World Leader in MALDI-QIT-TOF MS Technology

Matrix Assisted Laser Desorption/Ionization (MALDI) technology achieves high efficiency ionization by mixing the sample to be analyzed with a laser energy-absorbing chemical compound known as a matrix, and then irradiating this mixture with a pulse laser. As is well known, the MALDI technique was originally developed in the 1980s by Shimadzu Central Research Lab. in Japan, and was later refined by developments mostly in Europe and the U.S.A. When MALDI ion sources are incorporated into time-of-flight (ToF) mass spectrometers they provide a range of outstanding performance features, such as high speed and high sensitivity (1fmol), high accuracy (10ppm error), high resolution (m/dm>10,000), and wide mass range (m>10kDa). As a result, MALDI-TOF mass spectrometers have been widely used for analysis of biochemical samples (e.g., peptides/proteins, oligosaccharides, oligonucleotides, lipids) and chemical compounds (e.g., synthetic polymers). Kratos, which became a subsidiary of Shimadzu in 1989, released a series of MALDI-TOF MS systems under the name KOMPACT in 1992, from which it earned world-wide acclaim as a leader in this field, both industrially and academically.

Quadrupole ion trap (QIT) mass analyzers, on the other hand, work by trapping an ionized sample within an RF electromagnetic field generated by specially constructed electrodes. The ions can then be resolved within the electrodes over many levels (according to their charge-mass ratios). These kinds of analyzers are often used for the analysis of structures containing unknown (de novo) substances.

MALDI-QIT-TOF MS refers to spectrometry systems that combine the MALDI-TOF and QIT techniques described above. Many of the world's leading researchers believed it was impractical to consolidate the features of both kinds of analyzers. Kratos, however, accomplished this feat in its AXIMA-QIT series, which was developed on the basis of research initiated by Shimadzu Research Laboratory (Europe) based in UK.

Expected to become the leading technology for proteome analysis

The MALDI-QIT-TOF MS technology is anticipated to be used in a vast range of applications. For instance, it is expected to serve as a primary technology for the analysis of proteome, a key substance in the post-genome era. With the advent of "tailor-made" medical treatment, doctors can start to take into account the unique genetic characteristics of individual patients when providing treatment. In addition, by taking advantage of increasing knowledge about proteome, a greater insight into the symptoms of patients will enable more accurate medical treatment.

Kratos offers total solutions

In the area of mass spectrometers, Kratos extended its product lineup in 2000 by adding the highly cost-effective AXIMA-LNR and the AXIMA-CFR, a high-throughput analyzer for identifying already-known substances, to the conventional COMPACT series. This year, Kratos is further expanding its product range with the release of the AXIMA-QIT, consolidating its position as an manufacturer of mass spectrometers that provides a wide range of products from general-purpose instruments to the most advanced equipment featuring cutting-edge technologies. In parallel to MS instruments, Kratos also produces surface analyzers, utilizing the company's internationally renowned vacuum technology.

Shimadzu KRATOS MALDI-QIT-TOF MS

As a member of the Shimadzu group, Kratos is now set for further growth, collaborating closely with the recently created Shimadzu Biotech (a "virtual company" established by Shimadzu and Shimadzu overseas affiliats). Through mutual exchanges of technology and human resources with Shimadzu Biotec, and through strategic alliances with companies such as Proteome Systems Ltd. and Sigma Corp., Kratos will further grow to provide customers with superior products and complete analytical solutions.

Koichi Tanaka, Assistant Manager, Life Science Business Unit, Analytical & Measuring Instruments Division, Shimadzu Corporation

LC/MS Used Increasingly for High-reliability Detection

Shimadzu's latest LC/MS system – LCMS-2010

LC/MS instruments are used for analyzing a wide variety of chemical substances

LC/MS combines high-performance liquid chromatograph (HPLC) and mass spectrometer. In the past, it was difficult to successfully combine HPLC and MS functions, due to the fact that HPLC works with liquids, while MS relies on the ionization of the chemical compounds to be measured. The difficulty of making an LC/MS was once likened to "a marriage between a fish (in water) and bird (in the sky)."

The key to successfully combining an HPLC and MS into an on-line system was the advancement and development of a kind of ionization method known generically as Atmospheric Pressure Ionization (API). In the API method, the targeted chemical compounds are removed from the mobile-phase (liquid) in the HPLC in the form of ions, and then introduced into the MS. Typical API methods include Electrospray Ionization (ESI) and Atmospheric Pressure Chemical Ionization (APCI). In the ESI method, ionization is achieved by the application of high voltage charges. This method is suitable for the ionization of highly polar chemical substances and high-mass biomolecules, such as proteins. The APCI method utilizes ion/molecule reactions, similar to the chemical ionization method used in GC/MS, thus making it better suited than ESI for the ionization of low-polarity chemical compounds. Options of API techniques, including ESI and APCI, allow for successful detection of a wide range of chemical compounds. As a result, LC/MS systems are being used in an increasingly diverse range of applications.

LC/MS in drug discovery: to achieve high throughput and productivity

The first LC/MS that utilized the API method was the so-called LC/MS/MS which featured the triple-quadrupole mass spectrometer. This technology commanded a great deal of attention after it was applied to pharmacokinetics. Later, LC/MS featuring single-quadrupole mass spectrometers appeared on the market to determine molecular weights as detectors in HPLC systems. More recently, technological advances have resulted in single-quadrupole LC/MS which offers high-level sensitivity, excellent quantitative analysis performance (repeatability, linearity, dynamic range, etc.), and simple operation (as easy as HPLC) at affordable cost. In view of its rapid adoption LC/MS is now being described as the third-generation detection technology for HPLC systems, following UV and photo diode array (PDA) detectors.

LC/MS detection is being employed in a broad range of applications. Examples include determination of impurities, confirmation of molecular weights of synthetic chemical compounds, process optimization of organic synthesis by monitoring target compounds, and quantitative analyses of trace compounds. LC/MS operates on the basis of molecular weights information, a unique identifying characteristic of chemical compounds. Unlike UV and PDA systems, it therefore can be used for detection, qualitative analysis, and quantitative analysis without complete separation of chemical substances. Its excellent reliability and high-speed (qualitative and quantitative) capabilities make it well suited for the demands of many contemporary applications, where high throughput and high productivity are crucial.

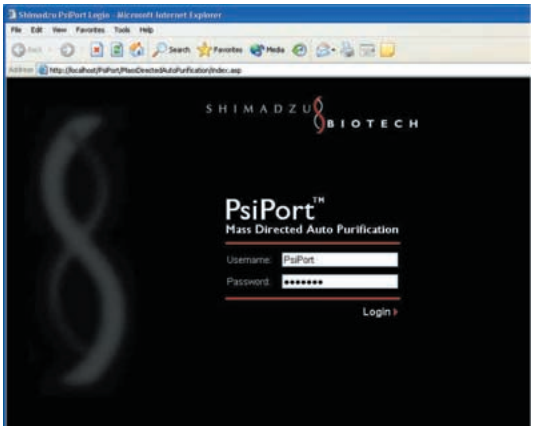
An example of an application where LC/MS systems offer enhanced analytical productivity

is automatic purification in which large numbers of chemical substances synthesized by combinatorial chemistry are purified with mass directed preparative LC/MS systems. An example of a quantitative application, for which LC/MS systems are increasingly used, is "early ADEM", which studies ADEM characteristics (absorption, distribution, exclusion and metabolism) at the stage of drug discovery.

LCMS-2010 offers superior sensitivity, operability and ruggedness

In 1997, Shimadzu released the LCMS-QP8000, which was based on the basic concept of a "high-performance detector for HPLC systems." Since then, Shimadzu has continuously worked to further enhance the performance and operability of LCMS in order to make it the best detector for HPLC systems. This effort bore fruit in 2000, when Shimadzu released the LCMS-2010 – its third-generation LC/MS. The LCMS-2010 provides superior sensitivity due to its unique Q-Array technology (patent pending), as well as greater robustness, thanks to its orthogonal "angle spray" interface. Shimadzu also launched ISS (Innovative Software Systems) in U.K., a software development group devoted to developing application software that meet customer needs. ISS is currently engaged in joint development work with the software development group based at Shimadzu's head office. The first product created by the group, a web-based application called PsiPort MDAP (Mass Directed Auto Purification), is due to be released soon.

Shimadzu's strong HPLC R&D group also contributes greatly to the strength of the company's LC/MS systems. Over the last few years, the performance of MS systems has been significantly improved. Further gains in productivity and performance require higher degrees of integration with the HPLC system and pre-treatment systems (before introducing samples to the HPLC). Shimadzu's commitment to continued cooperation with the HPLC R&D group, and to further development of hardware and software of its LC/MS products, assures HPLC users of greater ease-of-use and higher productivity.



New web-based application software "PsiPort"

Junko Iida, Product Manager, Mass Spectrometers, MS & GC Business Unit, Analytical & Measuring Instruments Division, Shimadzu Corporation

New Era of Shimadzu GC/MS in Environmental Analysis

The excellent sensitivity, reliability, and expandability of the GCMS-QP2010

Our environment contains a huge number of chemical compounds. Although these chemicals help in various ways to make our lives more convenient, many of them can also be very harmful. In some cases, chemicals that were once thought to be considerably useful were later found to be extremely dangerous. One example is polychlorinated biphenyls (PCBs), which were widely used in a number of products, including transformer oils. The inherent danger of PCBs was eventually recognized, which led to the prohibition of their production and use. Dioxins are another example of harmful chemical compounds. The generation of dioxins, which

are a by-product of various industrial processes, has become a serious problem. They were first synthesized in the manufacturing of agricultural chemicals; more recently, however, dioxins generated by waste incinerators have become a serious public health issue. A third, more familiar example of chemicals now deemed threatening to our health is tap water; the chlorination of drinking water generates trihalomethanes. Many such hazardous chemicals are now controlled by environmental laws, which regulate the levels and concentrations of these substances to be accurately measured and controlled. Since the majority of these are organic compounds, gas chromatograph/mass spectrometers (GC/MS) are necessary tools to measure them.

Last year, Shimadzu released its latest GC/MS, the GCMS-QP2010. This device features high sensitivity, reliability, and expandability, and is now widely used. In addition to high sensitivity, environmental measurements require precise accuracy. The GCMS-QP2010 offers superb performance in both of these areas.

Shimadzu GC/MS in United Nations University environmental project

Because environmental problems cannot generally be isolated within national boundaries, they tend to be global in nature. In light of this fact, in 1997, Shimadzu formed a joint project team with the United Nations University, with the aim of monitoring the environment throughout Southeast Asia. Nine countries are participating in the project: South Korea, China, Vietnam, the Philippines, Singapore, Malaysia, Indonesia, Thailand, and Japan. To facilitate monitoring the levels of several environmental pollutants in this region, the team has provided GC/MS equipment. In the first three years, the team monitored food, water quality, and air. During the period of 1998-2000, the team also measured levels of suspected endocrine disruptors, such as chlorinated agricultural chemicals, alkylphenols, bisphenol A, and phthalate esters. The results of these measurements are posted on the web site of the United Nations University. As the third phase starts from this year, the team will commence monitoring POPs (Persistent Organic Pollutants). The team is currently preparing manuals for the measuring of these chemical substances, as well as providing training sessions on measuring them, and organizing symposiums. This April, the team held a two-day symposium in Hanoi, Vietnam, in which nearly 200 participants engaged in active interactions and discussions. In July, the team will host another symposium at the United Nations University in Japan to review the achievements of the past three years.

Shimadzu's corporate philosophy is "Contributing to the Well-Being of Mankind and the Earth." As the 21st century gets under way, the focus of the company is fixed on such growing areas as environmental solutions, life science and semiconductors & FPD technology. Shimadzu's GC/MS products are playing a major role in environmental measurement and monitoring, and we are confident that its importance will continue to grow in the years ahead.

Shimadzu's latest GC/MS system – GCMS-QP2010

Symposium in Hanoi under United Nations University Project

Takaharu Kitsuwa, Assistant Manager at Tokyo Customer Support Center, Analytical Applications Department, Analytical & Measuring Instruments Division, Shimadzu Corporation

Presenting an Advanced ICP-MS for Environmental Analysis of Metal Pollutants

Shimadzu Inductively Coupled Plasma Mass Spectrometer ICPM-8500

Inductively Coupled Plasma Mass Spectrometers (ICP-MS) are advanced analysis instruments (first commercialized in the 1980s) that are used for the elemental analysis of liquid samples. Before the development of the ICP-MS, Atomic Absorption Spectrometers and ICP Emission Spectrometers were generally used for this kind of analysis. Shimadzu, manufacturing these three types of analyzers, offers the most suitable model for each customer's application.

An ICP-MS works by atomizing the sample solution into a fine mist and introducing this into a plasma of argon gas that has been heated by high-frequency induction to a temperature of approximately 10,000°C. As a result of this intense heating, the elements contained in the solution sample are ionized; they are then analyzed qualitatively and quantitatively with a quadrupole mass spectrometry system, similar to that used in regular GC-MS instruments. The special characteristic of ICP-MS equipment is its ability to perform extremely sensitive analyses on almost any chemical element to ppb or ppt levels, and to allow rapid, simultaneous analysis of multiple elements. Atomic absorption spectrometers can perform very high-sensitivity measurements for certain elements. However, they can analyze only one element at a time. ICP emission spectrometers can handle multiple elements at once, but require preprocessing (e.g., concentration) for ppt-level analysis.

ICP-MS instruments are increasingly used in the field of environmental analysis, as concern over global-scale environmental problems caused by heavy metal pollutants steadily increases. The analysis of environmental water quality for toxic pollutants, like lead, arsenic and cadmium (which are regulated to ppb levels), requires large numbers of samples and very high reliability, which, consequently, makes ICP-MS the most suitable measurement tool. ICP-MS instruments are also widely used in the semiconductor industry, where high-density and highly integrated devices require ppt or ppq levels of control of the quantity of metal impurities contained in raw materials and reagent solutions used in processes.

Shimadzu is a comprehensive manufacturer of a wide range of analytical instruments with a deep concern about the environment. As such, the company has combined its vast expertise in the areas of liquid analysis and GC-MS technology to develop the ICPM-8500, a new analyzer with unique features. This product boasts such major innovations as a mini-torch system, which suppresses the formation of molecular ions that prevent the accurate measurement of target elements and drastically reduces the consumption of argon gas, as well as an ion optical system that greatly improves ion collection efficiency.

Having produced an ICP-MS capable of the highest levels of precision, Shimadzu is now committed to further refining this technology and expanding the range of application for these instruments.

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