



PATENT



TECHNOLOGY SUMMARY

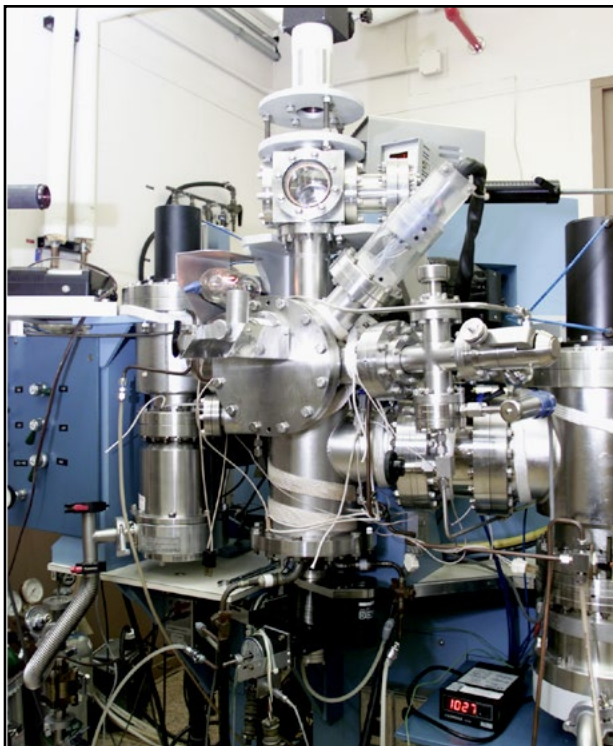
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AFRL Patent Collaboration Leads to Improved Instrument Calibration

Though chemical warfare is internationally condemned in the form of the Geneva Protocol of 1925 and the Chemical Weapons Convention (CWC) of 1993, that hasn't completely erased the danger of their potential use against the American warfighter.

According to the Arms Control Association, Russia, a signee of the CWC, claimed in 2017 to have destroyed its cache of chemical weapons. However, they used an advanced chemical agent to kill a suspected spy and his daughter the following year. North Korea, who did not sign the CWC agreement, is largely believed to possess more than 5,000 metric tons of chemical weapons, including mustard, phosgene, and nerve agents. In addition, any terrorist organization, domestic or otherwise, could use chemical agents in any given attack.



A mass spectrometer located at John H. Glenn Research Center at Lewis Field. (photo courtesy NASA)

TECHNOLOGY

PATENT NUMBERS:

US 11,456,163 B1

US 11,515,133 B2

TECHNOLOGY NAME:

Method of Improving an Analytical Instrument and Improved Analytical Instruments

Method of Improving a Mass Spectrometer, Module for Improving a Mass Spectrometer and an Improved Mass Spectrometer

INVENTORS:

Mitchell H. Rubenstein

Benjamin A. Clapp

TECHNICAL PROJECT OFFICE:

AFRL 711 Human Performance Wing

PATENT DATE:

September 2022

November 2022

SOURCE:

US Patent and Trademark Office

www.uspto.gov

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While there are detection methods available, a recent set of patents from an Air Force Research Laboratories (AFRL) collaboration could be a vast improvement in the accuracy of detection. Mitchell Rubenstein, Ph.D., of the 711th Human Performance Wing (HPW) Airman Systems Directorate (RH) and Benjamin Clapp of the United States School of Aerospace Medicine (USAFSAM) have been awarded two patents derived from their study of gas chromatography-mass spectrometry instruments, which are used to detect chemical warfare agents (CWA) in the vapor. In fact, Rubenstein has already earned two patents and co-authored numerous published studies related to the subject.

“After implementation of US Patents 11,099,165 (August 2021), Focusing agents for improving the accuracy and precision of gas chromatography-mass spectrometry field instruments, and 11,215,596 (January 2022), Focusing agents and methods of using same, it was apparent that the low-level values had a lack of precision,” Rubenstein said.

His two most recent patents, in collaboration with Clapp, 11,456,163 (September 2022), Method of improving an analytical instrument and improved analytical instruments, and 11,515,133 (November 2022) Method for Improving a Mass Spectrometer and an Improved Mass Spectrometer, both deal in quantifying low concentrations of highly toxic substances in vapor samples.

“I began working on Focusing Agents in 2017 and the current patent(s) (were) submitted two years ago. The bulk of the mathematics was developed by Mr. Clapp and proofed by my data interpretation,” Rubenstein explained.

The first of these patents is a calibration correction module for instruments to report the most accurate results using a formula modifying the relative squared error. A relative squared error is what the result would have been if a predictor had been used. The predictor is decided by the average of actual values.

“Here we realize that there is a large error when quantifying small amounts of toxic substances.

Primarily because commonly used least squares emphasize the greater values on a curve. This patent indexed the least squares so that the low points are more properly quantified. This results in a significant improvement of the analytical instrument in question that leads to more precise and accurate results.” Rubenstein said.

The second patent – Focusing agents and methods of doing the same -- deals with applying that correction module to improve mass spectrometers – instruments used for separating isotopes, molecules, and molecular fragments according to mass.

Rubenstein believes these two developments shall provide a significant benefit to the Air Force and beyond.

“The patent(s) will allow precision at lower-level concentrations and directly aid in low-level detection of nerve agents to protect the warfighter. This has numerous applications for laboratories conducting analyses in industry, academia, and other government agencies,” he said.

Rubenstein says persistence is how he and Clapp got to the point where they could celebrate two patents and just as many goals reached.

“Of course, one must meet the needs of the mission, but it is exciting to pursue innovation to push science forward.”

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