ABSTRACT

In many industrial applications mass spectrometry (MS) has not been used because of its high cost or perceived complexity. Traditionally, MS has been coupled with other techniques (e.g., gas chromatography) to provide two-dimensional analysis of complex sample streams, but MS is not often used in simpler applications because of its initial and operational expense. We believe that it is possible to provide MS solutions in these areas by reducing the size and complexity of the MS to deliver a package with an attractive price-to-performance ratio. We have accomplished this using an ExB sector field geometry pioneered by Gentry, Giese, and Diaz.[1] We present data from a variety of applications including plasma rocket diagnostics, landfill monitoring, and helium leak detection. Our present sensitivity is 10 microamps/Torr at m/z = 4. We discuss advantages and limitations of our system with regard to a number of parameters including performance, cost, internet and wireless connectivity, and portability.

DISCUSSION

Our mass sensors are based on a compact double-focusing mass spectrometer pioneered at the University of Minnesota (CDMFS).[1] The design employs superimposed electric and magnetic fields to achieve both direction and energy focusing. This allows the devices to be compact without sacrificing resolving power.

A SIMION model of a 50 amu sensor is shown in Figure 1. The unit consists of three parts: source, analyzer, and detector. An electron impact source generates the ions, crossed E and B fields separate the ions, and an electron multiplier detects the ions.

SIMION and FEA modeling are used to focus on viable designs for miniaturizing the sensor and getting adequate performance in a package that can be mass produced. Our LabView-based software provides full interactive control of the sensor and supports full scan, selected ion monitoring, and leak test modes. It provides powerful plotting and analysis tools and direct export of data into Excel format files. The sensor controller can also operate in full standalone mode, providing continuous monitoring, data processing via downloaded calculation scripts, and extended data logging to nonvolatile memory. Our CyberSpec™ concept is to have a distributed network of mass sensors that are accessible through the Internet. Thus, users can retrieve the data from a network of sensors any time, anywhere as long as they have a device which can access the Internet. This should allow desktop or PDA-monitoring of real-time harsh environment data (e.g., around a volcano, along a pipeline) that is being collected anywhere in the world. This network may be either a wired LAN or a wireless implementation.

At present we have made two sensors, a 50 amu unit (R8, Figure 3) and a 150amu unit (R20, Figure 4). When produced in low quantities, we are able to sell them for ~$6000. Table 1 lists some of their properties. The sensors have been tested in a variety of beta sites in both industrial and laboratory settings.[2-5]

REFERENCES