

## Corporate Backgrounder

Day by day it becomes more important to identify – precisely and quickly – the chemicals in the world we live in. It is crucial in protecting life, resources and processes in our increasingly complex society and necessary to make decisions that require actionable information that is acted upon in the field at real time – Protection by Detection™.

Soldiers on the line of battle and those protecting the country from terrorist attacks need to sense the first indication of a threat in the air. Doctors are gaining greater and greater ability to diagnose and treat diseases that they can identify by subtle chemical “biomarkers” in human breath. Manufacturers, processors and refineries need to detect minute changes in the composition of their products as they flow from the plants.

To meet these needs, Sionex Corporation ([www.sionex.com](http://www.sionex.com)) is commercializing a miniature trace chemical sensor, and related subsystems, for applications that protect life, processes, and resources. Its customers – major domestic and overseas original equipment manufacturers (OEMs) – design Sionex products and technology into the products they sell in markets such as threat detection (the military and homeland security), medical diagnostics, process control and monitoring.

A common theme across these industries is the desire to move the detection and quantification of chemical compounds from centralized labs out into the field at the point of sampling and decision. Building on breakthrough science from the Charles Stark Draper Laboratory at MIT, Sionex delivers sensor systems that are small enough and light enough to serve at the front lines of the military, business and industry, yet are able to provide quick, precise readings. The result is information that can be acted upon essentially in real time at the point of decision.

Two Sionex customers have already transitioned from design stage to revenue stage, a third is in final Government testing, six are in design stage, and approximately a dozen are in evaluation for specific applications.

Founded in 2001 with technology licensed from Draper Laboratories in Cambridge, MA, the privately held company has grown to 24 full-time employees at their 20,000 square foot office in Bedford, MA. The company has a very strong position in intellectual property and has been granted more than 30 patents, both domestic and overseas, covering the core technology, structure, function, and applications.

### The microDMx™ Sensor

Sionex’s small, microDMx™ sensor is based upon differential mobility spectroscopy, often referred to as either DMS or FAIMS. In typical applications, it detects trace levels of chemicals in concentrations of parts per billion to parts per trillion. That is roughly the

equivalent of a grain of salt in a swimming pool, yet the sensor itself is a mere 42 mm by 16 mm by 3mm.

The sensor meets a common theme that cuts across a number of industries: to move detection (identification and quantification) of chemical compounds from centralized labs to the point of detection. A single sensor can identify a wide range of compounds (field selectable) at very low concentrations with a high degree of specificity and sensitivity to minimize false alarms. Since the technology is driven by software and firmware, an instrument or monitor incorporating the technology can be easily updated in the field with new algorithms to detect new or newly important chemicals.

## Technology

As the compounds are sampled, they are ionized by an ionization source. The ions are transported by a gas flow (usually air) through the microDMx™ sensor, which consists of two parallel plates about 0.5mm apart. An asymmetric oscillating radio frequency (Rf) field is applied perpendicular to their motion, which causes the ions to move in a “zigzag” motion as the field is applied. Ions of different chemicals follow different, uniquely characteristic paths, which allows them to be identified.

Ions that hit the plates are neutralized and are not detected by the faraday detectors at the end of the filtration region. Those ions whose net movement allows them to pass through the filter are subsequently detected.

In order to make the microDMx™ sensor tunable, or to detect ions of interest, a perpendicular DC tuning field, known as the compensation voltage, is also applied. This DC field is superimposed on the oscillating asymmetrical field and keeps the ions of interest in the center of the plates, and, thus, detectable. The compensation voltage can be adjusted to allow only specific ions to pass through the sensor to the detectors. Consequently, the microDMx™ sensor operates as a programmable chemical filter which can select individual ions (filter mode) or can scan a range of ions (spectrometer mode).

## Products

Sionex offers three types of products:

- Sensor products in which microDMX technology is used to detect target compounds.
- Products that use microDMX technology as a pre-filter to a discrete detection technology such as mass spectrometry and ion mobility spectroscopy, increasing the sensitivity and accuracy of the paired technology.
- Software-only products that support the microDMX technology sensor and pre-filter platforms.

The microDMx sensor has several features that make it an excellent sensor.

- It is quantitative and has extremely sensitive detection limits, in the parts-per-trillion range;

- It is highly selective since each chemical or group of chemicals has a unique signature in the microDMx spectra due to different chemicals having their own unique differential ion mobility;
- Additionally, the microDMx can simultaneously detect chemical ions in both the positive and negative ion ranges thereby improving its selectivity.

## *Sensor Products*

### ***The microAnalyzer™***

The new Sionex microAnalyzer was developed to deliver sensor capability with rapid analysis in a small form factor, all in a form that enables OEMs to easily integrate it into specific applications. The microAnalyzer combines a gas chromatograph column with its microDMx technology. Sensitivity depends on the application, but the microAnalyzer has been shown to detect chemicals in the sub-parts-per-trillion (ppt) range.

With the addition of the gas chromatographic (GC) separation module, the microDMx™ detector can operate in extremely complex chemical environments where the background matrix may contain many potential interferents or moisture. The GC module adds another dimension of chemical discrimination to the detection data, thereby enabling the identification of the target compounds with extreme confidence and reliability.

The Sionex microAnalyzer has a GC separation module as the heart of the system, while the brain of the system is the microDMx detection technology. Incorporating these two independent but complementary technologies enables the system to take advantage of the benefits of each. This results in a fast, highly selective and highly sensitive platform.

Current customers have begun evaluating the use of the microAnalyzer in a variety of applications in four primary markets:

- Threat Detection
- Process Control
- Monitoring
- Medical Diagnostics

### ***The Sionex Value Added Component SVAC™***

The SVAC is a sub-system utilizing Sionex's DMS technology that allows for easy integration by our customers. The SVAC contains the detector and electronic boards as well as sample pumps, flow controllers and operational software. The SVAC is also a platform that can be used as a standalone evaluation product and as a detector for GC front-ends.

The SVAC has been incorporated by Varian Corporation in its CP4900 DMD MicroGC

for monitoring petroleum industry processes to detect one or more chemicals. ThermoFisher has incorporated the SVAC in its EGIS™ Defender system, designed to detect narcotics and explosives in transportation or other homeland security applications.

### ***Sensor and board kit***

The Sionex sensor and board kit is designed to be integrated by customers who possess a high level of engineering, design and computer engineering resources. Companies that have experience with ion mobility technologies and a strong data-processing capability will find the kit has all the necessary hardware and basic firmware to integrate the technology into a product design.

The sensor and kit have been adopted by General Dynamics in the Juno™ a hand-held battery operated Chemical Warfare Agent (CWA) detector developed under the auspices of the JCAD II Increment program.

### ***Pre-Filter Products***

#### ***DMS/IMS<sup>2</sup>***

Differential Mobility Spectroscopy (DMS) and Ion Mobility Spectroscopy (IMS) offer the greatest sensitivity at the fastest time over any other detection technology used today in applications that require fast actionable information.

DMS and IMS are complementary technologies. IMS measures the time it takes a certain chemical ion to move through a DC uniform low electric field. Whereas IMS measures velocity in a given electric field, DMS measures the change of velocity, or mobility, in both a low and a high electric field.

The Sionex DMS/IMS<sup>2</sup> detector enables identifying and confirming compounds in the presence of interferences or complex matrices in seconds. The dual DMS/IMS<sup>2</sup> detector provides data that is two-dimensional, yields greater sensitivity, and results in fewer false positives in contrast to the standalone IMS or DMS detectors.

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### ***Mass Spectrometry pre-filter***

DMS as a pre-filter to MS provides several advantages to current MS detectors. The instrument sensitivity of the MS is increased because the DMS pre-filter or ion filtration reduces chemical noise. In other words, only the desirable ions are permitted to the MS.

Another advantage is that DMS pre-filters ions based on ion shape. This allows for greater information of the targeted chemical species. Further, the use of DMS pre-filtering in a MS allows for the use of gas phase modifiers or dopants.

A major mass spectrometer company has licensed on an exclusive basis the DMS technology Sionex for use with laboratory mass spectrometers. Sionex has retained the right to use DMS as a pre-filter with “portable mass spectrometers” and Homeland Security and Defense applications that are field based

## Software Products

Sionex offers customized software development services to assist OEM customers in integrating its products into end-user systems and developing the systems themselves. As part of that support Sionex has developed two advanced software products.

**Expert™** The Expert software is designed as a tool to facilitate and support application development, production, diagnostics/troubleshooting, and data capture. It is used as a user interface to SVAC technology platform devices.

**Total Ion Flow modeling software** The Total Ion Flow software is designed as a tool to facilitate and support ionization optimization projects, radioactive and non-radioactive, by modeling ion flow to establish ion transmission efficiency and formation of discrete, positive, negative and neutral ion fragments generated. The software are allows Sionex to optimize current detector design for optimal detection performance.

## Markets

Sionex is pursuing a component business model, selling its sensor directly to OEMs with leadership positions in major markets. Originally, the company focused on original design manufacturing of components and sub system components. Over the past few years, Sionex has expanded its product line from just a base level components (sensor and electronics) to sub-systems and now OEM ready systems that provide a more complete solution to facilitate adoption by new prospects.

Sionex calls this next level “OEM-Ready Solutions.” The company has customers and active programs under development in four major markets: threat detection/defense, industrial, monitoring, and medical diagnostics. With the launch of a typical product, Sionex will have annual revenue from that customer of \$500,000 to \$2 million (although some Government programs, like the General Dynamics product, will have much higher revenue when in production).

### Threat Detection/Defense:

#### *Completed Products*

- ThermoFisher: Egis Defender™, an explosive detector for airport security

- General Dynamics: JUNOTM , a hand held, portable chemical warfare agent detector currently in test for the US DOD JCAD II program

#### *In Design*

- Smiths Detection: a handheld chemical warfare agent detector currently in development for the UK MOD HiFAWS program
- Hamilton Sundstrand: in Phase 3 of an HSARPA program to design a detector to protect high-risk buildings from chemical attack.
- Three organizations are working on products that are either a non-contact explosive/chemical detector or an area monitor for toxic chemicals

#### *In Evaluation:*

- Two organizations are in the final stages of evaluation of the technology

#### Industrial:

##### *Completed Products*

- Varian: launch the CP4900 Gas Chromatograph incorporating our technology as the Detector

#### *In Design*

- a company is in the design stage of a product to monitor hydrogen sulfide in natural gas

#### *In Evaluation*

- Five organizations are in final stages of evaluation of the technology for applications that include monitoring hydrogen sulfide & mercaptans in natural gas, a detector for process control oriented gas chromatographs

#### Monitoring:

#### *In Design*

- NASA: will place a system with our technology on the space shuttle in the fall of 2008 to monitor trace levels of volatile organic compounds

#### *In Evaluation*

- Several companies interested in measuring BTEX for health & safety requirements in refining and chemical plants.
- Companies interested in air plane cabin and enclosed area monitoring.

### Medical Diagnostics:

#### *In Evaluation:*

This is the latest major market to start to take interest in the Sionex sensor. Many of the applications involve the detection of chemicals – biomarkers – on breath as a diagnosis of the state of the patient.

- Draper Laboratories: detecting tuberculosis through either markers on breath or in- vitro
- Columbia University: in a program funded by NIH, detecting metabolites in sweat that are indicative of the level of radiation exposure to facilitate triage of a population subjected to a dirty bomb
- A major health care company is developing a product to test for the level of propofol in a patient's blood through levels in breath while undergoing surgery.

## **Management**

The company is committed to ultra trace detection applications that fit the tagline “protection by detection.” To assist partners the company has extensive applications and engineering resources committed to solving a partner's need with various OEM level solutions and now customer-specific OEM-ready solutions. The company is guided by a management team skilled in many different facets of the OEM, threat detection/defense, industrial, monitoring and medical diagnostics industries.

### **D. Westervelt Davis**, President and Chief Executive Officer

Wes joined Sionex in 2004 with 25 years of experience leading high technology companies, both public and privately held. Prior to Sionex, Wes was the CEO of Radiant Images, an early stage company with advanced microdisplay technology, where he successfully negotiated financing as well as a strategic partnership with the leader in the company's target market. While at MicroTouch, a leader in touchscreens, and Lasertron, the leader in lasers for the telecommunications market, Wes initiated the sale of both companies generating \$275 million in shareholder value. Earlier in his career, he was with Autographix and General Scanning and was a partner with the strategy consulting firm, Braxton Associates. Wes holds a BSE in Engineering from Princeton University and an MBA from Harvard.

### **Basil Pallone**, Chief Financial Officer and Vice President of Operations

Basil has 20 years of financial management and operating experience in public, private and venture-backed companies. He brings a successful track record of raising capital, effecting mergers and acquisitions, and providing financial leadership to emerging growth companies. Before joining Sionex, Basil served as Vice President and Chief Financial Officer of Essential.com and EnergyVision, LLC, two rapid-growth, start-up companies. Prior to that, he was Executive Vice President of EUA Cogenex Corporation where he was responsible for finance and operations. He also held financial management, planning and business development positions with several public companies. Basil earned a BA in Economics from Boston College and an MBA in Finance from Babson College.

**Kenneth Markoski**, Vice President of Engineering and Product Development  
Ken has more than 20 years' experience in product design and development, multi-disciplined engineering management, and cross-functional program management in the automation, robotics, inspection, and semiconductor capital equipment industries. He brings a successful track record of developing revenue generating, innovative, industry-leading products. Prior to leading the Sionex product development effort, Ken was Sr. Director of Programs at KLA-Tencor, Corp., and Sr. Director of Business Systems Development and New Product Development with PRI Automation. He also held lead engineering design and development, and project management positions with PRI Automation and Black and Decker Dynapert Division. Ken holds a BS in Mechanical Engineering from Worcester Polytechnic Institute and an MBA from Boston University.

**Erkinjon Nazarov**, Chief Technology Officer

Erkinjon is a pioneer in differential mobility spectrometry technology and was involved in the development of differential mobility spectrometers at Uzbek Academy of Sciences in the former Soviet Union and at New Mexico State University where he was an Associate Professor in Chemical & Biological Sciences. He has extensive experience in the design, fabrication and evaluation of differential mobility spectrometry-based sensors. Erkinjon has authored over 100 publications including technical papers, articles and a number of patents. He holds a Ph.D. from Ioffe Physical Technical Institute Polytechnic University in Leningrad and a Doctor of Physical and Mathematical Sciences from St. Petersburg Polytechnic University in Russia.

**Eric Kirleis**, Vice President of Sales & Marketing

Eric has more than 15 years experience in analytical instrumentation sales, marketing and service in both process control and regulatory applications. Before joining Sionex, Eric was responsible for the North American sales and marketing at Mettler-Toledo Ingold. Prior to that, he held the position of Director of Sales and Services at Thermo Electron, Environmental Instruments Division. Previous positions focused on account management, segment market share and service revenue growth. He also held at Thermo, product management and field sales positions. Eric holds a B.S. in International Business and Economics from the State University of New York – Plattsburgh , an ALM. from Harvard University and an MBA from Cornell University.

## Intellectual Property

The company has built a very strong patent portfolio to protect its core technology and its competitive position, and to build value for the company. The implementation of this strategy has been and is being executed in a number of phases.

- The exclusive worldwide license to the DMS technology and patent applications developed at Draper was negotiated in 2001. This license covers the core structure of the microDMx Chip and is composed of three patents that Draper initially filed and which have been issued by the U.S. Patent Office.

- Sionex took over filing and prosecution of three additional patents, which have subsequently issued, that were in various stages of disclosure and filing at Draper Laboratory.
- Sionex has subsequently filed an additional 23 utility applications, one of which has been issued. These new filings cover important functional and application areas and are designed to strengthen Sionex's position vis a vis potential competitors. Sionex expects that these applications will mature into issued patents to further expand its IP position. Sionex has also filed or plans to file for foreign patent protection in at least a dozen of its key cases to expand the protection worldwide.
- Sionex's aggressive IP plan is designed to protect its competitive advantages and to prevent others from practicing the microDMx technology. In the next few years, Sionex expects additional patent opportunities. The company has developed agreements with partner companies that protect its IP positions and enhance its field of applications.

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September 2008