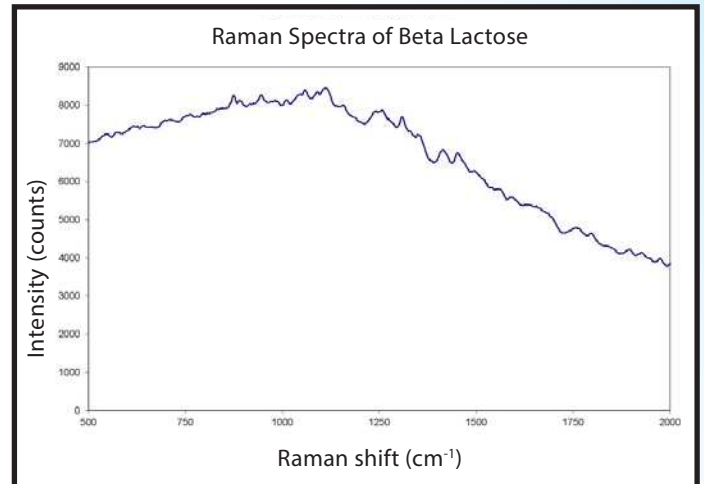


Figure 3: Raman analysis of excipients is a useful application in biomedical and pharmaceutical quality control.

In addition, our experiment showed that Raman response and fluorescence occurs in the lactose samples (Figure 3). Fluorescence is a common phenomenon in Raman measurements of some organic compounds and depends on the wavelength of the laser utilized.

## Conclusion

The availability of both turnkey and modular Raman systems, complemented by sophisticated chemometric analysis packages and spectral libraries, makes Raman spectroscopy a versatile choice for a host of applications. 🐼

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