

FROM SENSING TO MAKING SENSE

From Illicit-drug Identification To Chemical Warfare Combat: Fully Portable Sers Technology For The Rapid And Accurate Identification Of Chemical Compounds

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Over the years, chemical weapons have threatened warfighters and civilians, causing over a million casualties worldwide since World War I. Developing sensors for rapid and accurate identification of chemical warfare (CWA's) agents and explosives which can save many lives (Ganesan et al., 2010). Recent studies have focused on developing rapid and inexpensive techniques for detecting CW (Bogue, 2015; Kangas et al., 2016; Murray & Southard, 2002). However, interference of chemicals that are similar in composition to CW agents, such as pesticides and herbicides, presents a challenge. Separation techniques provide higher accuracy and rejection of interference, but these techniques are often bulky, time-consuming, and costly. Raman spectroscopy is a non-destructive analytical technique that provides a "molecular fingerprint" from the chemical bonds, that can be used to identify and quantify analytes. Surface-enhanced Raman scattering (SERS) is a technique allowing for the amplification of several orders of magnitude of the Raman signal (Wilson et al., 2021; Xie et al., 2020). We have developed an end-to-end user-friendly, sensitive, cost-effective, portable SERS-based platform to detect and identify a number of substances from CWA's to narcotics. Our platform is comprised of a Serstech Arx Raman Analyzer, a proprietary SERS structure (Amplifi IDTM, Spectra Plasmonics Inc., Canada), and our proprietary analytics software (Amplifi Analytics, Spectra Plasmonics Inc., Canada) for the detection and identification of harmful substances such as Fentanyl. Amplifi IDTM in combination with the Arx, ensures high sensitivity and allows for clinically relevant limits of detection through its SERS active nanostructures. Our software and chemometric techniques have demonstrated the ability to obtain highly specific results and distinguish similar drug compounds based on subtle chemical differences. We have demonstrated a detection (LOD) of 10 ppm for the detection of fentanyl in drug mixtures. This technology could be readily transferable for the detection of other analytes such as chemical and biologicals threats. Further investigation of the interaction of the analytes with the surface must be performed. JGW is a small business and has over 40 years of experience in supporting the development and fielding of CBD system globally and have an active CRADA (JGW – CBC CRADA # 2103C) with DEVCOM CBC to Assess, Protect, and Mitigate Technology Development and Advancement for CBRN Detection. The benefit to DTRA and the warfighter is a cost-effective, user friendly, portable SERS-based platform which when used with state-of-the art Raman technology to detect and identify threat chemical materials in low quantities.

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