Narcotic analysis using the Quest™ ATR accessory

Little or no sample preparation is needed to analyze drugs using ATR spectroscopy.

NARCOTICS HAVE BEEN CONSUMED for cultural and personal reasons throughout the ages. Security agencies are continually looking to enhance their methods of substance detection and testing, in an endless arms race of drug smuggling and dealing.

Any controlled narcotic or illegal ‘street’ drug needs to be routinely submitted for chemical analysis that has a fast turnaround time with minimal user error. Security services require non-destructive techniques so that samples can be presented as evidence after testing.

Attenuated Total Reflectance (ATR) spectroscopy is a fast method of analyzing liquid and solid drug samples non-destructively. The Quest™ ATR accessory allows users to quickly record qualitative and quantitative spectra, in order to test which drugs are present in the sample and in what proportions.

Figure 1: ATR spectra of cocaine, methamphetamine & ibuprofen

This note demonstrates how you can distinguish several common different narcotics easily and quickly.

Powdered samples

Figure 1 shows the ATR spectra of cocaine, methamphetamine and ibuprofen. All three can be seen as fine white powders, but they each absorb different quantities of infrared light.

The sharp peak at ~1750 cm\(^{-1}\) is only present in cocaine and ibuprofen. Even more differences can be seen at the lower wavenumber region, often called the fingerprint region.

Cocaine

There are several stages in the chemical process followed to make cocaine.

For instance, the coca leaves first need to be harvested before cocaine paste is extracted, which is then converted to the cocaine base. Finally this is turned into Cocaine HCl.

ATR spectroscopy can tell these two different forms apart, as shown in Figure 2. Such a capability is useful for forensics agents to immediately tell what stage of the process criminals have reached and the street value of their drugs.

Contaminants and cutting agents are sometimes found in narcotics (rat poison, baking soda, caffeine, etc). ATR spectroscopy can detect them all.

Figure 2: ATR spectra of cocaine base vs cocaine HCl
Awkward narcotic sample-types

Some narcotics, like cannabis, are not powders but resins, sticky solids or oils. The Quest™ ATR can still distinguish non-powdered substances than may be found on a crime scene.

Figure 4 shows the spectra of cannabis leaf, some hemp rope and an ordinary garden flower. Although each sample shares a noticeable water absorption band at 330 cm⁻¹, there are clear differences around the lower wavenumber region.

![Cocaine Hydrochloride (HCl) Salt](image)

![Cocaine Base](image)

**Figure 3: Cocaine HCl & Cocaine Base molecules**

**Figure 4: ATR spectra of Cannabis Leaf, Hemp Rope & Garden Flower**

**In conclusion...**

Modern forensic scientists and government security agencies need fast, reliable analysis techniques that allow them to determine what a substance is, in a non-destructive way.

The Quest™ ATR is the perfect tool for analyzing many samples quickly, without sample preparation. It is also very user friendly and gives reproducible results.

This note shows different legal and illegal drug samples analyzed using the Quest™ ATR accessory. Each chemical absorbs different quantities of IR light, and spectroscopy is a key way to rapidly confirm what the sample contains.

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**References**


2. An ATR library of 455 compounds was provided by the Illinois State Police Department.