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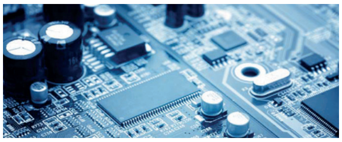


Continuing to Provide Support and Information for Users of Agilent ICP-MS Systems

These are exceptional times, with many people's lives severely disrupted and businesses and laboratories closed or working under tight restrictions. Working remotely, we are still collating information on new ICP-MS applications, product releases, and tips and tricks, in the hope and expectation of better times to come.

Meanwhile, many of the resources you access for training, software tutorials, user forums, and technical support can still be accessed online, via the Agilent online community Agilent digital solutions.

Guidance on optimizing and maintaining your Agilent ICP-MS can be found on the resource hub at Agilent ICP-MS resources.

Figure 1. Agilent 7900 ICP-MS and ICP-MS MassHunter software — check whether an upgrade to the latest revision is available for your system.

The Importance of Ultrapure Water in the Analysis of Semiconductor Process Chemicals

Kazuhiro Sakai[1], Mitsuo Takizawa[2], and Ed McCurdy[1], [1]Agilent Technologies, Inc., [2]Organo Corporation, Japan

Water quality in semiconductor analysis

Trace element contamination during semiconductor manufacturing can affect the silicon wafer's electrical properties, potentially leading to defects and device failure. High purity chemicals and ultrapure water (UPW) are used throughout the wafer fabrication process to minimize the potential for contamination.

Process and quality control laboratories also require UPW to perform ultratrace analysis of the high purity chemicals used in the semiconductor industry. To measure low analyte concentrations accurately and reliably requires low background levels, so trace element contamination of the UPW diluent must be minimized.

Water purity typically refers to the absence of organic and inorganic/ionic contaminants. The lower the level of impurities, the higher the electrical resistivity of the water, with a theoretical maximum resistivity for pure water of 18.24 MΩ-cm (megohms). The SEMI standards widely used in the semiconductor industry use the term ultrapure water (or UPW) for water with the highest purity (>18 MΩ-cm).

Laboratory-scale UPW systems are available from manufacturers such as Merck (Millipore), Organo, and ELGA. These systems use a series of reverse osmosis (RO), de-ionizer (DI), and ultrafiltration (UF) cartridges to remove particulate matter, organic contaminants, micro-organisms, and inorganic ions. The process takes a feed supply of normal tap water (or the site water supply in a semiconductor fabrication plant) and dispenses UPW in the laboratory.

Table 1 shows the concentrations of several elements in UPW produced by the Puric ω system supplied by Organo Corporation, Japan. Trace elements critical to the semiconductor industry can all be measured at sub-ppt levels using Agilent ICP-MS systems, in this case the Agilent 8900 ICP-QQQ. In a clean, dust-free laboratory environment, the purity of UPW should remain high. But contamination of some elements may occur from the container or the laboratory environment, which may impact solutions that are sampled over an extended period, such as rinse solutions.

Table 1. Trace elements in UPW from Organo Puric ω system, measured using the 8900 ICP-QQQ.

Element	*m/z*	DL (ppt)	BEC (ppt)
Li	7	0.05	< DL
B	11	0.69	3.71
Na	23	0.08	0.13
Mg	24	0.01	0.01
Al	27	0.00	0.05
K	39	0.03	0.04
Ca	40	0.04	0.14
Ti	48	0.12	< DL
V	51	0.01	0.01
Cr	52	0.14	0.24
Mn	55	0.02	0.03
Fe	56	0.33	< DL
Co	59	0.00	0.00
Ni	60	0.03	0.08
Cu	63	0.01	0.06
Zn	66	0.16	0.26
Ga	69	0.01	< DL
As	75	0.00	0.00
Rb	85	0.00	0.00
Sr	88	0.00	0.00
Zr	90	0.09	0.10
Mo	95	0.04	< DL
Ag	107	0.11	0.13
Cd	111	0.02	< DL
Cs	133	0.00	0.00
W	184	0.02	< DL
Pb	208	0.03	< DL
U	238	0.00	0.00

Continuously flowing rinse port for Agilent I-AS

Background levels may increase due to carry-over or contamination from the rinse container or laboratory environment. This can be avoided using a rinse port that is continually supplied with fresh rinse solution.

The UPW system manufacturer Organo has developed a dedicated flowing rinse port accessory for the Agilent Integrated Autosampler (I-AS) that is used with Agilent ICP-MS and ICP-QQQ systems. The Organo rinse port accessory supplies fresh UPW from the Organo Puric ω UPW system to the autosampler rinse port to flush the I-AS probe between samples. The Organo flowing rinse port is shown connected to the I-AS autosampler in Figure 1.

Figure 1. Agilent I-AS autosampler with Organo UPW flowing rinse port system.

Boron (B) is one of the most troublesome trace level contaminants in clean laboratories. It is one of the first elements to break through the resin beds of laboratory water deionizer systems, so maintaining a consistently low B background in UPW can be difficult. Also, there are several potential sources of B—both particulate and gaseous—in a typical clean laboratory.

Even if airborne particulates are well controlled, contamination can still occur due to solutions absorbing gaseous B compounds from the laboratory air. Sources of B include borosilicate glassware and the borosilicate glass fibers used in high efficiency particulate air (HEPA) filters. Decomposition or acid attack of these materials can release volatile B compounds, which may be absorbed by solutions left in open vials or containers. This process leads to a gradual increase in blank levels.

B contamination of UPW in a clean laboratory was assessed in the cleanroom at Agilent. The B concentration in a container of UPW was measured periodically using the Agilent 8900 ICP-QQQ. B in UPW from the Organo flowing rinse port on the I-AS was also monitored. Data were collected for 6 hours and the results are shown in Figure 2.

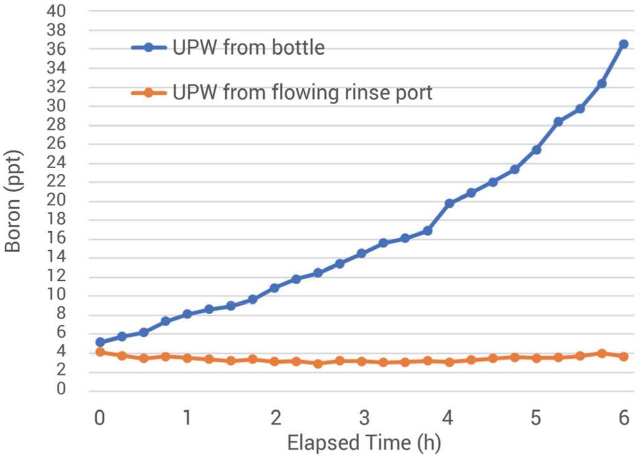


Figure 2. Boron blank level (ppt) in UPW from container (blue) and from flowing rinse port (orange).

Figure 2 shows that contamination from the laboratory environment increased the B level in the UPW in the bottle. The concentration of B in the UPW supplied from the flowing rinse port system remained stable with no contamination. The comparison shows the importance of regularly changing the rinse container UPW, either by manually exchanging the rinse bottle, or using a flowing rinse port system.

The Organo flowing rinse port system for the I-AS is currently available in Japan, China, South Korea, Taiwan, Singapore, Malaysia, Thailand, Vietnam, and Indonesia.

Conclusion

Agilent ICP-MS and ICP-QQQ instruments can measure very low levels of most elements, with DLs and BECs typically in the sub-ppt range. But low DLs and BECs can only be maintained if high-quality UPW is available for sample dilution and preparation of calibration standards. Contamination of rinse solutions can be avoided using a continuously flowing rinse port solution.

More information

www.organo.co.jp/english/products/ultrapure-water/

Introducing Some New Features of Agilent ICP-MS MassHunter Software Revision 4.6

Glenn Woods and Ed McCurdy, Agilent Technologies, Inc.

ICP-MS MassHunter software

All current Agilent ICP-MS and ICP-QQQ systems are controlled by ICP-MS MassHunter software. Revision 4.6 (G7201C, rev.C.01.06) is the latest release of the software. It is compatible with all current 7800 and 7900 ICP-MS and 8900 ICP-QQQ systems, as well as the 7700 Series ICP-MS and 8800 ICP-QQQ.

ICP-MS MassHunter controls all aspects of instrument configuration, optimization, method setup, and data acquisition, processing and reporting. Built in method presets and auto-optimization functions simplify workflows and minimize errors.

For labs that typically follow a consistent analytical workflow, ICP Go provides a simplified, browser-based interface to control routine operations.

Optional modules extend ICP-MS MassHunter capability for advanced applications. These applications include speciation with LC or GC, nanoparticle and single cell analysis, automated in-run QC, and regulatory compliance functionality.

New features in ICP-MS MassHunter revision 4.6

Each new release of ICP-MS MassHunter brings new and updated features to enable new applications, support new accessories, and simplify and streamline workflows. In this article, we highlight two of the new capabilities introduced in ICP-MS MassHunter revision 4.6:

- New IntelliQuant feature that simplifies setup and improves visualization and interpretation of Quick Scan semiquantitative data in routine batch analysis.
- Configurable settings for nanoparticle signal frequency distribution plots that add flexibility for advanced single nanoparticle (sNP) and single cell measurements.

IntelliQuant screening

IntelliQuant is an easy to use screening function that operates seamlessly with ICP-MS MassHunter acquisition and quantitative data analysis processes. IntelliQuant is selected via a check box in the Semiquant Analysis Parameters of the acquisition method—see Figure 1, top.

IntelliQuant uses the full mass Quick Scan data, which many users routinely collect to provide additional sample insight for their quantitative methods. Quick Scan is usually acquired in helium (He) cell mode, so analytes are largely free from errors caused by polyatomic ion overlaps. Adding Quick Scan acquisition to a method is easily done by selecting the appropriate tune step in the acquisition method settings, shown in Figure 1, bottom.

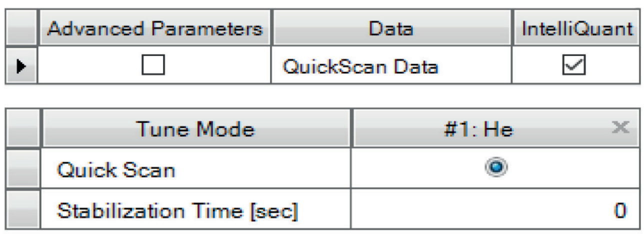


Figure 1. Selection of IntelliQuant processing in Semiquant Analysis Parameters (top) and selection of tune step for Quick Scan (bottom).

With IntelliQuant, the Quick Scan data is automatically processed using information already entered for the full quant method, requiring little or no input from the user:

- The full quant analyte/internal standard (ISTD) lists automatically define the elements used for calibration of the IntelliQuant mass response curve and ISTD correction.
- The full quant calibration blank (CalBlk) is automatically set as the reference for IntelliQuant ISTD and background signals.
- The element responses measured in the full quant calibration standards (CalStds) automatically update the batch-specific semiquant response factors.

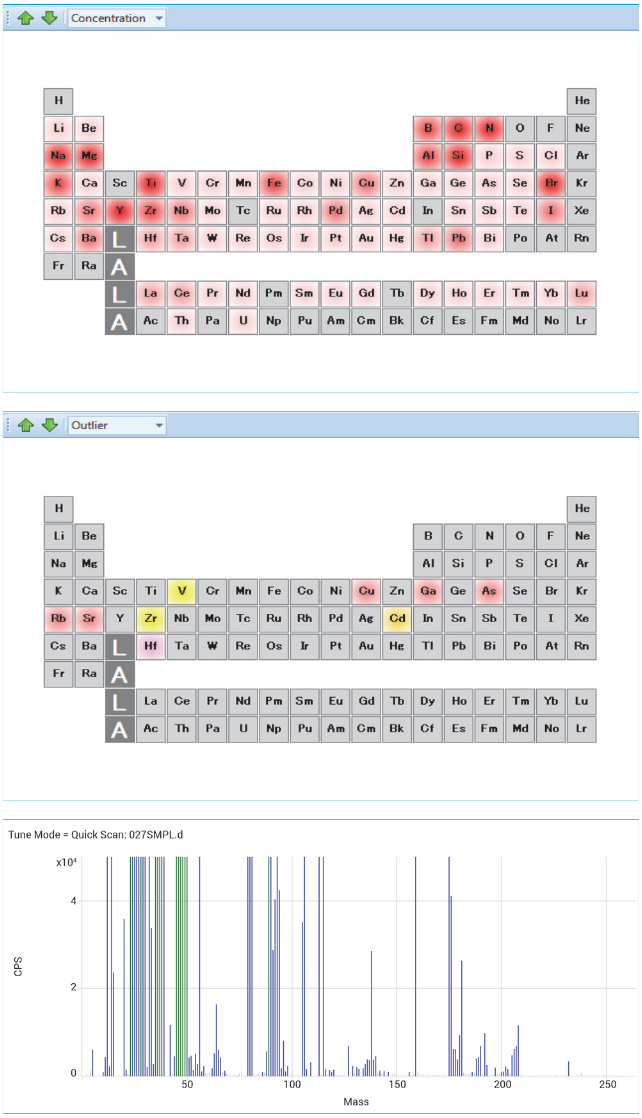


Figure 2. Top and middle: ICP-MS MassHunter IntelliQuant concentration heat map and outlier flags indicating possible spectral overlap. Bottom: Quick Scan full mass spectrum enables identification and confirmation of semiquantitative results for uncalibrated elements.

IntelliQuant results are displayed in a separate table, accessed from the tabs at the top of the Data Analysis batch pane. Results are presented for all measurable elements, except for those assigned as ISTDs.

As well as the table of results, the concentrations in each sample are shown in a periodic table "heat map" view, Figure 2, top. The second periodic table view indicates "outlier" results that may be affected by spectral overlap, including polyatomic ions, doubly charged interferences, and adjacent mass overlaps. The periodic table views give an easily interpreted overview of each sample's composition and any potential sources of error.

Single nanoparticle signal distribution plots

Single nanoparticle analysis is increasingly of interest in food and environmental monitoring, and for development of nanoscale products used in industrial materials, agriculture, and pharmaceutical products.

Agilent ICP-MS MassHunter revision 4.6 includes flexible control of the bin size or sampling range width for sNP data, which can clarify the particle distribution of measured NP signals. The new flexible bin size function is illustrated in Figure 3.

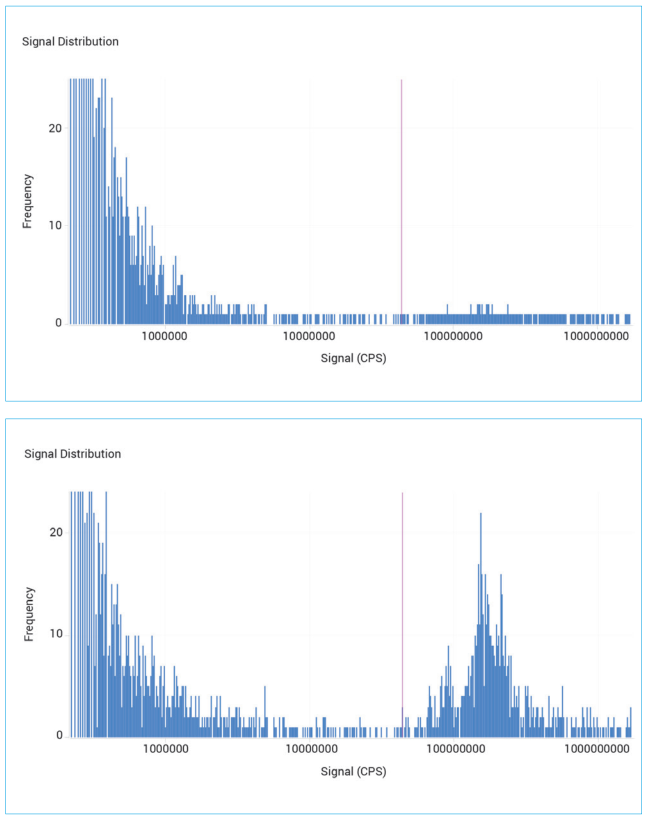


Figure 3. Frequency distribution plots for SiO_2 NPs. Top, equal bin size. Bottom, weighted bin size.

The top plot in Figure 3 shows a frequency distribution plot using equal bin sizes for all count rates. The bottom plot used a weighted bin size, where a larger bin size is used for higher count rates. A weighted bin size shows the variation in signal intensities more clearly.

Celebrating a Successful 2020 Winter Conference on Plasma Spectrochemistry

Chuck Schneider, Agilent Technologies, Inc.

Tucson, Arizona, USA, January 12-18, 2020

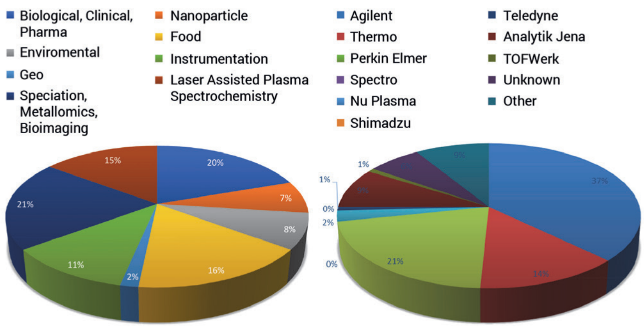
Agilent had a busy week at the recent Winter Conference on Plasma Spectrochemistry with at least one customer event held each day from Sunday to Thursday. The team introduced the all-new Agilent 5800 and 5900 ICP-OES systems during the opening of the exhibition on Monday evening. At the Software Boot Camp, customers tried the new releases of both Agilent ICP Expert and ICP-MS MassHunter software. The "hands-on" software workshops—designed to improve skills around method development, method optimization, and reporting—were very well received by all attendees. At the first lunch seminar of the week, Paul Krampitz, Agilent ICP-OES Applications Engineer (AE), gave an in-depth overview of the new ICP-OES systems. At the two ICP-MS lunch seminars, Bert Woods and Craig Jones, Agilent ICP-MS AEs, talked about the latest developments in single quadrupole (SQ) and triple quadrupole ICP-MS (ICP-QQQ). Special thanks to Sara Erhadl from the Mayo Clinic, who gave the keynote presentation at the ICP-QQQ user group meeting. With just one more talk by Tomoyuki Yamada from the Agilent ICP-MS development team, there was plenty of time for more informal information exchange. On Wednesday evening, guests at the Agilent Customer Appreciation Event traveled by motor coach to The Rail Yard in downtown Tucson where they ate, drank, danced, and played bar games until late.

21st conference in biennial series

Since the first Winter Conference on Plasma Spectrochemistry took place in 1980, the conference has remained an important event in the calendar. This year, around 500 delegates traveled to Tucson from all parts of the world to discuss developments in plasma spectrochemistry. Popular themes included single nanoparticle and single cell analysis, life science research, laser ablation, isotope ratio and isotope dilution, and speciation. Triple quadrupole ICP-MS remains the hot topic in plasma instrumentation.

A review of the poster presentations

Bioimaging, metallomics, speciation analysis, biological, clinical research, pharma, food, nanoparticles, and instrumentation were the main application areas of interest, as shown by the poster review. The review also showed that Agilent ICP-OES, ICP-MS, and ICP-QQQ systems were used in almost 40% of all posters:



International team of experts

Representatives from the Agilent ICP-MS, ICP-OES, and MP-AES marketing and R&D teams joined colleagues from North America. Between them, the team presented more than 20 posters or oral presentations, and Agilent hosted six different customer events.

Looking ahead: The European Winter Conference on Plasma Spectrochemistry will take place in Ljubljana, Slovenia January 31 to February 5, 2021.

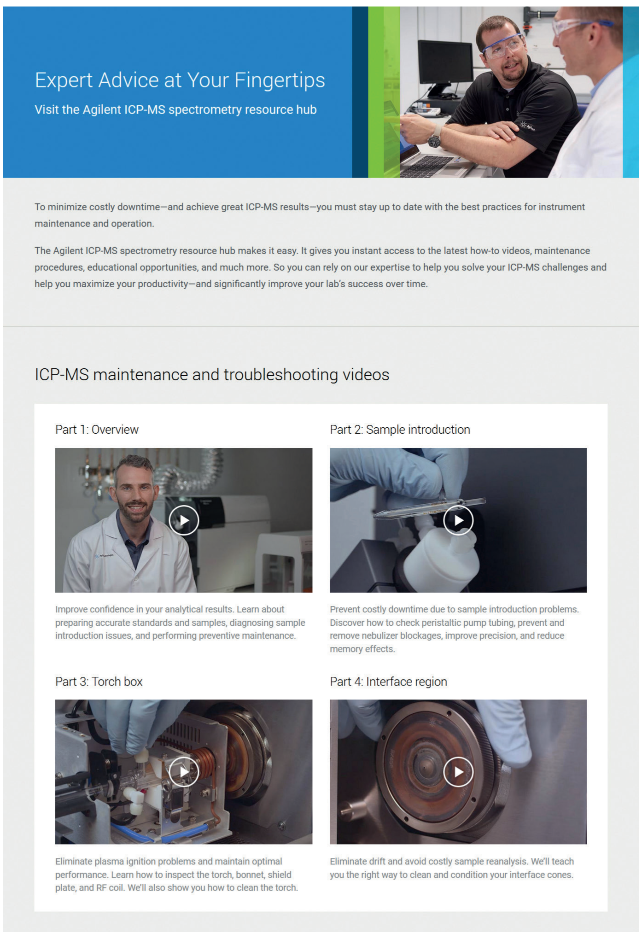
ICP-MS Resource Hub Updated with Exciting Educational Content

Gareth Pearson and Kate Lee, Agilent Technologies, Inc.

Introduction

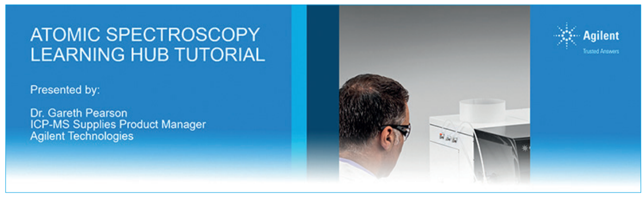
The Agilent ICP-MS resource hub makes it easy to stay up to date with the best practices for instrument maintenance and operation. By giving you instant access to how-to videos, maintenance procedures, training opportunities, and more we help you achieve great ICP-MS results and avoid any costly downtime.

This is the third update of the ICP-MS resource hub. Since its launch in 2017, the hub has been visited many times by customers looking for technical information and guidance.



New content: Atomic Spectroscopy Learning Hub

The Learning Hub is a platform where users can access e-learning content and keep track of their learning progress.



Agilent is currently offering a free-access course on Sample Introduction (available now). Three further modules will be available later in 2020, covering application-specific setup, in-depth topical applications, and ask-an-expert interview.

https://www.sepscience-spectroscopytutorials.com/courses/atomic-spectroscopy-learning-hub/

New content: Interface Cone Selection Guide

The Selection Guide enables you to quickly select the right ICP-MS cone for your application and instrument model.

The guide features our new Ni-plated Pt-tipped sampling cone (G3280-67142) that reduces corrosion when analyzing samples in strong acids such as aqua regia. The new cone extends lifetime, simplifies maintenance, and boosts productivity. https://www.agilent.com/en/promotions/icp-ms-cone-selection-guide

Learn more

https://www.agilent.com/en/promotions/icp-ms-resource
Or search Agilent.com for ICP-MS resource.

Webinar Series on How to Improve Your ICP Data Quality

In this three-part webinar series hosted by Spectroscopy, Agilent Specialists will present some practical ways to identify and understand sources of errors in ICP-MS and ICP-OES data. We will look at the benefits and limitation of some common approaches used to monitor data quality. And we will introduce the latest instrumentation and strategies that users can use to address some common errors.

Join us for this webinar series as we look to:

- Identify the sources of errors in ICP-OES and ICP-MS data.
- Address common errors and improve data quality in ICP applications.
- Reveal approaches to dealing with the challenges of extending ICP methods into novel applications, new sample types, and emerging contaminants.

Learn more and register at:
Agilent Webinar Series on Errors and Interferences in ICP-OES and ICP-MS

Latest Agilent ICP-MS publications

- **Application note:** Elemental Impurity Analysis of Sterile Artificial Tear Eye Drops Following USP <232>/<233> and ICH Q3D/Q2(R1) Protocols on the Agilent 7900 ICP-MS, 5994-1561EN
- **Application note:** Direct Analysis of Ultratrace Rare Earth Elements in Environmental Waters by ICP-QQQ: Measure emerging pollutants in river water using the Agilent 8900 ICP-QQQ in MS/MS mass-shift mode, 5994-1785EN
- **Application brief:** Analysis of 15 nm Iron Nanoparticles in Organic Solvents by spICP-MS: Using the exceptional sensitivity and low background of the Agilent 8900 ICP-QQQ, 5994-1747EN
- **Application brief:** Routine Detection of Nanoparticles in Infant Formula using Single Particle ICP-MS: Identifying 13 major and trace element-containing nanoparticles using an Agilent 7800 ICP-MS, 5994-1748EN

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