smiths detection

Fourier-Transform Infrared (FT-IR) Spectroscopy

A VIBRATIONAL SPECTROSCOPY TECHNIQUE THAT IS USED FOR THE FIELD IDENTIFICATION OF UNKNOWN SUBSTANCES

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FT-IR is a vibrational spectroscopy technique that has been used for the field identification of unknown substances for more than 10 years.

Smiths Detection's HazMatID system was the first FT-IR chemical identifier designed specifically for use close to the chemical threat and in hotzone enviroments. The new HazMatID Elite incorporates state-of-the-art technology to further increase the ruggedness and portability of FT-IR spectroscopy and enable deployment by a wider range of personnel in many of the world's most challenging environments.

Interferometer: The Engine of an FT-IR System

Interferometry is an efficient way to conduct spectroscopic measurements using infrared (IR) light. This approach, as opposed to monochromatic or dispersive methods, enables the throughput, multiplex, and precision advantages that are required for end-user applications. A typical interferometer works by splitting IR light from a spectral source into two beams and reflecting one beam off of a fixed mirror and the other off of a moving mirror. The moving mirror introduces a time delay that causes a mix of constructive and destructive interference when the beams are recombined. The scan of this signal versus the mirror position produces an interferogram, which can be reconstructed into an IR spectrum using Fourier transform mathematics.

Maintaining the precision motion inside of an interferometer requires a robust mechanical and electrical design to allow reliable measurements to occur under a wide range of field conditions including high and low temperatures, plus the shock and vibrational loads encountered during human and vehicle transport. The design used in the original HazMatID system has proven reliable for the last 10 years and has satisfied many mission requirements of Military and emergency response personnel worldwide. The new design in the HazMatID Elite system further miniaturizes this technology and provides the robustness required for true handheld chemical identification applications.

Diamond Attenuated Total Reflectance (ATR): An Enabling Technology

While the interferometer manages the IR light required for FT-IR spectral measurements, reliable sample introduction to the FT-IR system is essential to carry out chemical identification procedures. Although many sample introduction techniques exist, diamond ATR sampling has been the enabling technique for the field. When a chemical sample is placed in contact with the diamond ATR sensor, a small amount of IR light penetrates into the sample and is absorbed at certain frequencies characteristic of that material. This recording of the characteristic frequencies can be performed without any sample preparation or destruction of the sample. In addition, this surface analysis technique only requires that the sample interface area be wiped clean after an analysis, instead of the labor-intensive and cleaning and clear-down procedures encountered with other analysis methods. The diamond surface also provides a high-level of ruggedness and chemical resistance for repeated use.

Spectral Databases and Algorithms

It has been said that the characteristic IR light frequencies absorbed by a chemical produce a "molecular fingerprint". Tens-of-thousands of unique FT-IR spectra have been recorded on HazMatID systems and are incorporated into our spectral libraries. When these libraries are searched against unknown spectra recorded in the field, a best match or matches to the library can be reported to the user to aid in on-scene chemical hazard assessment. In recent years, Smiths Detection has developed advanced chemometric library search algorithms that allow faster reporting and accurate results for samples that contain a mixture of chemical components. Users also have the capability to develop their own spectral libraries to tailor their FT-IR equipment for their own specialized needs.

Key Benefits of FTIR Technology

FT-IR technology enables the rapid assessment of a wide range of chemical threats including chemical warfare agents, explosives, toxic industrial chemicals, pesticides, narcotics, and common white powders. Eliminating the need for sample preparation, FT-IR technology provides an easy-to-use capability that can be utilized by security personnel worldwide. It is truly a gold-standard method for unknown chemical identification in the field.

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Smiths Detection, 1 Sheldon Square, Paddington London, United Kingdom W2 6TT

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