

Terahertz- and Millimeter-Wave Test Facility

Detect Terrorist-Related Contraband with Terahertz Technology

APPLICATIONS

- Detect trace explosives
- Detect image concealed weapons
- Sense remote gas leaks, chemicals and nuclear materials
- Locate and track chemical and radioactive plumes
- Perform medical imaging

BENEFITS

- Spectral “fingerprints” uniquely identify materials
- Can identify the factory where explosives and other chemicals were manufactured
- Detects minute amounts of chemicals from a distance
- Identifies materials in seconds

Companies that develop or manufacture instruments to detect terrorist contraband can benefit by using a unique facility at the U.S. Department of Energy’s Argonne National Laboratory. Called the Terahertz Test Facility, its sensitive, new instruments – developed at Argonne and available nowhere else in the world – can obtain spectral “fingerprints” that uniquely identify explosives, chemicals, and biological agents– and can even identify the factories where chemicals and explosives were made.

Companies can use the Terahertz Test Facility to build a library of spectral fingerprints for dozens of substances and then use that data to design instruments that quickly and accurately detect any material in the library. Companies can send their own researchers to use the facility – Argonne will orient and train them, as needed – or they can hire Argonne to test samples for them. In either case, results can be kept proprietary.

The laboratory performs rotational spectroscopy using electromagnetic radiation in the wavelength range from 0.1 to 0.5 terahertz (THz). This range includes millimeter-range energies and is particularly sensitive to chemical molecules. The process vaporizes a minute sample of material in a vacuum chamber, then shines a beam of THz radiation through it to excite the molecules’ rotational energies. The resulting THz absorption produces a unique and reproducible spectral pattern that identifies the material.

In addition to spectroscopy, the capabilities of the Terahertz Test Facility include THz-wave radar and passive detection and imaging techniques. Because THz radiation is biologically safe, it can be used in high-resolution imaging to detect tumors.



Instruments at Argonne’s Terahertz Test Facility can detect trace chemicals at the part-per-billion level.

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ABOUT ARGONNE TECHNOLOGY TRANSFER

Argonne National Laboratory is committed to developing and transferring new technologies that meet industry's goals of improving energy efficiency, reducing wastes and pollution, lowering production costs, and improving productivity. Argonne's industrial research program, comprised of leading-edge materials research, cost-saving modeling, and unique testing and analysis facilities, is providing solutions to the challenges that face U.S. manufacturing and processing industries.

Argonne researchers have already demonstrated a number of detection capabilities using the facility's instruments and methods:

- **Detect trace amounts of explosives** – THz spectroscopy can detect trace amounts of explosives in less than one second with a low false-alarm rate. Because explosives continually emit trace amounts of vapor, it should be possible to use these methods to detect concealed explosives from a distance.
- **Sense gas leaks, chemicals and nuclear materials** – In field tests, THz-wave radar detected chemicals at the 10-ppm level from 60 meters away. This method can be used in a fence-line- or aircraft-mounted system that works day or night in any weather. Radioactive plumes from nuclear plants have been detected several kilometers away based on radiation-induced ionization effects in air.
- **Detect concealed weapons** – THz waves easily penetrate cloth and plastic to detect and image contraband materials.
- **Locate plumes and concealed nuclear materials** – Passive THz-wave techniques can detect concealed nuclear materials, as well as detect and make images of chemical and radioactive plumes. This technology is well suited to remote-detection instruments that work in all weather.
- **Detect biological aerosols** – THz wavelengths interact well with biological molecules, making it possible to remotely detect biological aerosols in less than a minute with a low false-alarm rate.

