Towards better explosives detectors

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Over the past decade, Christine Mahoney and a team of scientists at the National Institute of Standards and Technology (NIST) in Maryland have been working to stop the threat of terrorist-based attacks in the form of explosives or explosive-based devices, by providing a sound measurement and standard infrastructure.

"Our program encompasses many different aspects of explosives research, from development of measurement standards for trace explosives detection at airports, to the development and application of new metrology for the direct characterization and identification of these explosives," says Mahoney, who is making a presentation today at the AVS 57th International Symposium & Exhibition, which takes place this week at the Albuquerque Convention Center in New Mexico.

One measurement technique, Time-of-Flight Secondary Ion Mass Spectrometry (ToF-SIMS) is proving to be critical for identifying and differentiating the various components of explosives. ToF-SIMS is a mass spectrometric-based imaging technique that is able to detect components such as plasticizers, binders, oils, and the explosives themselves. It can potentially be used to differentiate between explosive manufacturers and to reveal an explosive material's country of origin.

Unlike traditional analytical techniques such as gas and liquid chromatography, which can provide a partial analysis of extracted samples, ToF-SIMS and other mass spectrometric imaging techniques allow for the simultaneous and direct characterization of all the components in explosives like C4, including the explosive active

components, additives, binders, and contaminants. ToF-SIMS provides rapid identification of both organic and inorganic constituents and their characteristic isotopic abundances with excellent sensitivity. Most importantly, it is well-suited for direct analysis of small explosive particulates collected directly in the field and sent back to the lab.

According to Mahoney, the laboratory technique is sensitive enough to detect bits of explosive material scattered in a fingerprint, making it a potentially powerful forensic tool. "It's a more thorough way of looking at the material," says Mahoney. "We look at everything all at once."

Using ToF-SIMS in combination with other techniques that visualize the crystal structure of the samples, Mahoney identified and differentiated between commercial C4, military C4 from the United States, and C4 from the U.K.

The ultimate goal of the project, though, is not to develop ToF-SIMS as a portable technology to use in the field. Rather, Mahoney is creating a library of precise, standardized reference samples that could be used to test, calibrate, and optimize new technologies for detecting explosives in the field.

"We can really nail down the differences in the chemistries between different kinds of explosives," said Mahoney.

More information: The talk, "Characterization of Composition C4 Explosives using Time-of-Flight Secondary Ion Mass Sepctrometry (ToF-SIMS) and X-Ray Photoelectron Spectroscopy (XPS)" is at 10:40 a.m. on Thursday, October 21, 2010. Abstract: www.avssymposium.org/Open/Sear … aperNumber=AS2-ThM-9

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