Vapor Detection of Nitrogen Oxide Containing Explosives by Catalytic Thermal Dissociation Blue Diode Laser Cavity Ring-Down Spectroscopy

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The ubiquitous threat of terror attacks on airplanes, trains, and important infrastructure has led to a strong demand and interest in new instrumentation for detection of explosives. To avoid disrupting the flow of individuals and goods instrumentation is posed with the difficulty of rapidly detecting low vapor-pressure compounds in the gas phase requiring detection limits below the parts-per-billion by volume (ppbv) level. Many explosives contain nitrogen oxides, such as the nitroalkanes (e.g., ethylene glycol dinitrate, EGDN), nitroaromatic compounds (e.g., 2,4,6-trinitrotoluene, TNT), and the nitramines (e.g., hexahydro-1,3,5-trinitro-1,3,5-triazine, RDX). Here, a compact 2-channel (55 cm optical path length) blue diode laser catalytic thermal dissociation cavity ring-down spectrometer (cTD-CRDS) for detection of nitroaromatic vapors is presented. The instrument utilizes a 405 nm cw diode laser which is square-wave modulated at a frequency of 2000 Hz. A heated quartz tube containing platinum (IV) oxide catalyst is used to dissociate nitrogen containing organic compounds to NO_2, which is detected via its absorption at 405 nm. Any NO generated is oxidized to NO_2 via addition of excess ozone prior to detection. The cTD-CRDS detection limit (3σ) is sufficiently low (0.3 ppbv) to allow direct detection of 2,4-dinitrotoluene (DNT) and TNT in real-time. We have recently constructed an automated preconcentration trap for detection of less volatile compounds, including RDX.