A112 Trace Analysis and Physical Property Characterization of Energetic Materials (Explosives)

Thomas J. Bruno, PhD, National Institute of Standards and Technology, 325 Broadway, Boulder, CO 80305*

The goal of this presentation is to teach an integrated approach to sampling and property measurement for the identification and characterization of explosives in concealed devices. It will also cover the importance of explicitly considering the surface upon which the explosive is deposited.

This presentation will impact the forensic community by demonstrating how the rapid analysis of explosive vapors found in the presence of explosives is crtical to the identification of those explosives, and our new method, called cryoadsorption, provides this. Moreover, we demonstrate that unless the deposit surface is explicitly considered, the results will be incorrect.

Currently, there is a need for standardization, calibration and certification of energetic (explosive) material detection devices. To this end, our laboratory is making quantitative headspace measurements on energetic materials, e.g., trinitrotoluene (TNT), C-4, SEMTEX-A (a plastic explosive made from RDX and PETN (trinitro-triazacyclohexane and pentaerythritol trinitrate, respectively), and detonator cord (lead azide). A headspace measurement is made by a newly developed method called cryoadsorption. The method is implemented by placing a small amount of a material in a sealed vial in a temperature controlled environment. A capillary is attached to flow He gas into the vial and an activated PLOT column is attached to the vial to allow He gas and other volatile constituents in the headspace to flow out of the vial. The PLOT column is housed mainly in a cryostat that is chilled to ~5°C. The low temperature aids in collecting the constituents of the headspace onto the PLOT column. After a predetermined time the PLOT column is removed, the constituents are collected by flowing acetone through the column, and gas chromatography- mass spectrometry is used to identify and determine the concentration of the analytes. In this presentation, we discuss the identification and concentration of constituents in the headspace of TNT, C-4, Semtex-A and H, Flex-X and detonator cord as a function of temperature. Additionally, we discuss vapor pressure characterization of several common taggents (2-nitrotoluene (2-NT), 3-NT and 4-NT) that have been identified in energetic materials as a function of temperature. Work is also underway to elucidate the permeation of hydrogen peroxide (H_2O_2), a major component for making the organic peroxide-based explosive triacetone triperoxide (TATP), through selected polymers.

Explosive, Analysis, Vapor