ODAS-MOTAR 2021 Abstract Template

TITLE: REMOTE RAMAN SCATTERING DETECTION OF EXPLOSIVES
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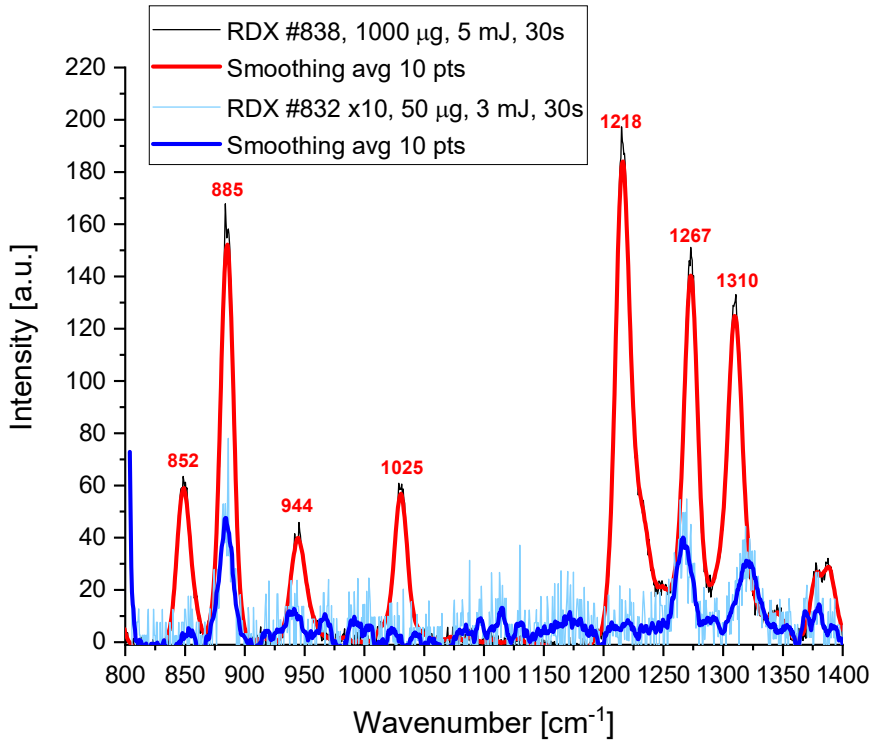
Abstract

An experimental setup for remote ultraviolet Raman spectroscopy [1] with short pulse systems was optimized [2] for the investigation of explosives on contaminated surfaces. The main goal was to quantify the minimum requirements for an unambiguous identification in remote detection (60 cm distance) with a commercial Czerny-Turner spectrometer coupled with a CCD camera. First results were presented in this study to identify the detection limits (laser energy and compound's concentration) for RDX [3] (explosive agent of C-4). Well-defined distributions of explosives on surface [4] were tested as standardized samples (NATO SET-237 [5]). Therefore, Raman spectra of RDX have been acquired for different sample concentrations (50, 250, and 1000 $\mu g/cm^2$ respectively) and under several laser energies (1.5, 3.0 and 5.0 mJ/pulse respectively) at 355 nm excitation wavelength. The Raman signature of the explosive corresponds to the signature of the pure substance known from the literature [6,7,8]. The minimum detectable RDX was 4.4 µg with exciting laser energy of 3.0 mJ/pulse. With this pulse energy, the signal to noise ratio was found too low for a clear identification, so 5.0 mJ/pulse are suggested to avoid false alarms. Increasing further the concentration of RDX (at least 89.7 µg) provided always a clear identification of the explosive material even with the lowest chosen laser energies of 1.5 mJ/pulse. A further optimization of the system (pulse energies and pulse diameter, collecting optics, detection device) is suggested and it will be examined in order to further decrease the detectable amount limits. Moreover, the preparation and description of a suitable sample plays an essential role in determining the sensitivities of the employed technologies. Their specified standard concentration ($\mu g/cm^2$) is discussed by means of an effective detection sensitivity, especially in the case of inhomogeneous surfaces with thick sample particles of random sizes and optical detection techniques. The proposed estimation of the sensitivity relies on homogeneous layers with a thickness equal to the penetration depth [9] of the exciting laser light.

Figures



RDX Raman spectra of 1000 µg/cm^2 (5 mJ/pulse energy) and 50 µg/cm^2 (3 mJ/pulse energy) multiplied by a factor 10 at 60 cm collecting distance

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