Explosives, Drug, and Hazmat Detection and Source Attribution

Challenge

Today's forward-deployed warfighter and security professionals need to rapidly and reliably identify various compounds or residues found in the field to distinguish between inert materials and home-made explosive (HME) compounds. Forensic experts also need timely data to help identify those responsible, in order to contain the proliferation of HME attacks.

Traditional Solutions

Raman spectroscopy is a proven technique for chemical identification, however current techniques occasionally produce erroneous readings, and do nothing to help determine "Who made it?" Forensic experts need data relating to ingredient sources, contaminants and methods of manufacture, as well as insights into the formulation and storage environment, which can reveal clues about where and how it was made. This can require large, expensive, equipment, and special sample handling and preparation.

Coherent Solution

Low-frequency/ THz-Raman analysis can identify and differentiate synthetic pathways, ingredients, and formulations, as well as reveal changes relating to environment and storage (e.g. heat, humidity). These can leave behind telltale "signatures" or "fingerprints" in the molecular structure that help the forensic specialist in narrowing or accelerating their search for the perpetrator. Coherent THz-Raman® systems extend the range of traditional Raman spectroscopy to the terahertz/low frequency domain, where differentiation of inter- and intra-molecular structures can be clearly seen in the Structural Fingerprint region. Anti-Stokes signals add to Raman intensity and improve SNR. Coherent THz-Raman® systems enable fast, reliable capture of both chemical fingerprints for detection and "synthetic signatures" to assist with source attribution, improved sensitivity, and reliability for even microscopic trace amounts of sample.
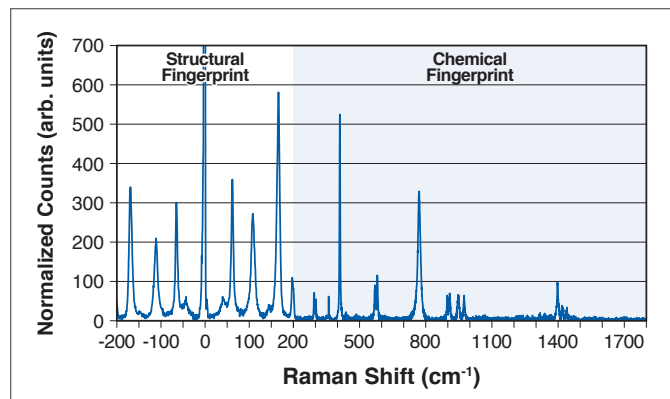

Figure 1 and 2.* THz-Raman analysis of HMTD (Hexamethylene Triperoxide Diamine) and Ammonium Nitrate is shown below. The strong, distinctive peaks in the low-frequency/THz-Raman region (white background) are typically higher than the traditional fingerprint range, adding signal, improving sensitivity and reducing false positives. Peak symmetry about the excitation line also enables auto-calibration and enhanced system and data reliability.
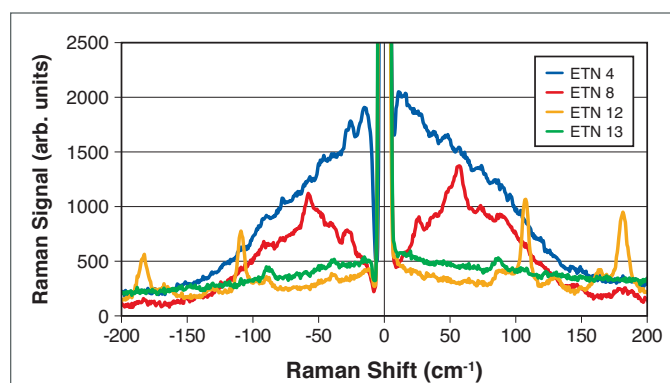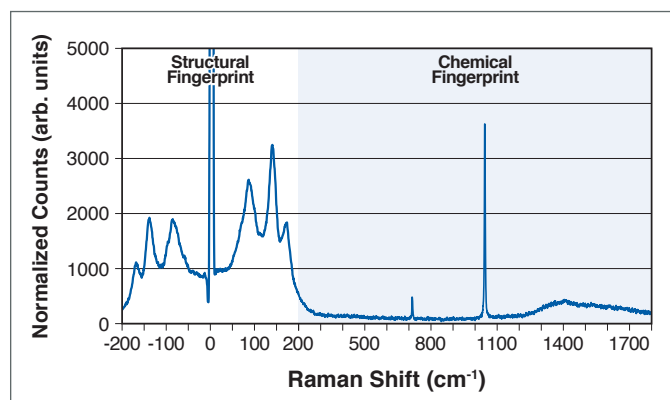

Figure 3. Multiple samples of ETN (Erythritol Tetranitrate), representing systematic variations in primary ingredients as well as types of acids, salts, and preparation routes, show distinctive differences.

Application Field

Explosives detection, forensic analysis, source attribution, CBRNE detection and analysis, low-frequency THz-Raman Spectroscopy.

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For more information, visit: http://www.thz-raman.com

* HMTD samples courtesy of Dr. Brian Leigh, Dept. of Chemistry and Biochemistry, University of California, San Diego.

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