



Agilent 8800 Triple Quadrupole ICP-MS

TECHNOLOGY TRANSFORMED. PERFORMANCE REDEFINED.

The Measure of Confidence



Agilent Technologies

8800 TRIPLE QUADRUPOLE ICP-MS

Technology transformed. Performance redefined.

The Agilent 8800 is the world's first ICP Triple Quad (ICP-QQQ) – a truly ground-breaking instrument that transforms the ICP-MS landscape. According to the IUPAC definition (term 538 from the 2013 Recommendations), the term “triple quadrupole” applies to a “*Tandem mass spectrometer comprising two transmission quadrupole mass spectrometers in series, with a (non-selecting) RF-only quadrupole (or other multipole) between them to act as a collision cell.*” In the 8800 ICP-QQQ, the two quadrupoles are separated by the ORS³ cell which, as in the 7900 and 7700 Series quadrupole ICP-MS (ICP-QMS) instruments, uses an octopole ion guide.

The unique tandem MS configuration permits unrivalled control of interferences in reaction mode delivering greater accuracy and more consistent results – particularly in complex sample matrices.

Equally at home in demanding, high throughput laboratories and research facilities, the 8800 excels in applications ranging from life science to semiconductor. And with its unique combination of flexibility, ease of use and unmatched analytical power, the 8800 takes ICP-MS to a whole new level of performance.

The power of MS/MS

- **Unparalleled accuracy** – MS/MS unleashes the full power of reaction cell ICP-MS by eliminating the variability associated with reaction mode on ICP-QMS. In ICP-QQQ, the first quadrupole prevents all off-mass ions from entering the cell, ensuring consistent and controlled interference removal in reaction mode. The result is more accurate and reliable data – regardless of sample type.
- **Incomparable performance** – the 8800 also sets new performance benchmarks in no gas mode and collision mode, with outstanding signal to noise compared to ICP-QMS. And MS/MS operation gives the 8800 the highest abundance sensitivity ever seen in ICP-MS: $<10^{-10}$, further improving data integrity in high matrix samples.
- **Total flexibility** – although it is designed to meet the demands of high throughput routine laboratories, the 8800 also offers complete flexibility in method development and operation, making it a perfect research tool. An array of advanced MS/MS acquisition modes is available, enabling the study of ion-molecule reactions, polyatomic ion formation and much more.



The Agilent 8800 ICP Triple Quad – the new benchmark in ICP-MS



8800 TRIPLE QUADRUPOLE ICP-MS

A history of innovation in ICP-MS

ICP-MS is the technique of choice for multi-elemental determinations across a wide range of applications and industries. Agilent has been at the forefront of innovation in ICP-MS since the early 1990s, with many of the most important developments in technology arising from a relentless drive to improve matrix tolerance and reduce errors caused by spectral interferences. Below are some examples of Agilent's innovation in interference control.

- **Cool plasma** – The 4500 Series revolutionized ICP-MS in the semiconductor industry with the introduction of the ShieldTorch System (STS). STS enabled cool plasma operation to remove plasma-based interferences, for the first time allowing routine, accurate ppt-level analysis of the critical trace elements Na, K, Ca and Fe.
- **Robust plasma** – An advanced solid-state RF generator and optimized, proprietary sample introduction design ensures that all Agilent ICP-MS instruments have a very robust (high temperature) plasma, giving the lowest oxide interferences of any ICP-MS.
- **UHMI** – Agilent's optional ultra high matrix introduction (UHMI) technology further increases plasma robustness, improving matrix tolerance of the 7900 to 25% total dissolved solids – further reducing oxide interferences and effectively eliminating matrix suppression.
- **Collision mode** – Agilent's fourth generation octopole reaction system (ORS⁴) is a unique octopole-based collision/reaction cell that provides unparalleled multi-element interference removal in collision mode using He cell gas. Collision mode has been almost universally adopted by ICP-QMS users who require effective removal of interferences in complex and variable sample types.
- **ICP-QQQ** – Now Agilent has introduced the ultimate solution to removing interferences in ICP-MS; the world's first ICP Triple Quad. The 8800 with MS/MS mode unlocks the full potential of reaction mode, improving accuracy and enabling low level analysis of difficult elements such as S, P and Cl.

Collision mode vs reaction mode in ICP-MS

Collision mode (using He cell gas) is used successfully in ICP-QMS to remove polyatomic interferences in high matrix samples. However He mode completely removed some of the very intense plasma-based interferences that affect elements such as Ca, P and S, so detection limits for these elements may not be low enough to allow accurate trace measurement in high-purity materials. For ultra-trace analysis with ICP-QMS, reaction mode (using a reactive cell gas) can be more efficient than He mode, but often gives erratic results due to unpredictable reaction processes and cell-formed product/cluster ions. The 8800 employs MS/MS to solve these problems, enabling reaction mode to be used to its full potential.

20+ years of ICP-MS leadership



Agilent 4500 Series

The world's first benchtop ICP-MS. Fully computer controlled and with full autotuning. The first ICP-MS with cool plasma, featuring Agilent's breakthrough ShieldTorch System. Nearly 1000 units installed worldwide.



Agilent 7500 Series

The flagship successor to the 4500 Series. Interference removal with the novel ORS cell. The most widely used ICP-MS in history, with almost 3000 units installed worldwide.



Agilent 7700 Series

An extraordinary new benchtop design coupled with unparalleled matrix tolerance and cell performance ensure the 7700 Series continued the success of Agilent's quadrupole ICP-MS family, in the smallest benchtop ICP-MS mainframe ever.



Agilent 7900

The new benchmark in quadrupole ICP-MS, delivering superior matrix tolerance, dynamic range and signal-to-noise, with the flexibility to address both routine and high-end research applications.



Agilent 7800

The new, Solution-Ready 7800 ICP-MS combines proven, robust hardware, auto-optimization tools, and Pre-set Methods to simplify routine analysis without compromising on performance.

REDEFINING PERFORMANCE

The ICP-QQQ advantage

The 8800 ICP-QQQ is a tandem MS. It uses two hyperbolic profile quadrupoles separated by the ORS cell, allowing operation in MS/MS mode. The 8800 can also be operated in conventional ICP-QMS or "Single Quad" mode, covering the same range of applications as Agilent's 7900 ICP-QMS.

In MS/MS mode, Q1 of the 8800 operates as a mass filter, allowing only the target analyte mass to enter the cell and rejecting all other masses. This improves performance in collision mode (using He cell gas) compared to ICP-QMS, but the greatest advantage of MS/MS is the breakthrough performance improvement in reaction mode.

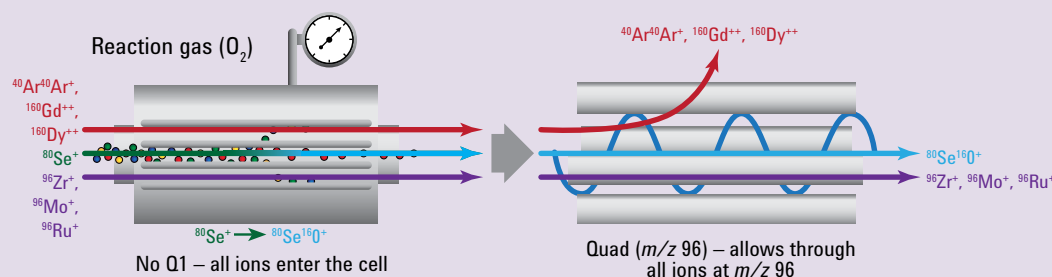
Unlocking the power of reaction mode

For ultra-trace level analysis, reaction mode may provide better interference removal than collision mode. But reaction gases also react with the sample matrix and other analytes to create new, unpredictable interferences. Quadrupole-based reaction cells used in ICP-QMS can reject some non-target ions by operating the ion guide as a low mass cutoff or bandpass filter. However these devices cannot reject all overlapping ions so reaction mode has previously only been successful for simple, known matrices such as semiconductor chemicals.

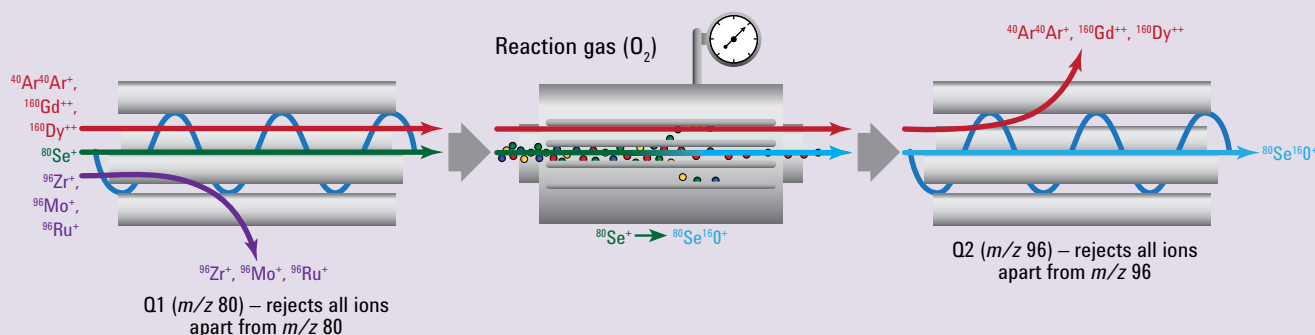
MS/MS allows the power of reaction mode to be employed for all sample types, because Q1 allows only the target analyte mass to pass through to the cell. All other matrix-derived and plasma-based ions are rejected, so the reactions and cell-formed product ions remain consistent with widely different sample matrices, enabling accurate analysis, regardless of sample type, as shown below.

Se measurement in mass-shift reaction mode: conventional ICP-QMS vs. ICP-QQQ

A: Conventional ICP-QMS. Using O_2 reaction gas, Se is reacted away from interferences (Ar_2^+ , Gd^{++} and Dy^{++}) at m/z 80. $^{80}Se^+$ is converted to $^{80}Se^{16}O^+$ in the cell and measured at m/z 96. However, Zr, Mo and Ru all overlap at m/z 96, leading to incorrect Se data



B: ICP-QQQ. Q1 operates as a mass filter allowing only ions at m/z 80 to pass to the cell – all other ions are rejected. $^{80}Se^+$ is converted to $^{80}Se^{16}O^+$ in the cell with O_2 reaction gas. Q2 is set to mass 96 to measure SeO^+ at m/z 96. Zr, Mo and Ru cannot interfere since they were rejected by Q1.



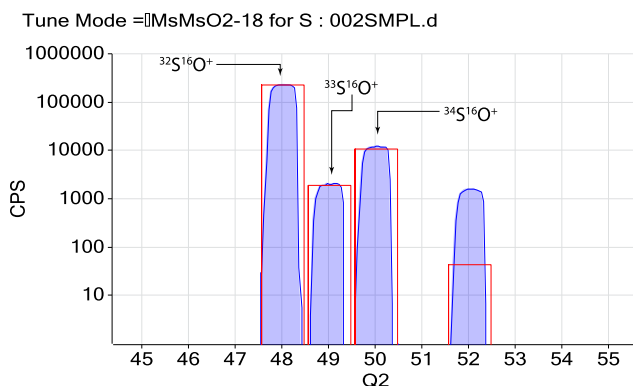
Ultimate flexibility. Total control.

MS/MS operation ensures reliable results in reaction mode whether using on-mass or mass-shift mode:

- On-Mass Mode, where reactive interferences are removed to allow an unreactive analyte to be measured at its original mass.
- Mass-Shift Mode, where the reactive analyte is moved to a new mass free from the original interference (as in the SO^+ example shown below).

The 8800 can also be operated in single-quad mode, with Q1 functioning as an ion guide or bandpass filter. This offers the familiarity of replicating existing ICP-QMS operating modes. In single-quad mode, the 8800 provides higher signal to noise than conventional ICP-QMS, delivering performance improvements even for uninterfered analytes.

Predefined operating conditions and application templates are supplied for both MS/MS and single-quad modes, providing simple turnkey operation for a range of cell modes and applications.



MS/MS mode allows sulfur (measured as SO^+) to be determined at low ppb levels, even in the presence of potential overlaps from $^{48}\text{Ca}^+$, $^{48}\text{Ti}^+$ and $^{36}\text{Ar}^{12}\text{C}^+$.

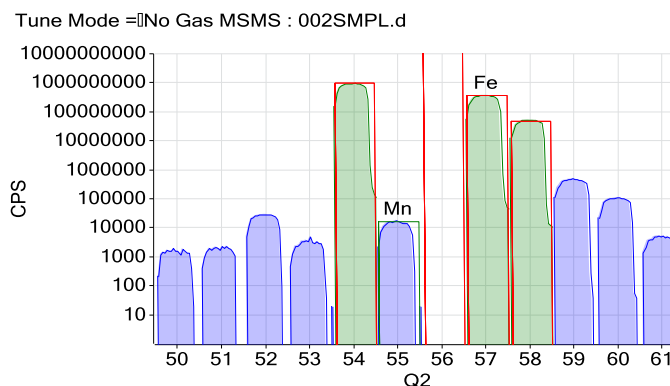
And since Q1 is scanned in concert with Q2, MS/MS also maintains the correct isotopic pattern for the three analytically useful S isotopes (the minor $^{36}\text{S}^{16}\text{O}^+$ product ion is overlapped by $^{36}\text{Ar}^{16}\text{O}^+$ at m/z 52)

Further benefits of MS/MS

MS/MS elevates reaction mode to a level of consistency and reliability comparable to that achieved with He mode on the 7900.

By eliminating coexisting ions that might cause new cell-formed interferences, MS/MS mode on the 8800 ensures that the optimum cell conditions used for a given analyte can be applied successfully across a wide range of sample types. Potential interferences on analyte product ions are also eliminated, as Q1 allows only the analyte ion mass into the cell, rejecting all the existing ions at the product ion mass.

The abundance sensitivity (AS) in MS/MS mode is the product of Q1 AS x Q2 AS, so major element overlaps on adjacent peaks are virtually eliminated and the AS specification becomes almost too good to measure ($<10^{-10}$). This is beneficial for many trace element measurements, such as trace Mn in Fe or whole blood, trace B in organics, and many more.



The unmatched abundance sensitivity of MS/MS allows trace (<1 ppb) Mn to be measured in 1000ppm Fe. The spectrum shows the trace Mn peak at m/z 55 completely separated from the major Fe peaks at m/z 54 and 56 (the over-range ^{56}Fe peak was skipped automatically).

TRANSFORMING TECHNOLOGY

Unique 8800 tandem MS configuration

The configuration and performance of the 8800 ICP-QQQ are unique. The tandem mass spectrometer configuration of the 8800 is based on two research-grade, high-frequency, hyperbolic profile quadrupoles, combined with Agilent's renowned Octapole Reaction System (ORS) collision/reaction cell.

As well as the quadrupole technology and ORS, the 8800 shares many additional hardware components and its software platform with Agilent's field-proven 7900 quadrupole ICP-MS. This ensures that the 8800 also offers class-leading reliability and supportability.

Sample introduction

The low-flow sample introduction system and Peltier cooled spray chamber deliver stable and consistent operation, while fully automated torch alignment ensures consistent daily performance. Utilizing the same sample introduction as the 7900 ensures that sampling peripherals and accessories such as autosamplers, LC and GC systems can easily be coupled to the 8800.

High Matrix Introduction (HMI)

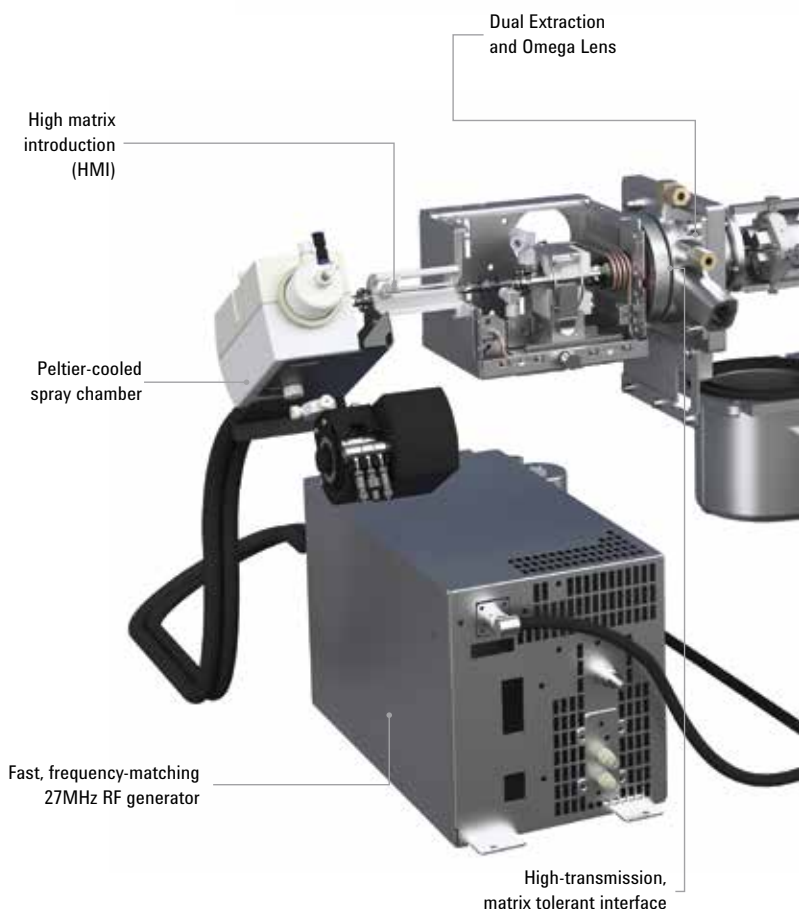
The 8800 benefits from Agilent's proprietary HMI technology, which increases matrix tolerance to allow % level sample matrices to be measured routinely. HMI is standard on the 8800, ensuring that the widest range of samples can be measured reliably, and improving accuracy by virtually eliminating matrix suppression.

Plasma RF generator

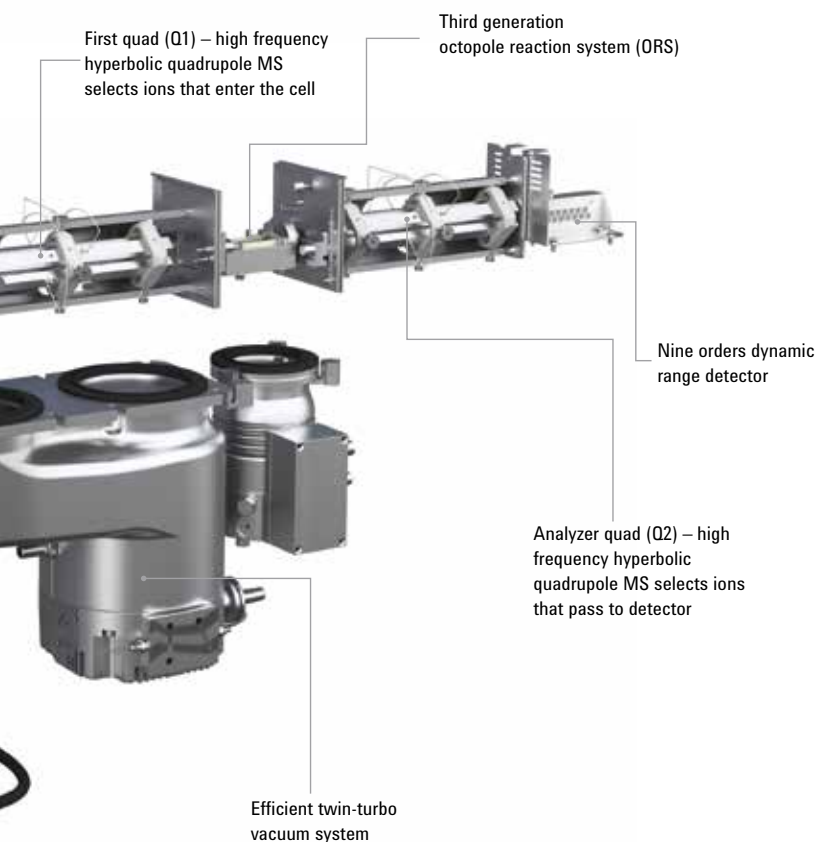
Utilizing the same solid-state 27.12MHz plasma RF generator as the 7900 ensures that the 8800 has the same robust plasma and unmatched matrix tolerance. The fast, frequency-matching RF generator offers the highest power transfer efficiency, and increases the tolerance of changing matrices. Even volatile organic solvents can be introduced without affecting plasma stability. Agilent's ShieldTorch System is included as standard, providing both the narrow ion energy spread required for effective interference removal in He mode, and supporting cool plasma operation.

Interface cones

Standard Ni, or optional Pt tipped sampler and skimmer cones are thread-mounted for easy access during routine maintenance. The interface cone design provides the ideal combination of exceptional matrix tolerance and high sensitivity.



TRANSFORMING TECHNOLOGY



Ion lens

The conical extraction and off-axis Omega lens provide continuous focusing of all ions across the mass range, ensuring high ion transmission and the lowest mass bias of any ICP-MS. The ion lens is located outside the high vacuum region, making it easy to access for routine maintenance.

First quadrupole (Q1)

The first high-frequency hyperbolic quadrupole is positioned in front of the ORS, to control the ions that are passed to the collision/reaction cell and enable MS/MS operation.

Octopole reaction system (ORS)

Temperature-controlled collision/reaction cell with Octopole ion guide and four cell gas lines are fitted as standard, for maximum flexibility in collision and reaction modes. Small internal volume cell ensures rapid cell gas switching and high ion transmission.

Second quadrupole (Q2)

The second high-frequency hyperbolic quadrupole filters the ions that emerge from the cell exit, passing only the target analyte/product ions to the detector. MS/MS operation delivers unmatched peak separation (abundance sensitivity $<10^{-10}$), as the resolution performance is the product of the two mass spectrometers.

Electron multiplier detector

Advanced, dual-mode, discrete dynode electron multiplier (DDEM) provides a full nine orders dynamic range with standard operating conditions. Integration time is short (100 μ s) in both pulse and analog mode, providing rapid sampling frequency for fast-transient signal analysis (such as Cap-LC, GC, single nanoparticles and laser ablation).

Vacuum system

High-performance 4-stage pumping system with one split-flow turbo pump, a second turbo pump and a single external rotary pump, to ensure fast pump-down, high reliability and simple maintenance. The enhanced vacuum performance contributes to the very high sensitivity and low background of the 8800.

SIMPLIFY YOUR DAILY WORKLOAD

Intuitive, configurable MassHunter software

From automated startup checks following plasma ignition, through method, batch and queue setup and sequencing, to integrated data processing and final report generation, the ICP-MS MassHunter Workstation software ensures your Agilent 8800 is always performing at an exceptional level.

- AutoTune and preset methods enable users to quickly produce reliable, consistent results.
- A single hardware control pane (shown below) provides a comprehensive overview of hardware configuration, performance reports, early maintenance feedback, and system diagnostics.
- Batch and queue interface puts all the important method setup and sample analysis at your fingertips.
- The batch pane brings together tune settings, acquisition/data analysis parameters, and sample list, so that all experimental details are accessed through a single convenient interface.
- The queue pane displays current and scheduled tasks, current batch sequence, and real-time status of the current sample.

For compliant environments, the MassHunter software can also be integrated with Agilent OpenLAB Data Store, ECM or SDA.



Data analysis in a single, clear window

The flexible, customizable batch-at-a-glance data table provides a comprehensive overview of the current batch, with user-configurable information including counts, concentrations, RSD and replicate data. It includes:

- Real-time update of results during sequence acquisition.
- Interactive calibration plots display, with current sample result, and real-time update after edits and during sequence acquisition.
- On-screen display and flags for user-selected outliers and QC failures; built-in LabQC sample charting.
- Graphical display of internal standard recovery, QC stability plots, and mass spectrum or chromatogram.
- Easy-to-edit report templates for print, screen or electronic output (including configurable export to LIMS); templates can be used for individual samples or a complete data batch.

Powerful software, consistent across Agilent MS platforms

Agilent's MassHunter software family includes ICP-MS, LC/MS, and GC/MS, simplifying and reducing the cost of cross-training staff. ICP-MS MassHunter data is compatible with Agilent's Mass Profiler Professional, for advanced data evaluation and comprehensive statistical functions.



AGILENT TECHNOLOGIES

PROVEN SPECIATION CAPABILITY

Agilent's 8800 ICP-QQQ links seamlessly with Agilent HPLC, GC and CE systems through field-proven and fully developed application kits. Agilent's new Capillary-LC interface has been developed alongside the 8800, to address emerging LC-ICP-MS applications in the life sciences.

The optional Chromatographic Analysis module for MassHunter supports a range of hyphenated 'speciation' applications with ICP-QQQ. All common current Agilent LC and GC modules are controlled directly from the ICP-MS MassHunter software, with integrated hardware control, method setup and sequencing.

Industry-leading speciation measurement

Environmental, food safety, pharmaceutical and consumer product regulations increasingly include the requirement to identify and quantify compounds (elemental species) as well as total elemental concentrations. Meanwhile, petrochemical applications require ever lower detection limits for a wider range of analytes, and bioanalysis in life science benefits from accurate quantitative analysis of elements such as S, P and Cl, which are difficult for conventional ICP-MS. As the leading supplier of ICP-MS instruments and chromatography systems, Agilent can help you identify the right system for your application, develop methods and train your staff. Agilent support engineers are also factory trained on all parts of the coupled system.



8800 ICP-QQQ with 1200 Series LC system

Pre-configured LC-ICP-MS kits

LC/IC is by far the most common separation technique that is coupled to ICP-MS, and Agilent can offer a range of pre-configured LC-ICP-MS kits for Capillary and nano-flow LC as well as conventional HPLC/IC-ICP-MS. With unmatched sensitivity and interference removal, combined with a proprietary RF generator that delivers industry-leading tolerance to high-salt buffers and organic mobile phases, the 8800 is the ideal solution for advanced LC/IC-ICP-MS applications.

Fully heated GC interface

Agilent's unique GC-ICP-MS interface is heated to the tip of the injector (up to 300° C) for routine analysis of high-boiling point compounds. In addition, the flexible transfer line and torch injector are inert (Sulfinert® lined) providing unparalleled performance for advanced GC-ICP-MS applications, such as the measurement of siloxanes, brominated flame retardants, and sulfur species in fuels.



8800 ICP-QQQ with 7890 GC system

Chromatographic data analysis

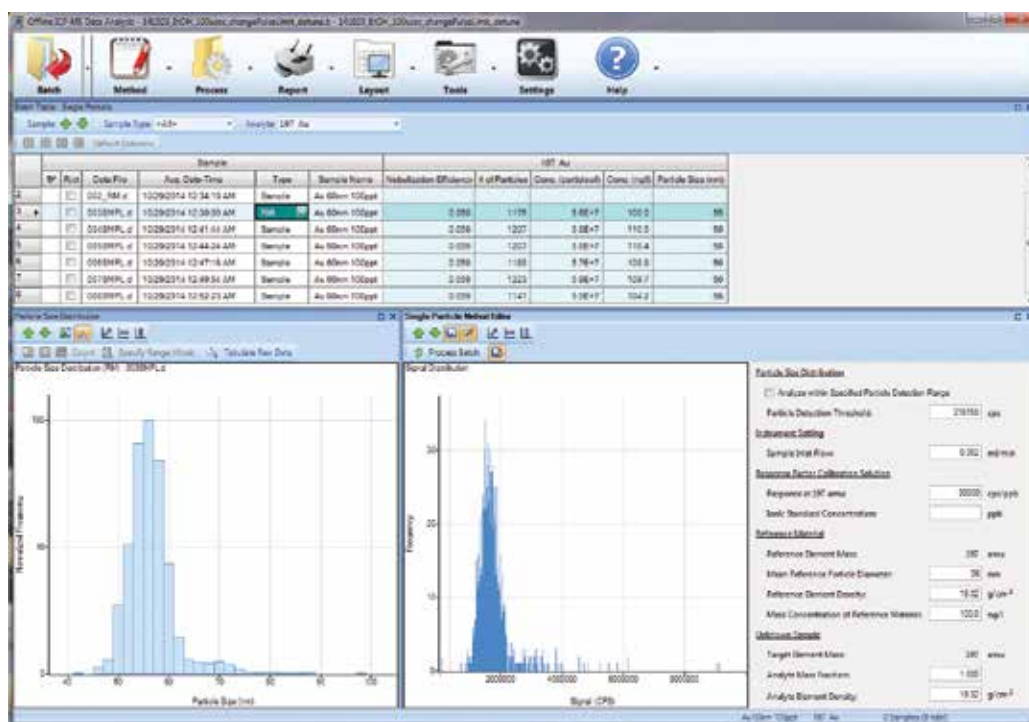
Chromatographic data analysis in ICP-MS MassHunter uses the same interactive batch-at-a-glance data table format as spectrum data, giving a consistent data analysis interface for all application types.

Advanced chromatography functionality includes compound independent calibration (CIC), point-to-point internal standard correction, flexible integration setup, automatic signal to noise calculation, and more.



AGILENT TECHNOLOGIES

SIMPLIFY YOUR NANOPARTICLE ANALYSIS



Final batch results are reported in tabular and graphical formats. Tab through individual samples in the table and review individual graphical results with powerful optimization tools

Powerful MS/MS capable hardware

No conventional quadrupole instrument can reduce interferences simultaneously from polyatomic and isobaric sources as effectively as the 8800 ICP-QQQ. The result is that in many cases, the background of the 8800 ICP-QQQ, even for difficult elements, is essentially zero. The 8800 ICP-QQQ also boasts extremely high sensitivity compared to competitive single quadrupole instruments. This combination of high sensitivity, low background, and superior interference removal enables the determination of much smaller nanoparticles composed of problematic elements including silicon and titanium. Since SiO_2 and TiO_2 are among the most commonly used nanomaterials in consumer products, the capability of the 8800 ICP-QQQ is critical.

Dedicated single nanoparticle application software

Agilent's fully integrated nanoparticle application module incorporates the entire process of nanoparticle determination into ICP-MS MassHunter software. The Method Wizard guides the user through the automated creation of new nanoparticle methods and supports data acquisition in both FFF-ICP-MS and single nanoparticle modes. With a few mouse clicks, a complete analytical method including optimized acquisition parameters, reference material values, and data analysis parameters is set up and ready to run. Reference Material and sample results for an entire batch are summarized in the familiar "Batch at a Glance" table. Detailed graphical results are displayed for selected samples, permitting visual confirmation and optimization of results if needed. Paper or electronic reports including all data and graphics are automatically generated.

PERFORMANCE ENHANCING CAPABILITIES

Extend the power of your 8800 ICP-QQQ

Whether you need to maximize sample throughput, measure organic solvents, analyze solid samples or separate the different chemical forms of an element, Agilent offers a range of options for the 8800 ICP-QQQ — plus the know-how to help you achieve your specific application goals.

SPS 4 Autosampler. A great choice for high-throughput laboratories requiring a fast, high-capacity (up to 768 samples) autosampler. An environmental enclosure, rinse and probe options also make it ideal for ultra-trace applications.

Agilent Integrated Autosampler (I-AS). Integrated, covered autosampler with pumped rinse station; ideal for ultra-trace analysis and small sample volumes (as low as 0.5 mL). Flexible rack configurations offer a maximum capacity of 89 vials, plus 3 rinse vials.

Nebulizer options. Agilent offers nebulizers to suit every sample type and volume, including low-flow, HF-resistant, concentric and parallel path.

Inert Sample Introduction kit. O-ring-free and manufactured from PFA for the lowest contamination levels. Demountable torch with Pt or sapphire injector options. HF resistant, and suitable for high-purity reagents.

LC Speciation kits. Sample introduction kits to facilitate LC coupling and provide turn-key methods for common speciation applications. A new Capillary-LC connection kit is also available.

GC Interface kit. A fully heated inert transfer line and separately heated inert torch injector provide reliable separation of volatile compounds.

Laser ablation. With its fast simultaneous detector and 9 orders dynamic range, the 8800 is ideally suited to the direct analysis of solid samples — both bulk and time-resolved — by laser ablation.

Organics kit. Contains the sample introduction parts you need to run volatile organic solvents. Includes organics torch, solvent-resistant drain kit and uptake tubing.

Robust operation in a streamlined design

The Agilent 8800 ICP-QQQ has been engineered to endure the toughest lab environments, while delivering operational cost savings through higher productivity, shorter training times, simpler method development, and lower service requirements (particularly important in clean-room installations).

High reliability boosts uptime and productivity

Like all Agilent ICP-MS systems, the 8800 ICP-QQQ is built for high performance and flexibility, while also offering high sample capacity and a healthy return on your investment. The 8800 is manufactured at an ISO 9001 and ISO 14001 facility and features:

- Rugged stainless steel chassis and panels.
- Extensive shock, vibration, temperature and humidity testing at the production prototype stage to ensure optimum performance, even under extreme conditions.
- Auto-recover — saves time by safely returning the 8800 from shutdown to standby state when power is restored following a power outage.
- Predictive Maintenance software to minimize unplanned downtime.
- Advanced error reporting and system diagnostic tools that simplify troubleshooting.
- A modular design for shorter repair times.

Agilent has a global network of factory-trained ICP-MS engineers ready to provide support with hardware, software, or applications.

For more information

Learn more

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For customers who require full system validation, Agilent offers complete qualification services for the 8800 ICP-QQQ.

And if ever your Agilent instrument requires service while covered by an Agilent service agreement, we guarantee repair or we will replace your instrument for free. No other manufacturer or service provider offers this level of commitment.

The Agilent Value Promise

10 years of guaranteed performance. In addition to our continually evolving products, Agilent offers the industry's only 10-year value guarantee. Agilent guarantees you at least 10 years of instrument use from your date of purchase, or we will credit you with the residual value of that system toward an upgraded model. It's our way of assuring you of a safe purchase now, and protecting your investment in the long run.

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Agilent MP-AES



Agilent ICP-OES



Agilent ICP-MS



Agilent ICP-QQQ



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