

White paper

ThermoFisher
SCIENTIFIC



Smarter field identification using flexible FTIR and Raman analysis

Any attempt to identify unknown substances creates risks before providing answers. A powder in a bag, a liquid in a bottle, a dark residue, a suspicious mixture, or a suspected narcotic sample can all force the same field decision: How do we identify this material without making the scene more dangerous by inadvertently using an inappropriate type of analysis?

It may seem logical and efficient to save time by analyzing an unknown material using both Fourier transform infrared spectroscopy (FTIR) and Raman spectroscopy simultaneously, but flexible spectroscopic analysis provides a safer path for the operator. Having multiple technologies available on a single device while being able to run them separately, deliberately, and in the safest order for the specific sample in front of the operator, enables smarter field identification.

Each analytical technique interacts with a sample differently: Raman spectroscopy uses laser-based analysis, while FTIR analysis requires direct contact with a sample at an interface with an attenuated total reflection (ATR) crystal. Other surface-enhanced Raman spectroscopy (SERS) workflows may involve additional sample preparation for low-concentration narcotics. Employing a flexible multi-method analytical process with a step-by-step workflow lets operators start with the safest analysis mode first for the sample at hand and escalate only when the material or mission requires it.

The Thermo Scientific™ Gemini™ Analyzer supports this safety-first approach by integrating Raman and FTIR capabilities in a lightweight, handheld platform, with additional SERS-enabled narcotics workflows available through on-board LowDoseID software. The Gemini analyzer also includes a Scan Assist feature to guide technology selection, along with a scan delay function for both Raman and FTIR analyses that provides the operator time to move to a safe area, and adjustable laser power.



thermo scientific



Safety step 1:

Keep the package closed when you can

When a substance is visible through clear or semi-translucent packaging, Raman analysis can often be the first step. Raman spectroscopy enables analysis through transparent and translucent containers, helping eliminate the need for direct contact with potentially hazardous unknowns.

For suspected narcotics, including high potency fentanyl-containing materials, that capability is especially important. Opening packaging, transferring powders, or manipulating evidence can increase opportunities for exposure or contamination. In the field, this means Raman analysis can provide information while adhering to the first safety checkpoint: Can I get an answer without opening the container?

Safety step 2:

Use FTIR when Raman is not the safer first move

Because Raman analysis uses a focused laser, samples that absorb laser energy—particularly dark or highly absorbing materials—may become heated during analysis. For dark substances, strongly colored samples, fluorescent materials, and certain suspected energetic materials, laser interaction may not be the safest first choice.

Rather than relying on a material's Raman scattering properties in response to its interaction with a laser, FTIR analysis measures how a material absorbs infrared light. That distinction matters in the field: FTIR spectroscopy can be a better option for colored or fluorescent materials, and it can help operators avoid applying Raman laser energy to samples where heating, fluorescence, or sample sensitivity is a concern.

Running an FTIR analysis before attempting Raman analysis can be a valuable safety practice when a sample may be dark, highly absorbing, energetic, or otherwise sensitive to laser-based analysis. However, FTIR is not always the safest first step. ATR-FTIR analysis requires direct contact with the sample at the instrument interface, which may require opening packaging, transferring material, or otherwise manipulating

an unknown substance. For suspected narcotics, including fentanyl-containing materials, those actions can increase the potential for exposure or contamination. If the substance is visible through clear or semi-translucent packaging, Raman spectroscopy may provide a safer initial checkpoint by allowing the operator to attempt identification while the container remains closed. FTIR should therefore be used deliberately when Raman is not appropriate; it should not be an automatic first step for every unknown.

The Gemini analyzer's FTIR scan delay, enabled by the motorized anvil component, adds another field-safety advantage. Operators can position the sample, initiate a delayed scan, and avoid remaining near the unknown as analysis begins. That added time and distance can be especially valuable when working with materials that are poorly characterized, potentially reactive, or otherwise of higher concern.

Safety step 3:

Use SERS when low-concentration narcotics complicate the analysis

Illicit drug samples can contain potent compounds at low concentrations, especially in mixtures or pills. In these cases, standard Raman and FTIR analyses may be challenging. Surface-enhanced Raman spectroscopy (SERS) should be treated as a deliberate follow-up step: Use it for a focused workflow when additional sensitivity is worth a small, controlled amount of sample preparation.

With the Gemini Analyzer and the Thermo Scientific™ LowDoseID™ accessory, the SERS-based H-Kit uses a small amount of material, typically only 2–4 mg dissolved in solvent. A few drops are placed onto a specialty SERS substrate, which is then dried to evaporate the solvent. The sample can then be scanned with a Raman probe. The substrate can enhance the Raman signal by several orders of magnitude, helping detect low concentrations of illicit drugs in mixtures and pills.



Why flexible beats simultaneous

The safety advantage of the Gemini analyzer lies in the choices it makes available. Users can select the safest analysis with sample interaction in mind, one step at a time. Raman-only analysis might be safer when the unknown material can remain sealed in clear packaging, allowing operators to gather information without opening, pouring, or touching the substance. FTIR-only analysis can be safer when working with dark, colored, fluorescent, or potentially laser-sensitive materials, because FTIR avoids applying Raman laser energy that could create localized sample heating. SERS adds value when suspected narcotics may be present at low concentrations or masked by cutting agents; the enhanced signal it provides helps improve field information without repeated trial-and-error handling. With the Gemini analyzer's scan delay features, operators can also build time and distance into the analytical process, allowing them to move to a safe area before the scan is initiated. The result is a more deliberate and safer workflow: Use the least invasive mode first, switch when the sample demands it, and handle the material only when necessary.

Learn more at thermofisher.com/threatdetection

For research use only. Not for use in diagnostic procedures. For current certifications, visit thermofisher.com/certifications
© 2026 Thermo Fisher Scientific Inc. All rights reserved. All trademarks are the property of Thermo Fisher Scientific and its subsidiaries unless otherwise specified. MCS-AN1861-EN 0626