
State-of-the-Industry: Innovation and Dynamic Change Characterize the MS Marketplace

As mass spectrometry comes into widespread usage, technology providers continue to refine the technique to improve analytical performance and appeal to a broader base of users.

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During the past decade, mass spectrometry (MS) has been in an exponential mode of change, primarily due to the development of the techniques of electrospray ionization (ESI) and matrix-assisted laser desorption ionization (MALDI). These and other MS techniques are finding uses in areas that traditionally have not been associated with MS, such as imaging for determination of drug distribution in tissue and liquid chromatography (LC) coupled with inductively coupled plasma (ICP) MS for the speciation of elements, to say nothing of the continuing growth in biotechnology. These new uses, along with developments in micro-processor technology, have spawned new and better ways of separating ions according to their mass-to-charge ratios (m/z). These improved separation techniques have led to the development of new types of mass spectrometers.

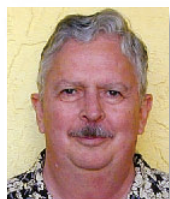
A Year of Progress

In the past year, several advancements in instrumentation have allowed for improved detection limits and ease of use, including the linear quadrupole ion traps from Applied Biosystems/MDS Sciex (Foster City, CA) and Thermo Electron (Waltham, MA); improved electrospray interfaces from several manufacturers; new ways to do MALDI from Thermo Electron and others (vMALDI and API-MALDI); enhancements to the 3D quadrupole ion-trap LC-MS-MS instruments from Bruker Daltonics (Billerica, MA) and Agilent Technologies (Wilmington, DE); new electrospray time-of-flight instruments from JEOL (Peabody, MA), LECO (St. Joseph, MO), and Agilent; and new gas chromatography-

MS-MS instruments (triple quadrupoles) from Varian (Walnut Creek, CA) and Waters (Milford, MA).

There also have been advances in software. John Wiley and Sons (Hoboken, NJ) has announced a series of boutique electron ionization mass spectral databases. At PittCon 2004, Palisade Corporation (Newfield, NY) announced a database that contains the Wiley7 database, the NIST02 database, and an additional 150,000 spectra that previously have not been included in any electron ionization database — the Palisade Complete database contains 600,000 spectra. Interest continues to grow in portable GC-MS analyzers for environmental purposes, hazardous material situations, and homeland security. MS is moving away from the privy of the focused mass spectrometrist and into the hands of those looking for answer machines, and manufacturers are addressing the desires of these new users with software that is intuitive and easy to use. Instrumentation software also is now addressing requirements of government agencies such as the U.S. Food and Drug Administration's (FDA) 21 CFR Part 11 requirements. At PittCon 2004, Agilent Technologies announced a 21 CFR Part 11-compliant version of the GC-MS MSD ChemStation.

Just as Sun Microsystems and Microsoft ended their long-standing technology cold war, companies in the MS field are joining together to share technology to each other's benefit without causing competitive challenges. Agilent Technologies and Bruker Daltonics are now several years into their joint venture with a 3D quadrupole ion-trap LC-MS-MS system, with both companies providing significant technology. Agilent Technologies also is in an agreement with Applied Biosystems for the use of the company's *Analyst* data analysis software for Agilent's new 1100 LC-MSD TOF system (an electrospray time-of-flight instrument with an analog-to-digital converter rather than a time-to-digital converter to address the linear dynamic range issue of TOF mass spectrometers). This system was introduced at the 2003 American Society for Mass Spectrometry (ASMS) meeting in Montreal, Canada. Applied Biosystems is using Agilent's patented or-



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thional spray design on the interface of its API 4000 LC–MS–MS system and 4000 Q Trap™ LC–MS–MS system (an axial ion-ejection linear quadrupole ion trap as the third stage of a triple-quadrupole instrument).

Changing Venues for Product Introductions

One obvious paradigm shift is the trend toward introducing new instruments and technology at the ASMS annual meetings rather than at the Pittsburgh Conference. Thermo Electron did introduce its tandem linear quadrupole ion trap

ASMS Meeting. Varian announced its 4000 QIT GC–MS–MS instrument at PittCon 2004, but I think more significant new products are going to appear at the 2004 ASMS Meeting in Nashville, Tennessee.

One fact that points to the viability of MS as both a technique and an industry is the announcement by Thermo Electron that on March 23, 2004, the company shipped the 100th LTQ system to a customer. This is almost 10 months to the day since the product was announced. Other companies such as Shimadzu (Columbia, MD) and

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and 7 Tesla Fourier-transform ion cyclotron resonance (FT-ICR) instrument (called the Finnigan LTQ FT-MS) at PittCon 2003 and its vMALDI interface for the Finnigan LTQ and LTQ FT-MS systems at PittCon 2004; however, the company chose the 2003 ASMS meeting to announce its standalone linear quadrupole ion trap (the Finnigan LTQ, a radial ejection linear quadrupole ion trap with ion detection in both directions) as did Waters to announce its new Micromass T-Wave technology for ion injection and an enhanced collision-cell performance. Applied Biosystems announced its 4000 Q Trap LC–MS–MS system at the 2003

Shimadzu Kratos also report continued good response to their GC–MS, LC–MS, and MALDI instruments. There were two American Chemical Society and eight Pittsburgh Conference courses on different topics in MS at PittCon 2004 and three courses at the Spring National ACS meeting in Anaheim 10 days later. All of these courses had double-digit attendance.

Clearly, mass spectrometry has grown in interest, use, and capability in the past year and is poised to see continued growth for years to come. ■