8900
ICP-QQQ
Special Issue

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Agilent Technologies

The New Agilent 8900 ICP-QQQ Provides Improved Performance and Enhanced Flexibility

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Agilent is the worldwide market leader in quadrupole ICP-MS (ICP-QMS), and currently the only supplier of triple quadrupole ICP-MS (ICP-QQQ). ICP-QQQ is a tandem MS configuration, with two quadrupole mass filters separated by an Octopole Reaction System (ORS) collision reaction cell (CRC). The first ICP-QQQ was the Agilent 8800, introduced to great acclaim in June 2012.

Why ICP-QQQ?
In ICP-QQQ, the first mass filter, Q1, is positioned in front of the CRC, allowing control of the ions that enter the cell and interact with the cell gas. In MS/MS mode, both Q1 and Q2 are operated as unit mass filters; Q1 rejects all masses except the target analyte (and any on-mass interferences), so the ions that enter the cell are independent of the sample matrix composition. This means that ion-molecule reaction chemistry is consistent, so results are more reliable and accurate, and detection limits (DLs) are improved for challenging applications.

MS/MS operation with ICP-QQQ is illustrated in Figure 1, using the analysis of selenium as an example.

Unique application performance
The selectivity of reaction chemistry enables ICP-QQQ to achieve some unique performance capabilities. One example is the ability to use a reaction gas to separate direct isobaric overlaps, where isotopes of two different elements occur at the same mass, such as $^{204}Hg/^{204}Pb$. Direct isobaric overlaps like this typically require a mass resolution $(M/\Delta M)$ of several 100,000 to separate them, far beyond the capability of commercial high-resolution sector field ICP-MS, which is limited to a maximum resolution of 10,000.

MS/MS mode also improves abundance sensitivity (AS), reducing the impact of peak tailing. AS is a measure of the contribution that an intense peak makes to the adjacent masses. A typical quadrupole ICP-MS has an AS specification of 10^{-7}, but ICP-QQQ has two quadrupoles, and the AS is the product of Q1 AS x Q2 AS, so theoretically an AS of 10^{-14} could be achieved. Utilizing this superior AS performance, ICP-QQQ has been shown to provide vastly superior peak separation in a range of applications including trace boron in organic solvents, ultra-trace manganese in iron and whole blood, and trace analysis of radio isotopes such as U-236 and I-129.

Three application-specific models
The 8900 ICP-QQQ consists of a single, high-performance mainframe with one standard configuration and two application-specific configurations, to address the wide range of customer requirements from research to routine applications:
- **Agilent 8900 Standard configuration** – provides higher performance than quadrupole ICP-MS for typical applications in food, environmental, nanoparticle characterization, geological and clinical-research laboratories.
- **Agilent 8900 #100 Advanced Applications configuration** – suitable for materials analysis, life science, low level Si and S analysis, and research. This instrument offers higher sensitivity; improved cell performance; low Si and S background; wider dynamic range.
- **Agilent 8900 #200 Semiconductor configuration** – includes inert sample introduction; Pt interface cones; highest sensitivity; lowest DLs and cool plasma capability, providing the highest performance for high purity semiconductor reagents.

ICP-QQQ developments
The new Agilent 8900 ICP-QQQ provides performance and productivity improvements compared to its predecessor. It offers increased matrix tolerance, higher sensitivity, lower backgrounds for S and Si (on the 8900 #100 and #200), and more flexible cell gas options. The 8900 also has a new detector with fast Time Resolved Analysis (TRA) capability for single nanoparticle analysis, and a dynamic range of up to 11 orders of magnitude.

Technology advances address a wider range of applications
The Agilent 8900 ICP-QQQ introduces new hardware and software developments to enhance performance for a wider range of applications:
- Ultra high matrix introduction (UHMI) capability on the 8900 Standard and Advanced Applications configurations. UHMI uses Agilent's proprietary aerosol dilution technique to extend matrix tolerance up to 25% total dissolved solids (TDS), matching the market-leading robustness of Agilent's quadrupole ICP-MS systems.
- A new high-gain electron multiplier detector supports fast TRA acquisition, with minimum dwell times of 0.1 ms to enable single nanoparticle characterization (spICP-MS). The detector dynamic range is extended up to 11 orders for the 8900 Advanced Applications and Semiconductor configurations (10 orders for the 8900 Standard configuration).
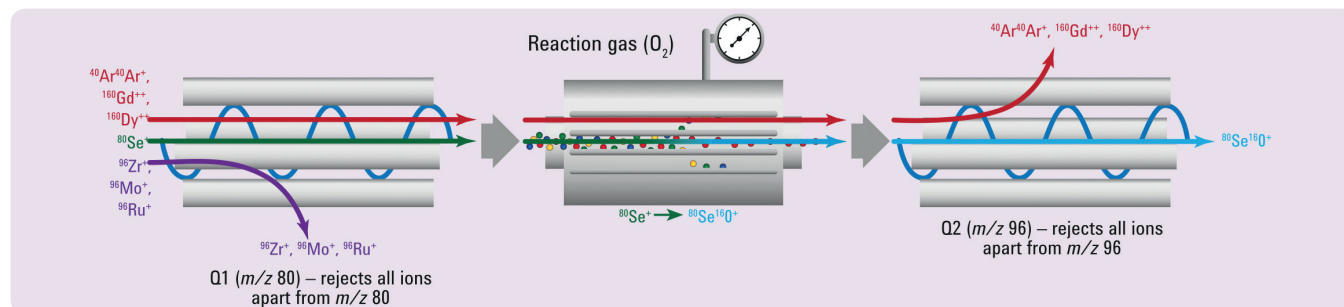

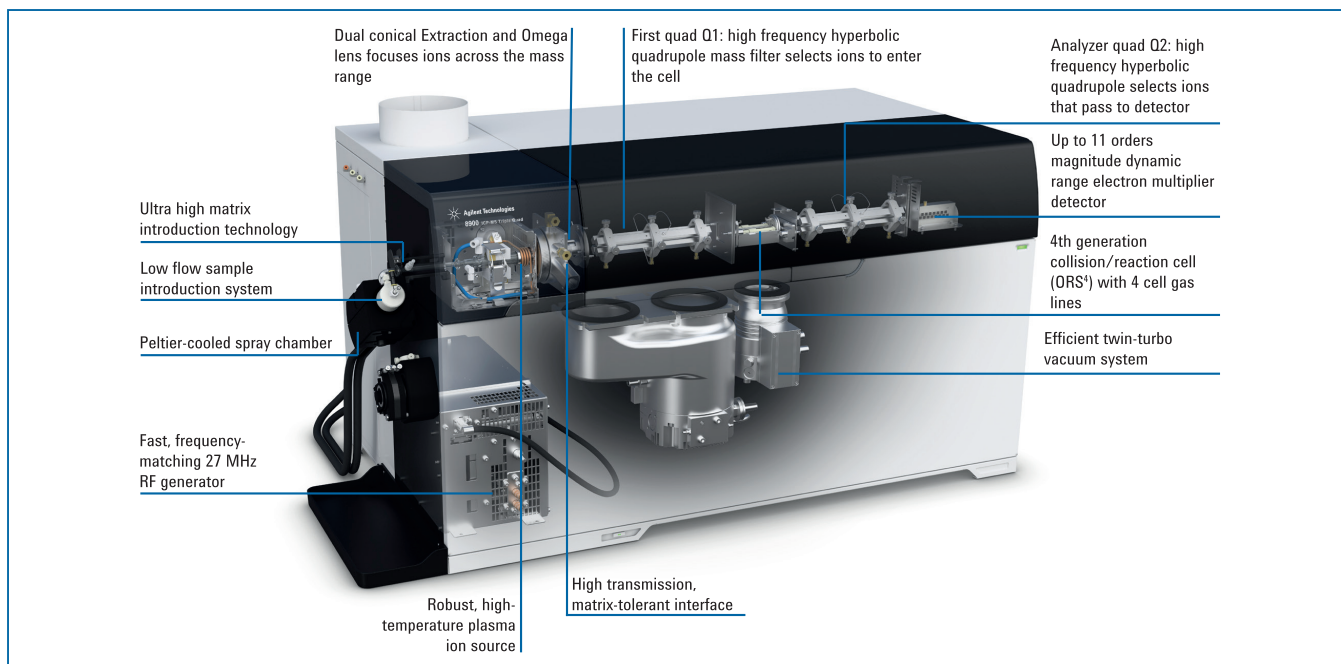**Figure 1.** ICP-QQQ: Q1 allows only ions at m/z 80 to pass to the cell – all other ions are rejected. $^{80}Se^+$ is converted to $^{80}Se^{16}O^+$ in the cell with O_2 reaction gas. Q2 measures SeO^+ at m/z 96. Zr, Mo and Ru cannot interfere since they were rejected by Q1.

Figure 2. Schematic showing key hardware components of the Agilent 8900 ICP-QQQ

Labels in figure:
- Dual conical Extraction and Omega lens focuses ions across the mass range
- First quad Q1: high frequency hyperbolic quadrupole mass filter selects ions to enter the cell
- Analyzer quad Q2: high frequency hyperbolic quadrupole selects ions that pass to detector
- Up to 11 orders magnitude dynamic range electron multiplier detector
- 4th generation collision/reaction cell (ORS⁴) with 4 cell gas lines
- Efficient twin-turbo vacuum system
- Ultra high matrix introduction technology
- Low flow sample introduction system
- Peltier-cooled spray chamber
- Fast, frequency-matching 27 MHz RF generator
- Robust, high-temperature plasma ion source
- High transmission, matrix-tolerant interface

• Agilent's optional ISIS 3 sample introduction accessory is compatible with the 8900 ICP-QQQ, delivering increased productivity for high throughput routine applications.
• The latest ICP-MS MassHunter 4.3 software platform, used for all current quadrupole ICP-MS and ICP-QQQ systems, includes an improved Method Wizard to simplify and accelerate method setup. A wider range of Pre-set Methods is provided, and additional method-specific report templates are included. ICP-MS MassHunter's optional Intelligent Sequencing QA/QC software module now supports ICP-QQQ, as well as quadrupole ICP-MS.

Key features of the Agilent 8900 ICP-QQQ instrument are shown in Figure 2.

Performance characteristics of the Agilent 8900 ICP-QQQ
High sensitivity
Sensitivity and signal-to-noise (S/N) are fundamental performance parameters for ICP-MS. The 8900 ICP-QQQ uses a high transmission interface vacuum design, which has been field-proven on Agilent's 7900 quadrupole ICP-MS. The extraction lens system has also been optimized for sensitivity, so the 8900 ICP-QQQ Advanced Applications and Semiconductor configurations now deliver double the sensitivity of the equivalent 8800 models.

Recognizing the application requirements of different industries, the 8900 Semiconductor configuration uses a new "s-lens", which supports exceptional cool plasma performance. The s-lens also provides higher sensitivity under normal hot plasma conditions than the "x-lens" used on the Standard and Advanced Applications configurations. The x-lens is suitable for general applications which require good sensitivity under the robust, hot plasma conditions used for measuring high matrix samples (typical $CeO^+/Ce^+ \leq 1\%$).

Low sulfur and silicon analysis capability
While quadrupole ICP-MS with helium (He) cell mode achieves sub-ppt level DLs for most commonly-measured elements, trace analysis of certain unusual elements remained challenging for ICP-MS until the introduction of ICP-QQQ. Elements such as Si and S suffer severe spectral interferences from CO^+ & N_2^+ and O_2^+, respectively. ICP-QQQ can utilize MS/MS methods to resolve the spectral interferences efficiently, but the DLs achievable are limited by background contamination.

Si and S are ubiquitous in laboratory consumables, supplies, and many of the materials used in instrument components, leading to a high background. To minimize the contribution from the ICP-MS hardware, key components of the argon gas flow path of the 8900 Advanced Applications and Semiconductor configurations have been replaced using more inert materials. This has successfully reduced the background signal for S and Si, allowing a DL specification of < 50 ppt for S, Si and P to be set; this limit is verified on every 8900 #100 and #200 during factory testing. This DL performance is unprecedented in ICP-MS, and provides a major breakthrough for applications where trace Si and/or S analysis is required, including life science, pharma/biopharma, petrochemical and other applications.

Single nanoparticle analysis
The 8900 ICP-QQQ is arguably the most suitable ICP-MS for the study of nanoparticles (NPs) for two reasons:
• The high sensitivity and ultra-low background means that NPs based on elements such as Ag and Au can be measured at very small particle diameters of 10 nm or less.
• The efficient removal of Si and S elemental backgrounds, combined with the unmatched control of interferences in MS/MS mode enable the 8900 ICP-QQQ to characterize NPs based on more difficult elements such as Si, Ti, Fe and S.

Outlook
ICP-QQQ is already widely used in hundreds of industrial, commercial and research/academic labs worldwide. The performance improvements offered by the 8900 extend the range of applications that can benefit from MS/MS operation.

Building on the Success of the Innovative Agilent 8800 ICP-QQQ

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Quadrupole ICP-MS (ICP-QMS) is an immensely powerful technique, widely used for multi-element analysis of a huge variety of sample types. In the thirty years since the first commercial ICP-MS systems were released, continuous development has addressed most of the early problems, including:

- Relatively poor matrix tolerance
- Spectral interferences due to poly-atomic ion overlaps
- Limited concentration range

Agilent's 7800 and 7900 quadrupole ICP-MS systems use high matrix introduction (HMI/UHMI) technology to tolerate matrix levels up to 25% total dissolved solids (TDS); helium (He) collision/reaction cell (CRC) mode offers a reliable approach to reduce most common polyatomic interferences; and new detector technology supports a dynamic range of up to 11 orders of magnitude. This combination means that trace level analytes and major elements can be measured accurately in most typical samples, on the same instrument, under the same conditions, using a single sample acquisition. Little wonder that ICP-MS is now established as the de facto standard method for "metals" analysis in industry, commercial labs and research institutes worldwide.

Remaining challenges
The evolving requirements of users in these labs mean, however, that some analytical challenges remain. Common to many applications are:

- The requirement for ever-lower detection limits in more complex samples
- The need to remove a wider range of interferences, such as doubly-charged ions and isobaric overlaps
- The wish to extend trace-level analysis to a wider range of elements, including Si, P, S, Cl...

The solution: ICP-QQQ and MS/MS
Launched in June 2012, the Agilent 8800 ICP-QQQ offered a radical new approach to address these emerging application requirements. With a tandem MS configuration, the 8800 offered a completely new way to deal with interferences. Using MS/MS to control the ions that enter the CRC allowed reaction chemistry to be applied reliably to difficult interferences and overlaps. The results were spectacular!

In the 4 years since the Agilent 8800 ICP-QQQ was launched, it has been used to address a wide range of difficult applications in industries from geochemistry to semiconductor; pharmaceuticals to petrochemicals, as well as clinical research, environmental and food analysis. The application range can be seen in the notes and publications referenced in the Agilent 8800 ICP-QQQ Application Handbook [1].

Figure 2. Agilent 8800 Application Handbook, 2nd Edition.

Not only a tool for research
ICP-QQQ advanced ICP-MS performance across the board, with higher sensitivity, lower detection limits, and improved accuracy compared to conventional quadrupole ICP-MS. The ability to use MS/MS mode also introduced some unique measurement capabilities for research and method development, notably:
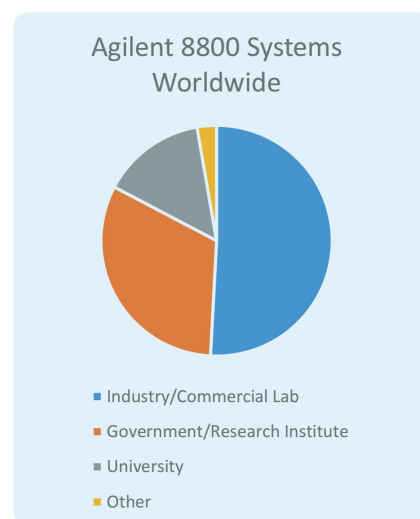
- **Product Ion Scan:** Q1 mass fixed; Q2 scans to measure product ions formed from target mass and cell gas. Used to identify most useful analyte product ions for analysis.

- **Precursor Ion Scan:** Q2 mass fixed; Q1 scanned to sequentially allow precursor ions to enter the cell and react. Used to identify overlaps on a target ion/product ion mass.

- **Neutral Gain Scan:** Q1 and Q2 scanned synchronously, with a fixed mass difference. Used to identify mass transitions, assess reactivity of sample components, and confirm correct isotope abundances.

Figure 1. Agilent 8800 ICP-QQQ

These unique method development tools make ICP-QQQ the ideal choice for advanced research and academic institutes. But in fact more than half of the 8800 instruments shipped to date have been installed in commercial or industrial laboratories. This is a clear indication of the value of the improved performance offered by ICP-QQQ, and seems set to continue with the developments introduced in the new Agilent 8900 ICP-QQQ [2].

Agilent 8800 Systems Worldwide

- Industry/Commercial Lab
- Government/Research Institute
- University
- Other

Figure 3. Industry sector for Agilent 8800 ICP-QQQ users – 2012 to 2016.

References
1. Agilent publication 5991-2802EN
2. Agilent publication 5991-6900EN

Characterization of Nanoparticle Content using Single Particle ICP-QQQ

Michiko Yamanaka, Takayuki Itagaki and Steve Wilbur

Agilent Technologies

Measurement of nanoparticles (NPs) is necessary to assess their impact on environmental systems, food safety and human health. The key factors that allow accurate analysis of small NPs are the sensitivity and background signal of the analytical instrument, and ICP-QQQ excels in both of these characteristics.

The NP content of a sample can be characterized by measuring the signal for each individual NP as it passes through the ICP and is atomized and ionized (single particle (sp) ICP-MS). This is supported on the Agilent 8900 ICP-QQQ, which has a detector capable of fast time resolved analysis (TRA) with dwell times of 0.1 ms. The 8900 ICP-QQQ also provides more effective interference removal than quadrupole ICP-MS (ICP-QMS), extending NP analysis to include particles composed of elements such as Si, Ti, S and Fe, that are difficult to measure using ICP-QMS.

Specialized NP software
The optional Single Nanoparticle Application Module for ICP-MS MassHunter automates method and batch setup for data acquisition and analysis of NPs. In single particle mode, the software automatically identifies the background signal, plots the frequency distribution, and converts the measured signals to particle sizes.

Analysis of SiO₂ NPs
Silica NPs present a particular problem for ICP-MS, as the main isotope of Si is measured at mass 28, which is overlapped by the polyatomic ions N_2 and CO. Furthermore, the elemental background signal for Si is typically high, due to the presence of Si in many common polymers, sealants, cleaning agents and other laboratory reagents.

The Agilent 8900 #100 (Advanced Applications configuration) has a new argon gas flow system that utilizes inert materials to minimize the
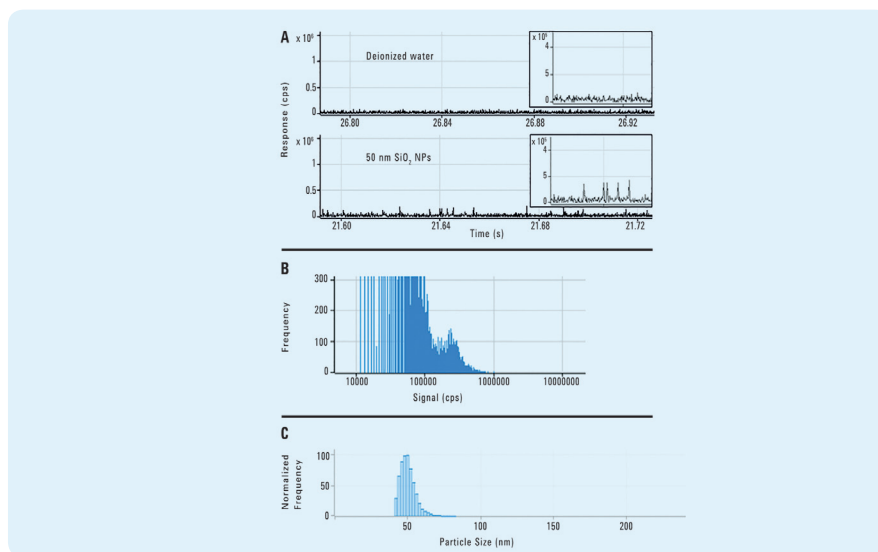

Figure 1. A: Measured signal, B: frequency distribution, and C: particle size for 50 nm SiO_2 nanoparticles (40 ng/L).

signal due to Si (and S) contamination from the ICP-MS hardware. This allows a detection limit specification of < 50 ppt for Si to be achieved. MS/MS mode with H_2 cell gas removes the N_2 and CO interferences, allowing accurate measurement of Si at low levels. This ensures that small particles (50 nm or less) can be distinguished from the background signal, allowing unprecedented accuracy for SiO_2 NP analysis, as illustrated in Figure 1.

The spICP-QQQ method provides fast analysis times, excellent detection limits for particle size and concentration, and accurate results for SiO_2 particles less than 100 nm [1].

Analysis of 10 nm gold NPs
Gold is a relatively easy element to measure by ICP-MS as it is not affected by common spectral interferences. However, the detection of very small particles (<20 nm) remains challenging for spICP-MS, due to the low signal generated from such particles. The 8900 ICP-QQQ has low background (<0.2 cps) and sensitivity up to Gcps/ppm, enabling detection of smaller particles.

Three NIST Au NP reference materials were analyzed: NIST 8011 (nominal diameter of 10 nm; 8.9 ± 0.1 nm determined by Transmission Electron Microscopy (TEM)), NIST 8012 (nominal diameter of 30 nm; 27.6 ± 2.1 nm determined by TEM) and NIST 8013 (nominal diameter of 60 nm; 56.0 ± 0.5 nm determined by TEM). Solutions of gold NPs were prepared at concentrations of 0.25 ng/L, 5 ng/L and 50 ng/L for the 10

nm, 30 nm and 60 nm particle sizes, respectively. Figure 2 shows the calculated particle size distribution for the mixture of 10, 30 and 60 nm Au NPs, demonstrating that multiple particle sizes could be analyzed accurately and with good resolution in a mixed solution using the Agilent 8900 ICP-QQQ. The measured results for the mode and mean particle sizes agreed well with the reference sizes obtained by TEM (Table 1).
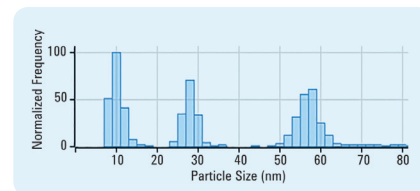

Figure 2. Particle size distribution calculated for Au NPs in a mixture of 10, 30 and 60 nm.

Table 1. Particle size determination for Au NPs.

Nominal size (nm)	Most frequent size		Mean size		Reference particle size by TEM (nm)
	Size (nm)	RSD (%)	Size (nm)	RSD (%)	
10	10	0.0	9.2	3.3	8.9 ± 0.1
30	28	0.0	27.0	0.3	27.6 ± 2.1
60	56	1.8	57.2	0.4	56.0 ± 0.5

The low background and high sensitivity of the Agilent 8900 ICP-QQQ allow single particle analysis at the smallest NP sizes [2].

References
1. Agilent publication 5991-6596EN
2. Agilent publication 5991-6944EN

The Advantages of Agilent ICP-QQQ for Nuclear Applications

Yasuyuki Shikamori, Naoki Sugiyama and Glenn Woods

Agilent Technologies

Introduction

Since its introduction in the mid-1980s, ICP-MS has been widely adopted by the nuclear industry due to its high sensitivity, simple mass spectra, and compatibility with conventional liquid sample introduction. More recently, ICP-QQQ has expanded the range of nuclear applications to include the ultra-trace determination of nuclear indicator elements and environmental contaminants such as iodine-129, uranium-236, and neptunium-237.

Why do analysts and researchers use ICP-QQQ for nuclear apps?

ICP-QQQ provides outstanding performance for existing nuclear applications, such as waste effluent analysis and monitoring occupational exposure. Exceptionally high matrix tolerance also enables difficult applications such as trace element analysis in reactor cooling water and uranium fuel to be performed. The tandem MS configuration of ICP-QQQ also enables new applications that utilize reaction cell methods to resolve spectral interferences. Coupled with ultra-low background noise, high sensitivity and unrivalled abundance sensitivity, ICP-QQQ delivers low level determinations of previously difficult elements, and separation of direct isobaric overlaps.

Determination of ultra-trace ^{129}I

High sensitivity and low background are critical for the accurate measurement of ^{129}I and ^{129}I/^{127}I ratios, as ^{129}I suffers an isobaric spectral interference from ^{129}Xe (present as an impurity in the argon plasma gas), and ^{129}I is present at extremely low concentrations.

An Agilent 8800 ICP-QQQ in MS/MS mode with O_2 reaction gas was used to measure ^{127}I and ^{129}I, as shown in Figure 1. Table 1 shows the isotope ratio results for ^{129}I/^{127}I in diluted NIST SRM 3231 Level I and II, using ICP-QQQ.

After subtracting the ^{129}I blank, the measured ^{129}I/^{127}I ratio of the NIST 3231 SRMs corresponded well with the certified values of 0.981 x 10^{-6} (Level I) and 0.982 x 10^{-8} (Level II). Precision was significantly improved over a previous study, especially for NIST 3231 Level II, due to the superior signal/noise of the ICP-QQQ [1].

Table 1. ICP-QQQ I isotope ratios for NIST 3231 Level I and Level II. Dilution factor = 10

NIST SRM 3231	^{129}I/^{127}I (av. n=5)	RSD %
Level I (^{129}I/^{127}I = 0.981 x 10^{-6})	0.981 x 10^{-6}	0.8
Level II (^{129}I/^{127}I = 0.982 x 10^{-8})	1.02 x 10^{-8}	7.2

Trace ^{236}U isotopic analysis

In a separate study, ICP-QQQ was used to measure the ^{236}U/^{238}U isotope ratio, which can be used to trace the accidental release of enriched uranium fuel, spent fuel and nuclear waste.

The main application challenges are the interference on ^{236}U$^+$ by the hydride ion ^{235}UH$^+$, and the contribution at m/z 236 from tailing of the ^{235}U$^+$ and ^{238}U$^+$ peaks. Hydride overlap and peak tailing are more problematic in samples that have been enriched, as these contain a higher proportion of ^{235}U.

The Agilent 8900 ICP-QQQ Advanced Applications configuration was used for the analysis, as it offers high sensitivity and an extended mass range to allow the measurement of uranium as the oxide (UO$^+$) and dioxide (UO$_2^+$) reaction product ions. Uranium was measured via its dioxide ion, UO$_2^+$, due to the efficient conversion (almost 100%) of U$^+$ to UO$_2^+$ with O_2 cell gas.

This approach was successful in reducing the contribution from uranium hydride (UO$_2$H$^+$/UO$_2^+$) by three orders of magnitude compared to direct, on mass measurement (UH$^+$/U$^+$). MS/MS mode with O_2 cell gas gave a hydride ratio in the 10^{-8} range, without the use of a desolvation system. Considering that the natural abundance of ^{235}U is only 0.72%, our results suggest that the ^{235}UH interference on ^{236}U can be reduced sufficiently to allow ^{236}U/^{238}U measurement in the 10^{-10} range to be achieved using this method. This has the potential to allow rapid trace-level measurement of ^{236}U/^{238}U isotopic ratios, providing valuable information on global fallout following accidental release of nuclear material into the environment.

The ultra-low instrumental background noise level and high sensitivity of the 8900 ICP-QQQ meant that a DL for uranium of 0.34 fg/g was achieved [2].

## Analysis of neptunium 237 in the presence of uranium

Neptunium (Np) is a long-lived radio nuclide produced as a by-product of nuclear power generation. The predominant isotope ^{237}Np is extremely mobile in the environment, as it readily forms aqueous solutions (more so than any other actinide), attaches to particles and colloids, and does not readily become trapped in humic substances such as soil.

Abundance sensitivity (AS) of ICP-QQQ with MS/MS

Samples that contain Np usually contain U at far higher concentrations. The determination of ultra-trace ^{237}Np in environmental samples and nuclear materials (fuel or waste) is difficult by ICP-MS because of the overlap due to peak tailing from the large ^{238}U peak.
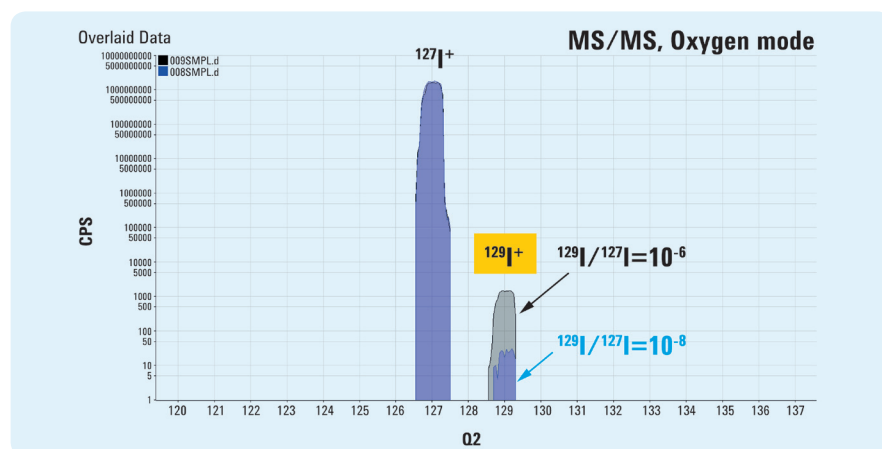
Figure 1. ^{127}I and ^{129}I measured using ICP-QQQ in MS/MS mode with O_2 reaction gas. NIST 3231 Level I (black) and II (blue) spectra are overlaid
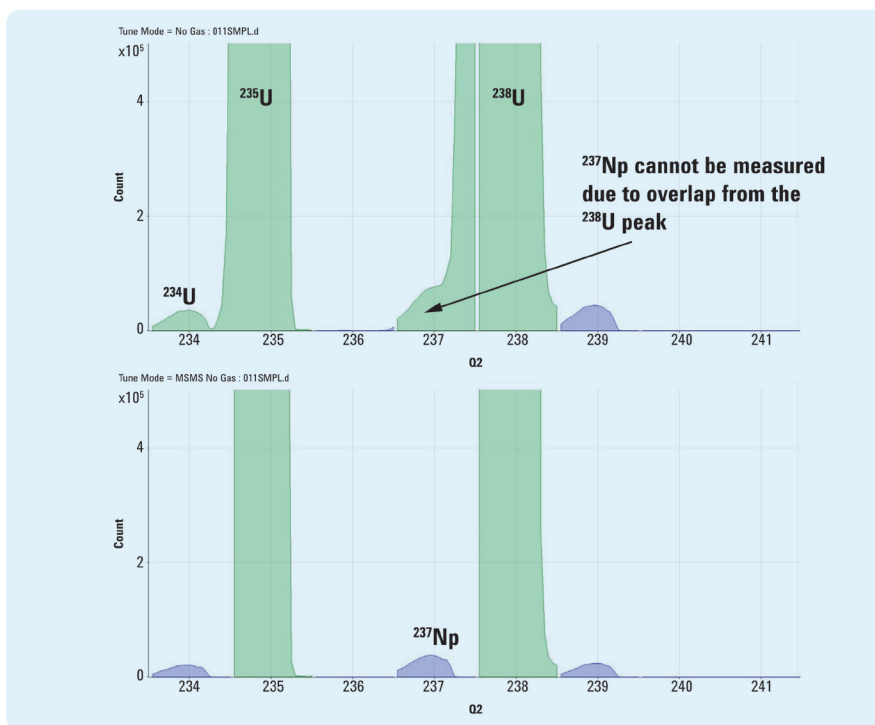
Figure 2. Spectra of 100 ppt Np in a 10 ppm U matrix sample solution obtained using ICP-QQQ in Single Quad mode (top) and MS/MS mode (bottom). MS/MS mode eliminates the peak tail on the low mass side of the intense ^{238}U peak.

Quadrupole ICP-MS instruments can achieve AS of up to 1 x 10^{-7} (a peak of 1 x 10^7 cps contributes 1 cps to the adjacent masses), so a peak with an intensity much higher than 10^7 cps will make a significant contribution to the peaks either side. High Resolution-Sector Field (HR-SF)-ICP-MS has better resolution than ICP-QMS (M/ΔM of up to 10,000), but poorer AS. So adjacent peaks may appear to be separated on the mass scale, but the peak tail of an intense peak may still contribute to the masses above and below. ICP-QQQ delivers unmatched peak separation because the abundance sensitivity performance is the product of two mass separations – Q1 AS x Q2 AS – giving an overall AS of <<10^{-10}.

ICP-QQQ is therefore able to successfully separate ^{237}Np from the ^{238}U overlap, even when the U is present at many orders of magnitude higher concentration. This is demonstrated in Figure 2, which shows the spectra of 100 ppt Np in a 10 ppm U matrix measured in Single Quad (SQ) mode (top) and MS/MS mode below. The ICP-QQQ spectrum shows the superior peak separation provided by MS/MS mode, and the clear elimination of the contribution on mass 237 from the adjacent 238 peak.

The AS performance of ICP-QQQ in MS/MS mode was tested using a series of spiked and unspiked uranium solutions.

Uranium matrix solutions were prepared at concentrations of 1, 10 and 100 mg/L (ppm). For each concentration level, the U matrix solutions were measured unspiked, and with Np spikes at 0.1 and 1.0 µg/L (ppb). For comparison purposes, the samples were analyzed using an Agilent 8800 ICP-QQQ and an Agilent 7900 ICP-QMS, to assess the impact of the improved AS performance of the QQQ configuration.

The results in Table 2 show that accurate recoveries were achieved for both Np spike levels in all of the U matrix samples analyzed by ICP-QQQ — even with U:Np concentrations at a ratio of 1,000,000:1. In contrast, the Np results measured by conventional quadrupole ICP-MS show a clear bias due to the U matrix. The low-mass peak-tail from ^{238}U causes a false-positive result for Np in the higher U matrix samples, including the unspiked U matrices. The contribution from U caused only a small increase in the apparent Np concentration (sub-µg/L), but the low level at which Np must be monitored means that this false signal is significant. The results show that the superior AS performance of ICP-QQQ can eliminate the interference effect observed with ICP-QMS.

Conclusions

The featured applications demonstrate how ICP-QQQ can overcome issues associated with problematic nuclear applications. ICP-QQQ offers a unique combination of high sensitivity; low backgrounds; exceptional AS; controlled, effective reaction cell methods; and measurement of high mass product ions such as UO_2^+.

References

1. Yasuyuki Shikamori, Kazumi Nakano, Naoki Sugiyama, Shinichiro Kakuta, Agilent Application Note 5991-0321EN (2012)
2. Naoki Sugiyama, Agilent Application Note 5991-6553EN (2016)
3. Garry Duckworth and Glenn Woods, Agilent Application Note 5991-6905EN (2016)

Table 2. Measurement of ^{237}Np in a series of U matrix samples using ICP-QQQ and ICP-QMS.

Sample Name	8800 ICP-QQQ		7900 ICP-QMS	
	Reported ^{237}Np conc., ug/L	CPS	Reported ^{237}Np conc., ug/L	CPS
1 ppm U - unspiked	0.0000	1.10	0.0016	570.48
1 ppm U, 0.1 ppb Np	0.1021	14942.85	0.1018	36525.19
1 ppm U, 1.0 ppb Np	1.0445	152806.38	1.0100	362304.66
10 ppm U - unspiked	0.0000	0.83	0.0154	5519.75
10 ppm U, 0.1 ppb Np	0.1029	15052.99	0.1152	41339.80
10 ppm U, 1.0 ppb Np	1.0486	153402.27	1.0196	365764.86
100 ppm U - unspiked	0.0000	3.97	0.1581	56728.76
100 ppm U, 0.1 ppb Np	0.0997	14586.02	0.2494	89482.09
100 ppm U, 1.0 ppb Np	0.9859	144228.95	1.0597	380137.27

Recorded webcast: Are You Sure Your ICP-MS Interferences Are Under Control?

Spectral overlaps have always posed a significant challenge in ICP-MS. Interferences can vary with the sample matrix, making them difficult to identify and correct. This affects the accuracy of measurements in many typical sample types, so controlling interferences has been a major focus for ICP-MS manufacturers and users.

The 2012 introduction of the Agilent 8800 Triple Quadrupole ICP-MS (ICP-QQQ) provided a new way to deal with interferences in ICP-MS. ICP-QQQ is a tandem mass spectrometer configuration, supporting MS/MS operation for controlled, consistent interference removal in reaction cell mode. MS/MS improves detection limits, extends the range of analytes that can be measured, and ensures accurate results in complex samples.

Did you miss the web seminar, first broadcast on July 12?

You can watch it now and learn how triple-quadrupole ICP-MS resolves interferences and improves accuracy for difficult analytes and challenging applications. These capabilities are illustrated with examples from a variety of applications.

You will also hear about the new Agilent 8900 ICP-QQQ, which provides increased sensitivity, even lower detection limits, and hardware developments that provide greater flexibility to address emerging applications.

Click on the "**Webcasts**" tab at http://www.spectroscopyonline.com and look for archived webcast: "Are You Sure Your ICP-MS Interferences are Under Control?"

This information is subject to change without notice.

Agilent Supports Two Awards at the European Winter Plasma Conference

Agilent has been the proud sponsor of the European Award for Plasma Spectrochemistry since its inception in 2003. For the first time, Agilent is also sponsoring a new award: "European Rising Star Award for Plasma Spectrochemistry" specifically dedicated to younger, upcoming scientists within the field of plasma spectrochemistry.

The **nomination deadline** for both awards is **31 August 2016.**

For full details of both awards and how to submit your nomination or application, go to www.ewcps2017.at. Both prizes will be presented at the European Winter Conference on Plasma Spectrochemistry held in St. Anton, Austria on February 19-24, 2017.

Conferences. Meetings. Seminars.

34th National MS Conference of China, Sept 9-13, Xining, China
www.cmss.org.cn/?action=viewevent&nid=207
Ilmac 2016, Sept 20-23, Basel, Switzerland,
www.ilmac.ch/en-US.aspx
SciX 2016, Sept 18-23, Minneapolis, MN, USA,
www.scixconference.org/
European Winter Conference on Plasma Spectrochemistry, Feb 19-24, 2017, St. Anton, Austria, www.ewcps2017.at

Agilent ICP-MS Publications

To view and download the latest ICP-MS literature, go to
www.agilent.com/chem/icpms

Product brochure: Agilent 8900 Triple Quadrupole ICP-MS, 5991-6900EN
Technical overview: Agilent 8900 Triple Quadrupole ICP-MS, 5991-6942EN
New 8900 ICP-QQQ application notes:
- Ultra-low level determination of phosphorus, sulfur, silicon and chlorine using the Agilent 8900 ICP-QQQ, 5991-6852EN
- Using ICP-QQQ for UO_2^+ product ion measurement to reduce uranium hydride ion interference and enable trace ^{236}U isotopic analysis, 5991-6553EN
- High sensitivity analysis of SiO_2 nanoparticles using the Agilent 8900 ICP-QQQ in MS/MS mode, 5991-6596EN
- Analysis of 10 nm gold nanoparticles using the high sensitivity of the Agilent 8900 ICP-QQQ, 5991-6944EN
- Benefits of the Agilent 8900 ICP-QQQ with MS/MS operation for routine food analysis, 5991-6943EN
- Determination of trace elements in ultrapure semiconductor grade sulfuric acid using the Agilent 8900 ICP-QQQ in MS/MS mode, 5991-7008EN
- Updated: Simultaneous quantitation of peptides and phosphopeptides by capLC-ICP-MS using the Agilent 8800/8900 ICP-QQQ, 5991-1461EN

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