ALERT F2-F Transition Projects: PinPointer™ and LaserScan™

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Abstract

New technologies based on Raman and Infrared spectroscopies such as the PinPointer™ (Agiltron, Inc.) and LaserScan™ (Block Engineering) provide rapid, precise identification of samples even through common containers (glass and plastics) or as trace contaminants amounts deposited on surfaces in real-time without sample preparation. These new system are able to detect different hazardous compounds employed by terrorist such as higjly energetic materials (HME), homemade explosives (HME) and other threat chemical and biological agents and Toxic Industrial Compounds and Materials (TIC/TIM).

Relevance

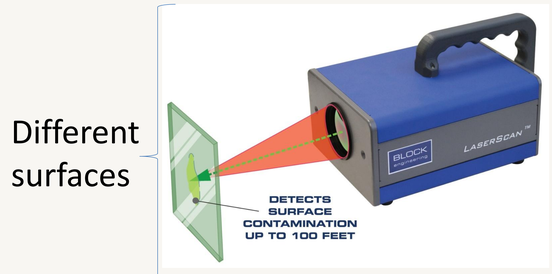
The most relevant features of these Raman System are their portability and the laser-based method can be performed through several surfaces and translucent containers such as glass or plastic, significantly reducing the potential of chemical hazards to the investigator as well as contamination of forensic evidence.

The **LaserScan™** employs a quantum cascade laser (QCL) as source, which operates in the MIR region. QCLs have revolutionized many areas of research and development in defense and security applications.

The **PinPointer™** is a handheld Raman spectrometer operated by a Smartphone would take advantage of both full PC and data networking capabilities.

Technical Approach

QCL based LaserScan™



We have evaluated a widely-tunable QCL scanner (1000–1600 cm^{-1}) for detection and quantification of HEM/HME deposited on reflective substrates. Figures 1 and 2 show some of the results obtained for experiments using RDX and TNT. PETN and Semtex-H deposited on Al.

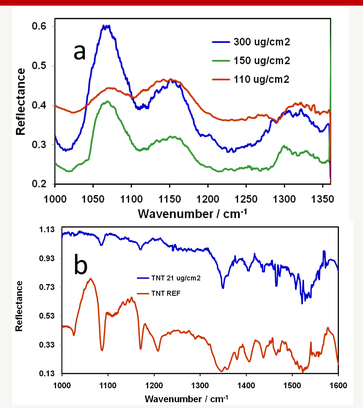


Figure 1. (a) QCL spectra RDX deposited on Al substrate at 110, 150 and 300 μg/cm^2 loadings. (b) Reference micro-FTIR spectrum of TNT and the corresponding QCL excited reflectance spectrum.

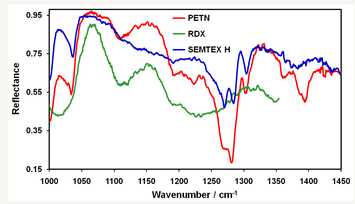


Figure 2. QCL spectra of PETN, RDX and SEMTEX-H formulation: 40.9% PETN and 41.2% RDX

Handheld Raman Spectrometer with Smartphone Technology (PinPointer™)

The PinPointer™ is a Raman spectrometer operated by a Smartphone that can take advantage of both full PC and data networking capabilities.

Future Work

PinPointer™

- Generating a Raman Spectral Database of HEM/HME and other common threat chemicals.
- Design and development chemometric models for discrimination and quantifications analysis.
- Development of graphical interface unit (GUI)

LaserScan™

- Testing the unit performance in terms of vibrational signatures of HEM/HME
- Determining low limits of detection of HEM/HME
- Study substrate effects on spectral response
- Perform study of interference/matrix effects
- Perform quantification/discrimination studies

PinPointer™ and **LaserScan™** system will be useful for defense and security applications, for monitoring HEM/HME. These system can be work together with the existent instrument employed by TSA in airports

Opportunities for Transition

Efforts under this program represent an initial step towards miniaturized spectrometers integrated with mobile communications platforms for CHEMBIO threats detection. Miniaturization will include development of high optical throughput non-slit based devices that avoid the size limitations of traditional spectrometers. Incorporation of Surface Enhanced Raman Spectroscopy (SERS) will improve detectivity of some materials by more than 6 orders of magnitudes by using nano-structures media as detection platform. This feature is intended to be implemented as an add-on to the **PinPointer™** product family that will be progressively developed from the outcomes of the current program.

Publications Acknowledging DHS Support

- Ortiz-Rivera, W; Pacheco-Londoño, L.C.; Hernández-Rivera, S. P. Remote Continuous Wave and Pulsed Laser Raman Detection of Chemical Warfare Agents Simulants and Toxic Industrial Compounds. Sensing and Imaging: An International Journal, **(2010),** 11 (3): 131-145.
- Ramírez, M.L., Ortiz-Rivera, W., Pacheco-Londoño, L.C. and Hernández-Rivera, S.P. Remote Detection of Hazardous Liquids Concealed in Glass and Plastic Containers. IEEE J. Sensors, 10 (3): 693-69, **2010**
- Pacheco-Londoño, L., Ortiz-Rivera W., (**2009**). "Vibrational spectroscopy standoff detection of explosives." Analytical and Bioanalytical Chemistry 395(2): 323-335.

Other References

For more information, please go to:
http://academic.uprm.edu/ccsde/

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