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Title:

A new, hand-held, 1 to 5 m standoff analyzer for real-time detection of trace chemical, biological, and explosive substances on surfaces.

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Abstract:

Real-time assessment of suspicious substances on surfaces is an important capability needed by warfighters/first responders. It is also important to perform these assessments without contact or spreading of the suspicious substance or use of reagents. We present work conducted under DTRA and Army funding to develop a hand-held, 1 m to 5 m standoff, optical sensor which detects and classifies trace and bulk concentrations of a wide range of chemical, biological, and explosives (CBE) materials in real-time and full daylight with a fully integrated analyzer weighing less than 9 pounds, including batteries.

The sensor method described here combines the complementary chemical information of molecular bonds using Raman and the electronic configuration information using fluorescence, with excitation below 250 nm. There are six main advantages of excitation below 250 nm compared to near-UV, visible or near-IR counterparts: 1) Solar blind detection enabling standoff operation in full daylight; 2) Fluorescence-free Raman and Raman-free fluorescence enabling enhanced detection and identification of target materials without mutual interference; 3) Resonance Raman signal enhancement for improved Raman sensitivity; 4) Simplification of Raman spectra due to resonance enhancement, 5) Short penetration depth, providing physical separation of surface contaminant materials from substrate; and 6) Eye retina safe. These detection capabilities are not possible with near UV, visible, or near IR sensors. A special feature of our sensor is the ability to detect trace biological materials at standoff distances in real time.

Photon Systems and JPL have developed these methods over many years, enabling instruments deployed to extreme environments on Earth and an upcoming lander mission to Mars in 2020.

Key Words: real-time, standoff, detection & classification, chemical detection, biological detection, explosives detection, hand-held, low SWAP/C