The Other Mass Spectrometry

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Ion Mobility Spectrometry (IMS) is seen at many conferences in past years but people tend not to be familiar with all of its capabilities. I have titled this contribution the other mass spectrometry since I like many of you am extremely familiar with GC/MS, LC/MS, MALDI, TOF and a variety of other mass spectrometry techniques but not IMS. IMS responds to a variety of organic compounds with pg. to ng. levels of sensitivity. The applications of IMS have been focused primarily in the area of law enforcement with one of the largest applications and one that many readers might have seen in operation is in airports since IMS is used in many airports for explosive detection. It requires no large piece of equipment like other types of spectroscopy since there is a handheld instrument that can be seen in Figure 1.

Figure 1

Portable IMS

The instrumentation is used by airport security personnel who obviously would have only minimal training and no experience in IMS hence it has to be trouble and error free operate in a variety of environments with rapid analysis time. The technique has also been used successfully in the detection of chemical warfare agents. Finally, it has been used for identification of drugs and drug residues. Before I get much further, it is worthwhile to provide thumbnail sketch of the IMS and its operation.

In IMS samples after being vaporized are ionized using either a positive or negative soft ionization and travel down a drift tube where their mobility is measured having similarities to Time of Flight (TOF). This mobility is obviously influenced not only by the ion size but also its shape and this information can provide some information of the identity of the molecule. What results is not the classical spectrum many trained in classical mass spectrometry might be used to seeing but a fingerprint. Some molecules are easier to ionize than others are and developing this information is important to the appropriate use of IMS.

I believed that there are excellent potentially untapped applications in diverse market segments and to add some support to this premise, the DOE Idaho National Engineering and Environmental Laboratory (INEEL) has committed 1.7 million to establish a Center for Ion Mobility Spectrometry (IMS Center). The center plans to develop an affiliation with the Center for Process Analytical Chemistry (CPAC) at the University of Washington. For those unfamiliar with CPAC, it is s a consortium of national laboratories and industrial sponsors who focus their efforts on problems emphasizing process analytical chemistry concerns. In my opinion, their focus is to bring the laboratory to plant or site.

In addition to the application base that has been previously mentioned, there are now activities by instrument vendors to broaden this base primarily with the emphasis in the pharmaceutical arena. Since many of the initial uses have been in the identification of drugs, this would seem to be a logical extension with one of the uses being the monitoring of line cleaning in cGMP environments. While Figure 1 provides an illustration of a handheld instrument there also are laboratory-based instruments that also take up very little laboratory “real estate”. Three additional application areas for IMS could be food manufacturing operations and related industries for ingredient and product quality, environmental and clinical analysis. The rapid determination of pesticides and herbicides in soil, water and commodities would be an excellent fit since these compounds occur at low levels and the specificity and sensitivity of IMS would seem an excellent fit. These applications are not without problems related to sample integrity and homogeneity since some sample types will be more amenable to IMS than others. For example, soil and other environmental samples could present some challenges. Applying IMS to clinical samples would offer just in time (JIT) analysis and could adds another dimension to point of care testing (POCT).

The future for IMS is extremely bright since the application base in currently limited. The developments in miniaturization will likely further bring down the size of the instrumentation as will advances in the use of chemometrics since we will likely see the inclusion of neural networks and other techniques in the instrumentation and potentially the development of application specific instrumentation based on market requirements and demands.

About The Author

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