Science & Technology

March 7, 2005
Volume 83, Number 10
p. 45

NO-PREP MASS SPEC

New atmospheric pressure ionization method is suitable for security and defense applications

CELIA M. HENRY, C&EN WASHINGTON

Robert B. Cody, the mass spectrometry product manager at JEOL USA in Peabody, Mass., has had lots of fun the past year seeing just what kinds of samples he can obtain a mass spectrum from. Just by sticking samples in front of a mass spectrometer, he's analyzed paper money, chocolate, hot peppers, and even a necktie laced with a trace of nitroglycerin.

ANALYZE THIS DART co-inventor Cody shows how easy it is to prepare a sample for analysis: Just stick it in front of the spectrometer.

COURTESY OF JEOL

He is able to do this no-sample-preparation-needed analysis through a new ionization method that he and James A. Laram ée of EAI Corp., Abingdon, Md., invented. They call the method DART, for direct analysis in real time. DART, which is currently being coupled with JEOL's AccuTOF time -of-flight mass spectrometer, debuted at the Pittsburgh Conference in Orlando, Fla., last week. Members of the press had gotten a sneak peek at the technology in early February at JEOL's headquarters.

DART can analyze liquids and gases. Solvents with a high vapor pressure can be detected from across the room just by opening the bottle. DART's real strength, however, is in analyzing surfaces without sample preparation. All of these analyses take place at atmospheric pressure, so no vacuum is required.

Cody expects that the method will be especially useful in defense and homeland security applications. H. Dupont Durst, a research chemist at the Edgewood Chemical Biological Center at the U.S. Army's Aberdeen Proving Ground, in Maryland, has been using DART in his laboratory for a year and a half under a nondisclosure agreement. Using DART, Durst has been able to analyze samples such as a bird feather spiked with the nerve agent VX. Current methods for analyzing VX, which has a low vapor pressure, require sampling times of four to eight hours. DART does the comparable analysis in three to five seconds.

DART works by applying an electrical potential to a gas such as nitrogen or helium to form a plasma of excited-state atoms and molecules that then interact with the sample and the atmosphere. Different ionization mechanisms are possible, and operating conditions can be manipulated to favor one over the others.

For example, proton transfer is the dominant mechanism of positive ionization. This type of ionization occurs when metastable helium atoms react with water in the atmosphere to produce ionized water clusters that can protonate the sample molecule, forming positively charged ions.

Under different conditions, electrons can be formed if the carrier gas can form metastable species with high enough internal energy. For example, helium reacts with atmospheric water to form negative-ion clusters of oxygen and water that in turn react with analytes to form negatively

charged ions.

In the negative-ionization mode, nitrate and nitrite ions are not produced because, in DART, plasma formation from the carrier gas is isolated from the air. Those ions can interfere with the detection of nitrogen-based explosives and reduce the sensitivity of anion detection.

Cody described the technique publicly for the first time in late January at the 17th Sanibel Conference on Mass Spectrometry. John D. (Jack) Henion, a mass spectrometrist who serves as chairman, president, and chief executive officer of Advion BioSciences, Ithaca, N.Y., saw that presentation.

"IT APPEARED incredibly simple and easy to use and provided easily interpretable data," Henion tells C&EN. "Unanswered questions include whether it will ionize larger molecules like peptides and proteins, and can it be used for LC/MS applications? However, for the kinds of applications Cody described, it appears like a simple and exciting new ionization technique worthy of commercialization and exploration and new applications."

JEOL is so excited about the prospects for DART that it created a spin-off company in October 2004 called IonSense to explore the possibility of partnerships with manufacturers of other detection technologies. Because the mandate of JEOL's U.S. office doesn't include product development, IonSense will carry out any further development of DART.

The DART intellectual property has been licensed to IonSense, but for now DART will be sold exclusively to JEOL for interfacing with AccuTOF, says Michael Kersker, vice president and transmission electron microscopy and scanning probe microscopy product manager at JEOL. IonSense will commercialize the technology for a variety of applications, not just mass spectrometry.

For now, IonSense is a virtual company housed at JEOL's U.S. headquarters. Members of the DART team include Cody; Kersker; and J. Douglas Meinhart, analytical instruments director at JEOL. At this point, none of them is leaving his current position.

Chemical & Engineering News
ISSN 0009-2347

Home | Latest News | Current Issue | ChemJobs

Pubs Page / chemistry.org / ChemPort / CAS