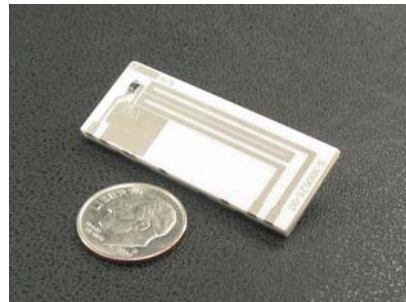


### Technology Backgrounder

Sionex's microDMX™ technology was developed at Draper Laboratory with an initial focus on applications in chemical and biological sensing. In 2001, Sionex Corporation was founded and was granted exclusive commercialization rights to this technology. Sionex now has commercial customers with products in the market, thereby validating the technology. The microDMx sensor has several features that make it an excellent sensor for a very wide range of chemicals:

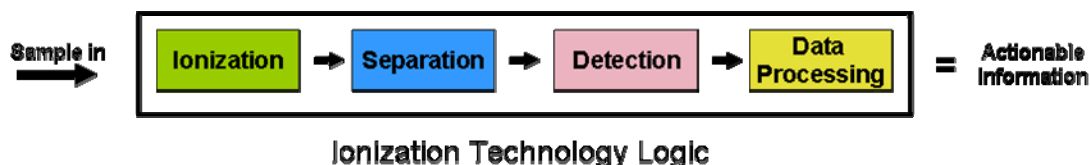


- It is quantitative and has extremely sensitive detection limits, in the parts-per-trillion range;
- It is highly selective, since each chemical or group of chemicals has a unique signature in the microDMx spectra, due to different chemicals having their own unique differential ion mobility;
- The microDMx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

#### Ionization Technology

microDMx technology relies upon ionization chemistry to detect the presence of a given chemical species. Ionization is the process of converting an atom or molecule into an ion by adding or removing a charged particle, such as an electron. An atom's ions can contain positive and/or negative ions and each chemical species has a set of discrete ions.

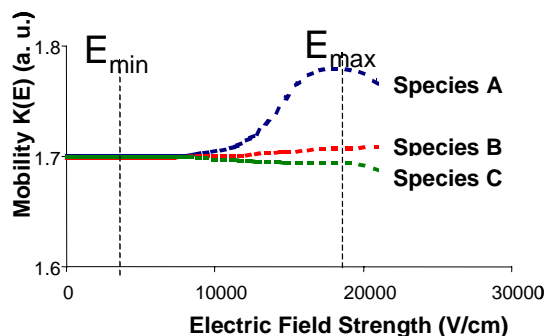
The atoms can be ionized by either a radioactive source (generally, <sup>63</sup>Ni) or non-radioactive source (UV, plasma or Carbon Nanotube). Once the sample is ionized the objective is then to separate one ion species from another. After separation has occurred, the sensor detects and quantifies one species from another and outputs the appropriate data.



## Selectivity: Identifying a Chemical Species by its Discrete Set of Ions

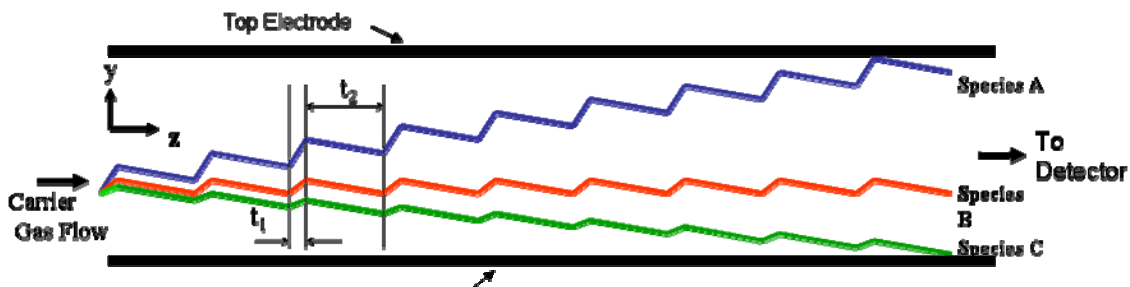
Differential Mobility Spectroscopy (DMS) or microDMx is based upon early research conducted by Sionex's founder Raanan Miller, Sionex's Chief Scientist Erkinjon Nazarov, and Professor Gary Eiceman of New Mexico State University. They found that, when ionized, each chemical presents a unique signature, based on ion mobility – how the ion moves through an electric field. This unique characteristic of behavior in a high electric field by ions is today referred to as the “alpha parameter.”

As illustrated in the adjacent diagram for chemicals A, B, and C, the alpha parameter refers to the discrete mobility of a given compound's ion(s) at a given high electric field strength. Miller, Nazarov and Eicemen were able to conclusively prove how a compound could be identified against a library of data on the ion mobility of a given compound at a plurality of peak electric fields (Rf voltages). This is what makes microDMx so selective.

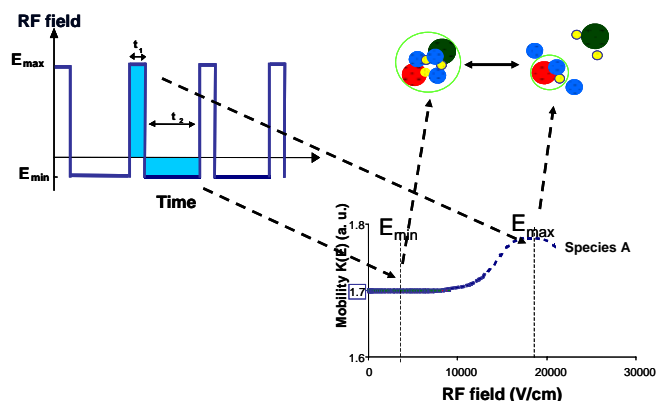


## microDMx Technology In Operation

microDMx is a technology that identifies and detects chemicals based upon a chemical species' ion mobility in a low and high electric field. Samples are ionized then flowed continuously via a carrier gas (typically 300cc/min) such as air, into the filtering area, parallel plates that are .5mm apart in the center of the Sionex sensor.

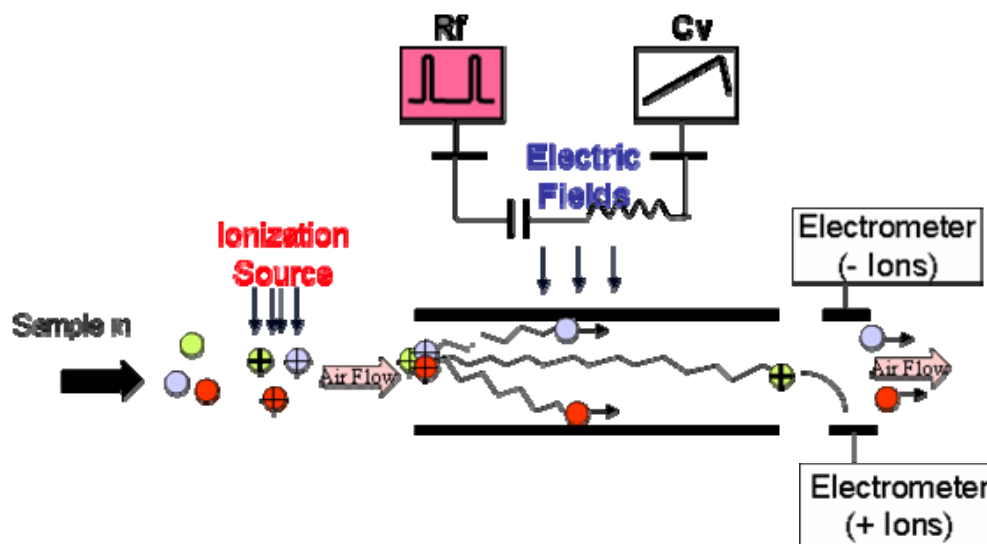


Once in the filtering area, the ions experience a uniform oscillating asymmetric radio frequency electric field – “Rf” - (typically 1 MHz and ranging from 500 to 1500 volts). The Rf causes a perpendicular motion of the ions causing the ions to move with a “zigzag”, up/down motion as the rapidly oscillating field is applied. If the ions contact either the top or bottom plate, they are “neutralized” or they, lose their charge. Ions that make it through the filtering region without being neutralized are detected at the end of the sensor by two faraday detectors, one for negative ions and the other for positive ions. The sensor is extremely fast, as the ions typically move through the filtering area in a few milliseconds.



In order to make the microDMx sensor detect a specific chemical or “analyte” of interest, a second, DC electric field, known as the compensation voltage (“Vc”), is applied. This field is superimposed on the oscillating asymmetrical Rf field and keeps the ions of interest centered between the parallel plates, and thus not neutralized, and therefore detectable simultaneously by the faraday detectors. The two electric field conditions necessary to enable a particular ion to pass through the filter to the detectors are specific to each ion species.

Below is a schematic of the microDMx sensor. Only the compounds ions of interest make it through the filter to the detectors as the non-selected ions hit one of the plates and are neutralized. Since the microDMx technology is bi-polar, both positive and negative ions are detected simultaneously.



**Principal of Differential Mobility Spectroscopy – DMS**

**Sionex microDMx™ Detector**

**Key Benefits of microDMx**

Key attributes of the microDMx technology include:

- Increased sensitivity, one to two orders of magnitude superior to current devices, since 100% of the ions go through the sensor
- Reduction of false positives by superior specificity over current devices
- Small, chip-size detector module, enabling hand-held systems
- Field-upgradeable software to enable detection of an expanding base of chemicals
- Generates a richer data set of information than existing chemical detectors, making it easier to unequivocally identify chemical compounds and reduce the impact of interferences.
- Less costly, the microDMx is microfabricated using manufacturing methods suitable for are mass production

### **microDMx: Both a Detector and a Filter**

The microDMx device can be used in several modes. In the first mode, it functions as a sensor capable of detecting at very low trace levels. One of the advantages of its use as a sensor is that it can be coupled with a number of different “front ends” to enhance even more its sensitivity and selectivity.

- Membrane
- Pre-concentrator
- Gas Chromatography
- Pre-concentrator/Gas Chromatography
- Pyrolysis
- Pyrolysis/Gas Chromatography

The second mode is operating the microDMx as an ion filter. In this case, the faraday detectors are removed so that the the microDMx pre-filters targeted chemical species to allow only those specific ions of interest to pass through for detection in a subsequent device. The benefit of this approach is that many commercially available detectors are enhanced by pre-filtering with microDMx prior to entry into these alternative detectors. Examples are:

- microDMx/IMS<sup>2</sup> – microDMx filters targeted ions to eliminate chemical species of no interest and then allows only the ions of interest to enter into two Ion Mobility Spectrometers to enable simultaneous bipolar ion detection from a common ionization source.
- microDMx/Mass Spectrometer – microDMx filters only targeted ions so that the Mass Spectrometer’s signal-to-noise ratio is enhanced due to ion filtering or eliminating unwanted ions.

## **ABOUT SIONEX CORPORATION**

Sionex Corporation provides breakthrough chemical and biological sensor chips and subsystems based on its proprietary microDMx detection technology. Sionex maintains its worldwide headquarters and laboratories in Bedford, Massachusetts. The Company is privately held and was founded in 2001 with patented technology exclusively licensed from the Charles Stark Draper Laboratory. Additional information about Sionex Corporation is available at [www.sionex.com](http://www.sionex.com).

# # # #

For further Sionex information contact: Mark Metzger  
Metzger Communications  
+1-781-648-2564  
[mmetzger@metzgerco.com](mailto:mmetzger@metzgerco.com)

September 2008