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Inside this Issue

The Measure of Confidence

Agilent Technologies

Single Particle ICP-MS Software Improves Characterization of Nanoparticles

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Introduction

Advances in nanotechnology are forecast to have a major impact on a broad range of industry segments. Because of the novel physical and chemical characteristics of nanoparticles (NPs), much remains unknown of their environmental fate and toxicological properties. As a result, there is a growing need for a rapid, accurate, sensitive technique for characterizing and quantifying NPs in a wide range of sample types.

ICP-MS can be used to measure individual NPs using a technique called single particle ICP-MS (sp-ICP-MS). This approach allows simultaneous determination of NP size, size distribution, elemental composition, and number concentration in a single, rapid analysis. Enhancements to ICP-MS hardware and software have further improved this technique.

Dedicated Software and Short Dwell Times

Agilent has developed a dedicated Single Nanoparticle Application Module (G5714A) for ICP-MS MassHunter software to simplify sp-ICP-MS analysis using the Agilent 7900 ICP-MS. The 7900 ICP-MS uses short dwell times (below 1 ms) and fast time resolved analysis (TRA) mode, permitting single element acquisition at a sampling rate as fast as 100 µs with no settling time. The capability to make multiple measurements during the signal pulse from a single particle significantly reduces the risk of overlapping signals from adjacent particles. Another advantage is the option to use a lower sample dilution and shorter sample acquisition time.

Characterization of Gold and Silver NP Standard Reference Materials

Measurements of two gold (Au) NP standard reference materials (NIST 8012 and NIST 8013), certified at 30 and 60 nm respectively, and silver (Ag) NP samples (Sigma-Aldrich) at 20 nm, 40 nm, 60 nm, and 100 nm were performed using the MassHunter Single Nanoparticle Application Module with the Agilent 7900 ICP-MS (Figure 1). All reference materials and samples were diluted to between 10 and 100 ng/L with 10% ethanol in deionized water, and sonicated to ensure sample homogeneity. The general settings of the Agilent 7900 ICP-MS are detailed in Table 1.

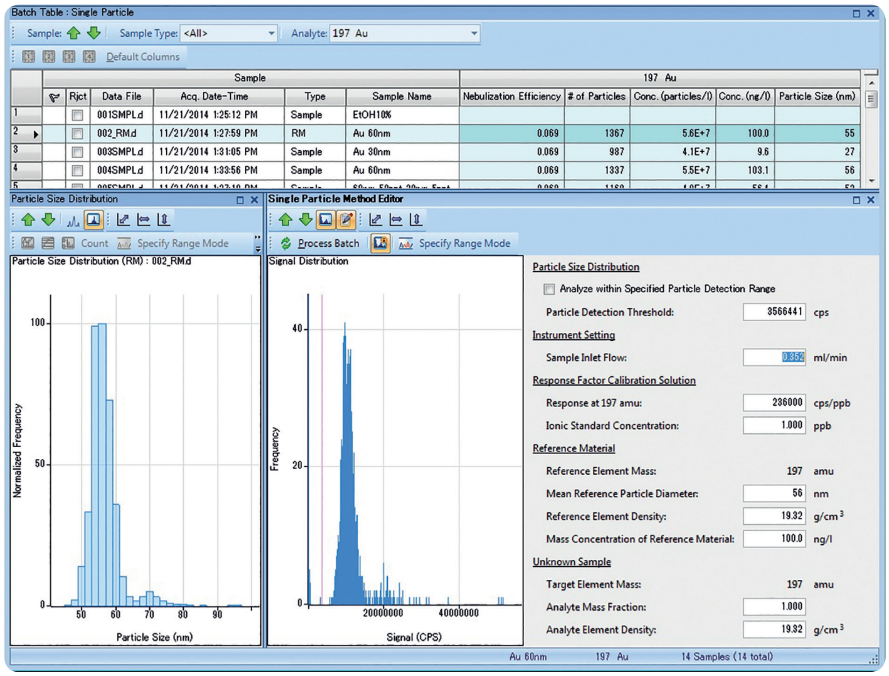

Figure 1. Single particle final batch results are automatically reported in tabular and graphical format. Users can scroll through the samples in the batch table and review individual graphical results. Powerful manual optimization tools are also available if required.

Table 1. ICP-MS general settings

RF power	1550 W
Sampling depth	7 mm
Carrier gas	0.76 L/min
Sample uptake rate	0.35 mL/min
Spray chamber temp.	2 °C
Dwell time	0.1 ms

Analysis of Au NPs

The measured concentrations of the Au NPs in the SRMs showed good agreement with the nominal concentrations (Table 2). Also, the measured particle sizes agreed with the Transmission Electron Microscopy (TEM) reference values. The particle size distribution for both NIST CRMs is displayed graphically in Figure 2.

Analysis of Mixtures of Au NPs

In addition to the excellent resolution of particle size, sp-ICP-MS can quantify the number of particles in different size groups. Two mixed solutions with different ratios of 60 nm and 30 nm Au NPs were prepared and measured. Good results were obtained for total particle concentration as shown in Table 3. The particle number distribution for each particle size shows excellent agreement with the prepared particle number. The results shown in Figure 3 suggest that this technique can accurately discriminate particle size groups.

Table 2. Results for the analysis of Au NPs

Sample (prepared concentration)	Measured Concentration (particles/L)	Measured Concentration (ng/L)	Measured Particle Size (nm)	Reference Particle Size obtained by TEM (nm)
NIST 8013 Nominal 60 nm (100 ng/L)	5.59×10^7	103	55	56.0 ± 0.5
NIST 8012 Nominal 30 nm (10 ng/L)	4.27×10^7	10.5	28	27.6 ± 2.1

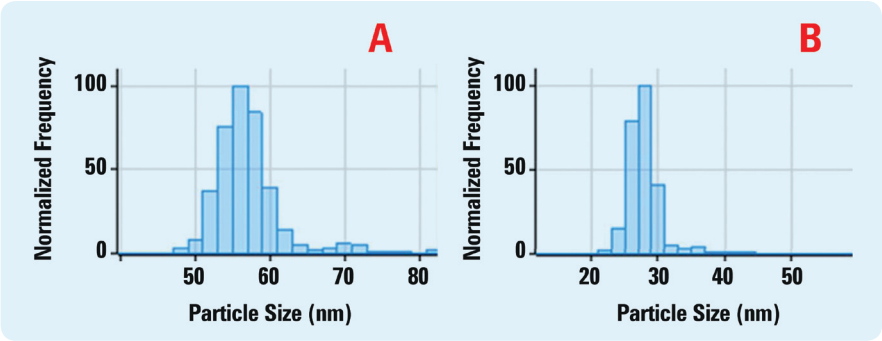

Figure 2. Particle size distribution for Au NPs. **A** NIST 8013 (nominal 60 nm). **B** NIST 8012 (nominal 30 nm).

Table 3. Results for the analysis of Au NPs mixture

Sample	Measured Concentration (particles/L)	Measured Concentration (ng/L)	Prepared Total Concentration (ng/L)	Recovery (%)
60 nm (NIST 8013) 50 ng/L + 30 nm (NIST 8012) 5 ng/L	4.78×10^7	57.6	55	**105**
60 nm (NIST 8013) 80 ng/L + 30 nm (NIST 8012) 2 ng/L	5.13×10^7	86.1	82	**105**

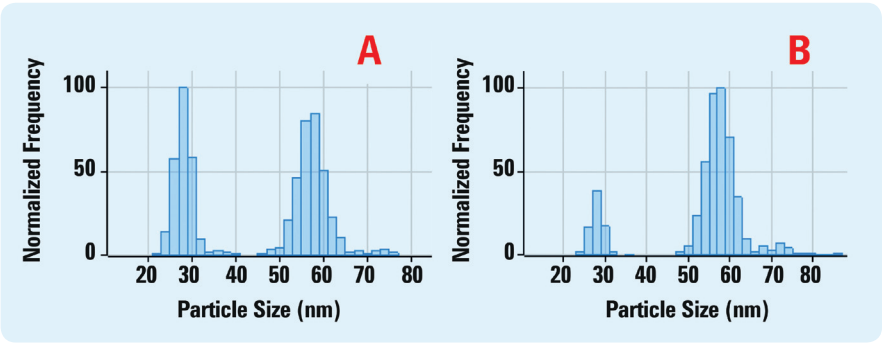

Figure 3. Particle size distribution for a sample containing **A)** 50 ng/L of 60 nm Au NPs and 5 ng/L 30 nm of Au NPs, **B)** 80 ng/L of 60 nm Au NPs and 2 ng/L 30 nm of Au NPs

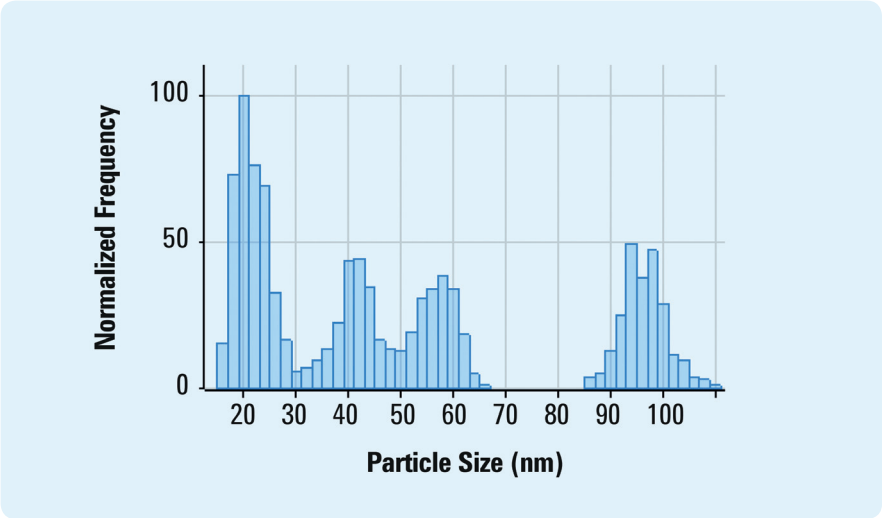

Figure 4. Size distribution results of 20, 40, 60, 100 nm Ag NPs

Analysis of Ag NPs

The results for the analysis of different Ag NP sizes are shown in Figure 4. The 20 nm Ag NP can be easily measured due to the high sensitivity of the Agilent 7900 ICP-MS. The particle size distribution measured in the Ag NP mixture indicates good resolution between the 20 nm, 40 nm, 60 nm, and 100 nm particles.

Conclusions

Using the Agilent 7900 ICP-MS with dedicated sp-ICP-MS software is an excellent approach for determining and characterizing nanoparticles. This method provides a combination of particle size distribution and sample concentration information that is generally not available with other techniques.

More Information

To learn more, download the Agilent White Paper *Characterization of nanoparticles in aqueous samples by ICP-MS*, 5991-5516EN

Industry Focus: Horse Racing Regulators use Agilent ICP-MS to Tackle Cobalt Doping

Funding Boost for Metals Analysis

Horse racing is a lucrative business with global appeal. As with many popular sports, a reputation for fairness is vital for its continued success. With doping scandals in professional cycling and athletics fresh in the mind of the public, the issue of performance-enhancing drugs in horse racing has drawn attention from the world's sports media. To protect the integrity of the sport, racing bodies are backing their condemnation of doping with active steps including increased funding of their regulatory labs to develop reliable methodology using the latest analytical instrumentation.

Following a number of well-publicized cases of positive tests for cobalt in race horses, the Australian Racing Board has introduced a national threshold for cobalt (Co) of 200 ug/L (ppb) in urine for thoroughbreds – the same level used in harness racing in New South Wales. The new rule came into force on 1 January 2015.

The Hong Kong Jockey Club's Racing Laboratory has been routinely screening thoroughbreds for Co since 2006, working to a limit of 100 ug/L. The results from the on-going study have shown that Co abuse has not been an issue locally. However, to help combat the use of Co in other jurisdictions, the Club is actively involved with the International Federation of Horseracing Authorities (IFHA) which is committed to establishing an International Threshold for cobalt. The Racing Lab is one of two reference/ referral labs in the world for Co and arsenic (As) testing. At the request of international authorities, it carries out "referee" analyses on "B" samples.

A number of similar Co studies are in progress in the USA. In June 2014, the United States Trotting Association announced funding of a project designed to develop regulatory controls for the use of Co in racehorses. The research, which will use an Agilent 8800 Triple Quadrupole ICP-MS, is being led by Dr. George Maylin of the New York Drug Testing and Research Program at Morrisville State College in New York. He is working with Dr. Karyn Malinowski and Dr. Ken McKeever of the Equine Science Center at Rutgers University in New Jersey. ICP-MS is already widely used in some states to test for Co and a research project being conducted by the Racing Medication and Testing Consortium is working to determine an appropriate threshold for cobalt.

Why Cobalt?

Cobalt is essential for blood cell formation but toxic – even lethal – at excessive levels. Co is incorporated into vitamin B-12, which is used in conjunction with iron and copper in the formation of blood cells. While it is not uncommon for race horses to be given vitamin and mineral supplements that contain low levels of Co and other trace metals, some trainers think that elevating the level of Co will act as a performance-enhancer. It is known that Co can be used to increase red blood cell production so that more oxygen will be carried through the bloodstream, allowing the horse to perform at a high level for longer. Typical sources of excess Co include water-soluble cobalt salts: cobalt sulphate and cobalt chloride. The vitamin and mineral supplements e.g. vitamin B12 have been shown to require massive dosage to be able to induce this effect.

Agilent ICP-MS in Racing

Before introducing the national threshold for Co in harness racing, representatives from Australia took advice from one of the world's leading racing analysts, Dr Terance Wan, head of the Hong Kong Jockey Club Racing Laboratory. Dr Wan and his team, which includes Dr Emmie Ho, has been researching Co in both urine and blood samples since 2007 using an Agilent 7500ce. Using ICP-MS methodology, the Australian harness racing authorities have upheld successful prosecutions of several trainers for Co abuse. To further strengthen the provision of Co testing, Victoria and Queensland Racing Forensic Laboratories (RFL) recently purchased Agilent ICP-MS. With Racing Forensic Laboratories in Western Australia and New South Wales already equipped with Agilent ICP-MS, the geographical coverage of Co testing using ICP-MS is extensive and will be applied to all forms of horse and dog racing.

Benefits of ICP-MS

The Racing Forensic Laboratories' identified ICP-MS as the preferred analytical technique for the analysis due to its spectral simplicity, sensitivity, and ability to easily measure additional elements, without requiring extensive redevelopment of methodology. The efficiency of the Agilent helium based collision cell is the enabling technology for this kind of forensic investigation.

Collaborative Approach to Problem Solving

Agilent Australia has been working closely with the various Racing Forensic Laboratories facilities over the last 2 years in anticipation of the rule change for Co. The Agilent team will continue to support the labs to harmonize analytical methods. Data integrity to satisfy legal scrutiny is vital if prosecution of suspected cheats is to be successful.

Racing Workshop in Melbourne

Agilent has organized a seminar to discuss all matters relating to ICP-MS in drug-related testing of trace metals in horse blood and urine samples. Some of the leading researchers in racing, metals and methodology are expected to attend to share their knowledge and experience. The meeting will be held in Melbourne on 19 and 20 May 2015.

For further information, contact Agilent's Fred Fryer: mailto: **fred_fryer@agilent.com**

Removal of the ^{204}Hg Isobaric Interference on ^{204}Pb using ICP-QQQ

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Introduction

Natural variation in the relative abundance of the radiogenic lead (Pb) isotopes can be used to trace the origin of materials in archaeology, environmental contamination, medicine, food, etc., as well as geochronology (rock and mineral dating) studies. However, geochronology often requires the accurate measurement of the ^{204}Pb reference isotope, and ^{204}Pb suffers an isobaric interference from ^{204}Hg when measured using ICP-MS. Even a high resolution sector-field ICP-MS instrument lacks the spectral resolution (M/ΔM) required to separate the ^{204}Hg and ^{204}Pb.

Reaction Cell Mode

"Chemical resolution" is an alternative approach that is available on ICP-MS instruments equipped with a collision/reaction cell (CRC). It involves utilizing ion-molecule chemistry with a reactive cell gas that either:
a) reacts with the interfering ion to neutralize it or move it to a different mass, or
b) reacts with the analyte ion to form a new product ion that can be measured at an alternative, interference-free mass.

Both of these reaction cell approaches have limitations when used with conventional quadrupole ICP-MS instruments, as all the ions from the sample enter the CRC, so the reactions are uncontrolled and vary with the sample matrix. This means that existing ions or new, cell-formed product ions derived from the sample matrix or other analytes may overlap the analyte ions being measured.

Triple Quadrupole ICP-MS (ICP-QQQ) offers a solution to this problem, as the tandem mass spec configuration uses Q1 (in front of the CRC) to control the ions that can enter the cell and take part in the reactions. This means that reaction chemistry is consistent, and no new cell-formed product ion interferences can occur.

Table 1. Analysis of 204/206 Pb ratio in certified NIST lead isotope standard with and without Hg and REE matrix spikes. NIST 982 material used for mass bias correction.

204/206	No gas		NH_3 "single quad" mode		NH_3 MS/MS	
	IR	Deviation	IR	Deviation	IR	Deviation
Certified	0.059042					
NIST 981*	0.1403	2.376	0.0605	1.025	0.0591	1.001
NIST 981 + Hg	22.0480	373.429	0.0589	0.998	0.0588	0.997
NIST 981 + REE	0.1489	2.522	0.1192	2.019	0.0582	0.986
NIST 981 + Hg & REE	17.0132	288.155	0.1192	2.018	0.0611	1.034
Certified	0.027219					
NIST 982	0.0272	1.000	0.0272	1.000	0.0272	1.000
NIST 982 + Hg	0.8851	32.517	0.0273	1.003	0.0278	1.022
NIST 982 + REE	0.0292	1.072	0.0989	3.633	0.0275	1.012
NIST 982 + Hg & REE	0.7251	26.639	0.0989	3.635	0.0276	1.013

In this study, the Agilent 8800 ICP-QQQ operating in MS/MS mode with ammonia (NH_3) cell gas was used to remove the ^{204}Hg overlap on ^{204}Pb. The Hg^+ ion reacts very efficiently with NH_3 and is neutralized to Hg^0 by a charge transfer reaction and removed from the ion beam.

Method Validation

To check the accuracy of the method for Pb isotope analysis, Pb isotope ratios were measured in two Pb isotopic standards, NIST 981 and 982. The Pb standards were analyzed unspiked; spiked with 10 ppb Hg; spiked with a 50 ppb Rare Earth Element (REE) mix; and spiked with both Hg and REEs. The unspiked NIST 982 standard was used as the reference standard to correct for mass bias. Table 1 displays the data for the 204/206 isotope ratio measured in the spiked and unspiked NIST 981 samples run as unknowns, together with the certified ratio and deviation/recovery against the certified values. Data is also included for the spiked NIST 982 samples, with all ratios being mass bias corrected using the unspiked NIST 982.

The measured values are in good agreement with the certified values, confirming that the 8800 ICP-QQQ operating in MS/MS mode with ammonia reaction gas was effective in removing the ^{204}Hg isobaric interference on ^{204}Pb.

In contrast, severe errors are observed when the Pb ratios are measured in the same solutions using either no gas mode, or with NH_3 cell gas in "single quad" mode.

Conclusions

Controlled reaction chemistry using the Agilent 8800 ICP-QQQ with ammonia reaction gas offers a powerful solution to the ^{204}Hg isobaric interference on ^{204}Pb, without the need for time consuming sample preparation. The methodology also opens up application areas that cannot be addressed using high resolution sector-field ICP-MS.

More Information

Application Note: Lead isotope analysis: *Removal of ^{204}Hg isobaric interference from ^{204}Pb using ICP-QQQ in MS/MS mode*, 5991-5270EN.

Improving Lab Efficiency using Agilent Certified Reference Materials

Melanie Rothermich and Alejandro Amorin
Agilent Technologies

Introduction

Accurate preparation of calibration standards is critical. Because most sample measurements are made with reference to the initial calibration, accuracy of analysis is dependent on the accuracy of calibration standards. The bulk standards used for preparation of calibration standards should be certified and supplied with a Certificate of Analysis (CoA) confirming both analyte and contaminant concentrations.

Many elemental analysis laboratories are accredited to, or working to achieve ISO/IEC 17025 certification - the global quality standard for the management and technical requirements for testing laboratories. These laboratories must demonstrate that they are technically competent, use documented and validated methods, and are able to produce precise and accurate test and/or calibration data with known uncertainties.

Using Certified Reference Materials (CRMs) for preparation of calibration standards improves accuracy, establishes traceability and allows quantification of the measurement uncertainty. Agilent now offers a complete line of spectroscopy CRMs for AA, MP-AES, ICP-OES, and ICP-MS applications. Manufactured in an ISO 9001, ISO Guide 34 facility and certified in an ISO/IEC 17025 testing laboratory, Agilent CRMs provide quality, purity, and consistency.

NIST Certified Standards

All Agilent spectroscopy CRMs are certified using the high performance spectroscopy protocol [1] developed by the National Institute of Standards and Technology (NIST). Both the certified concentration and uncertainty values are traceable to NIST 3100 Series spectrometric single element SRMs to ensure the highest accuracy and traceability.

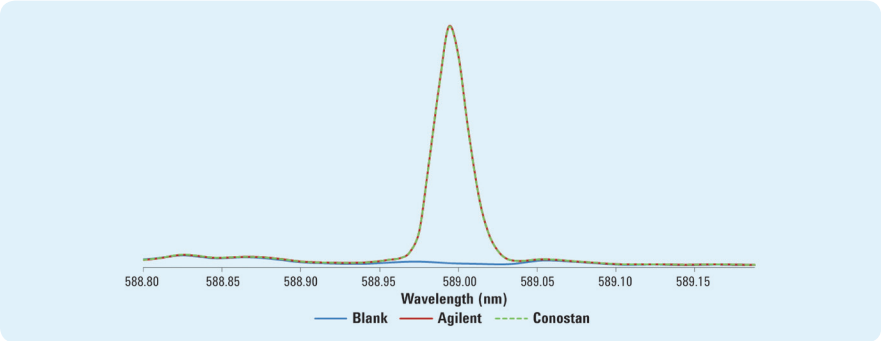


Figure 1. Overlaid ICP-OES signal graphics comparing traces for 50 µg/g sodium at 588.995 nm in the Agilent A21+K and Conostan S21+K wear metal standards.

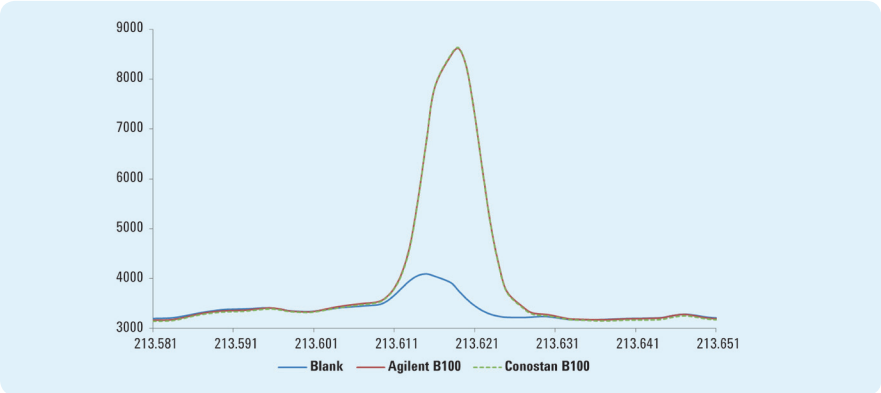


Figure 2. Overlaid ICP-OES signal graphics comparing traces for 2 µg/g phosphorus at 213.618 nm in the Agilent and Conostan B100 biodiesel standards.

Trace impurities are assayed using an Agilent ICP-MS and reported on the CoA for ICP-OES/ICP-MS standards. The standards have a long shelf life, up to 18 months, supported by long-term stability studies performed as part of the requirements for Guide 34 accreditation.

Metallo-organic Standards

Agilent also offers a full range of single and multi-element metallo-organic and biodiesel standards, base oil and pure solvent for use in blending and preparation of working standards for analysis of lubricant additives, wear metals and petroleum products. The metallo-organic standards are also manufactured in an ISO 9001, ISO Guide 34 facility and certified in an ISO/IEC 17025 testing laboratory. These standards are certified using NIST SRMs with trace impurities assayed using ICP-OES.

High Quality Standards

The quality of Agilent metallo-organic standards was investigated by comparing them with industry-leading Conostan metallo-organic multi-element oil and biodiesel standards. As trace impurities are assayed using ICP-OES, the analyses were also performed using the ICP-OES technique. An Agilent 5100 ICP-OES in radial view was used. The traces in Figures 1 and 2 show an excellent match between the wear metal and biodiesel standards from Agilent and Conostan. Sodium was selected as this is prone to contamination. Phosphorus was selected as it is a more challenging element to measure (e.g. low intensity and optics purging required). There were no differences in matrix background or response when comparing the Agilent A21+K and Conostan S21+K wear metal and B100 biodiesel standards. In addition, there is no significant change in the emission spectrum on either side of the analytical wavelength. The consistent baseline confirms the Agilent standards are free of unwanted components that may increase background, and are analytically equivalent to the Conostan standards.

More Information

Catalog: Agilent Certified Reference Materials, 5991-5678EN
www.chem.agilent.com/Library/catalogs/Public/5991-5678EN_Chemical_Stnds_Catalog_LR.pdf

Reference

1. Salit M., Turk G. et al., Anal Chem., 2001, 73, 4821 - 4829.

Record Number of Delegates at European Winter Conference on Plasma Spectrometry

Amparo Villar, Agilent Technologies

More than 700 scientists from 45 countries attended the European Winter Conference on Plasma Spectrochemistry (EWCPS) in February. Since the inaugural meeting in 1985, the biennial conference is firmly established as the major event in the calendar relating to analytical plasma spectrochemistry.

EWCPS 2015 took place in the historic city of Münster, Germany, February 22-26. An impressive program of high quality oral presentations and poster sessions (178 lectures and 260 posters) was enjoyed by a record number of attendees. Lively discussions were also continued in the exhibition and social areas.

Agilent had the pleasure of welcoming a high number of visitors to its exhibition stand themed “Innovation in Atomic Spectroscopy Solutions”. With nanoparticle analysis clearly emerging as an important topic in the scientific program, Agilent's new MassHunter Single Nanoparticle Application Module generated a lot of interest. Visitors were also able to look over the 7900 ICP-MS, 8800 ICP-QQQ, 5100 ICP-OES, 4200 MP-AES instruments and consumables kit on display, and Agilent technical experts were available for demonstrations and questions.

Scientific Workshop and Social Events Hosted by Agilent

Agilent’s Scientific Workshop on Wednesday focused on ICP-QQQ and nanoparticle analysis. Over 100 delegates listened to lectures on "Determination of number-based size distribution of titanium dioxide nanoparticles in liver tissue by ICP-QQQ" presented by Prof. Erik Larsen from the Technical University of Denmark (DTU), and "ICP-QQQ: Addressing important challenges in Metrology Research" from Dr. Heidi Goenaga-Infante from LGC Group UK.

Agilent’s highly anticipated Evening Event was held at the LWL Museum Münster. Around 240 participants enjoyed dinner, dancing, and indoor golf! It was the perfect opportunity to build and renew friendships, share experiences and have fun.

An analysis of the poster presentations showed that more than twice as many presenters (excluding vendor representatives) use Agilent ICP-MS than any other manufacturer's system, with an additional 11 posters citing the use of ICP-QQQ. Agilent staff presented 14 posters and 2 oral presentations. You can download a copy of some of the posters from: **www.agilent.com/chem/ewcps15**. See page 8 for a list of titles.

Plasma Award winner Prof. Jörg Feldmann (center) with Agilent's Sayuri Otaki (right) and conference chair, Prof. Dr. Uwe Karst of the University of Münster (left)

Congratulations to 7th Plasma Prize Winner

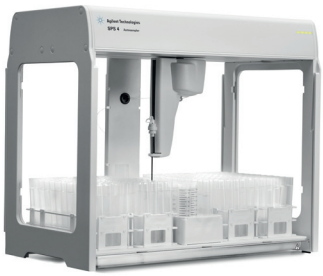
Agilent has sponsored the prestigious European Award for Plasma Spectrochemistry at each European Winter Conference since its inception in 2002. The prize supports plasma spectrochemical developments and applications in Europe, and is awarded for a single outstanding piece of work, or for continued important contribution in the field. This year, the Award was presented to Prof. Jörg Feldmann from the University of Aberdeen, Scotland by Sayuri Otaki, Agilent's ICP-MS Marketing Manager.

As winner of the prize, Prof. Feldmann presented a plenary lecture at the conference. Entitled: "Arsenolipids - the Wolf in Sheep Clothing?", he discussed arsenolipids in marine organisms, their distribution and toxicity. The award also includes a cash prize and an expenses paid trip to Japan to present a paper at a symposium or Agilent event.

Sponsorship of the prize underlines Agilent's continued commitment to supporting high quality research and innovation in the lab and discussion of important topics at the EWCPS.

The next EWCPS will take place in St. Anton, Austria in 2017.

Boost Productivity with New Agilent SPS 4 Autosampler



The SPS 4 is a next generation high performance autosampler for atomic spectroscopy applications. Designed to meet the needs of high throughput laboratories requiring a fast, high capacity, reliable autosampler, the SPS 4 is suitable for ultra-trace analysis by ICP-MS, with the ruggedness and robustness required for FAAS, MP-AES and ICP-OES users.

Built around an innovative gantry design which supports the mechanical components between two rigid pillars, the SPS 4 provides improved probe accuracy and precision, high speed, ease of access and corrosion resistance all within with a footprint that is nearly 40% smaller than other autosamplers in its class. With the integrated environmental enclosure (optional), the SPS 4 offers maximum sample integrity while protecting your laboratory environment from hazardous sample vapors. The power switch, peristaltic pump and all electrical and communications ports are outside the cover for easy access and protection from corrosion.

- Unique Agilent design ensures compatibility with all current atomic spectroscopy instruments*
- Three channel peristaltic pump and optional dual port flow through rinse station
- User programmable high speed probe movement
- Flexible sample and standard rack configuration enables wide range of sample capacities
- Four rack capacity supports up to 360 samples or 768 microtiter wells (with ICP-MS).

*See product brochure for details of supported products

This information is subject to change without notice.

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5991-5737EN

Free Access to Agilent Winter Plasma Conference Presentations

Oral Paper Title

- Removal of spectral interferences on noble metal isotopes by MS/MS reaction cell of Agilent 8800 ICP-QQQ by Naoki Sugiyama
- Evaluation of a dichroic filter in an ICP-OES to eliminate EIE interferences by Glyn Russell

Poster Presentation Title

- Utilizing aerosol dilution technology and He collision mode to extend the matrix tolerance of ICP-MS while maintaining accuracy for interfered trace elements by Ed McCurdy
- Optimization of data acquisition parameters for single particle - ICP-MS by Michiko Yamanaka
- Elemental analysis of coffee beans for geographical origin authentication by Jenny Nelson
- Determination of trace elements in steel by ICP-MS by Kazuhiro Sakai
- Direct, sample preparation-free trace elemental analysis of distilled alcoholic beverages using ICP-MS fitted with a gas dilution system by Glenn Woods
- The direct analysis of a 10% copper solution using UHMI on the Agilent 7900 ICP-MS by Bert Woods
- Study of possible IHH interference and stability of internal standards in several solvents used for the extraction and determination of trace radioactive iodine by ICP-QQQ by Yasuyuki Shikamori
- Understanding protein expression levels and quantitation in single cell analyses using ICP-QQQ by Amir Liba
- Ultra-fast determination of trace elements in water using the Agilent 5100 ICP-OES by Glyn Russell
- Elemental profiling of wines from Argentina and California made under controlled winemaking conditions using MP-AES by Jenny Nelson
- Measuring major and minor elements in milk using the Agilent 4200 MP-AES by Robeul Alom
- Estimation of available nutrients in soils using MP-AES by Dharmendra Vummiti
- Direct analysis of wine using MP-AES by Gian Maria Beone and Andrea Carcano

Download a copy of the presentations at: **www.agilent.com/chem/ewcps15**

Conferences. Meetings. Seminars.

- **Agilent Atomic Spectroscopy User Meeting**, May19, Xiamen, China
- **6th Asia-Pacific Winter Conference on Plasma Spectrochemistry (APWC)**, May 19-22, Xiamen, China, **www.apwc2015.xmu.edu.cn/**
- **AOAC Europe**, May 21-22, Stockholm, Sweden, **www.aoaceurope.com**
- **ASMS**, May 31-June 4, St. Louis, MO, USA, **www.asms.org**
- **ACS Fall**, August 16-20, Boston, MA, USA, **www.acs.org**
- **SciX**, Sept 27-Oct 2, Providence, RI, USA, **www.scixconference.org**

Agilent ICP-MS Publications

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

- **Brochure:** SPS 4 Autosampler, 5991-5730EN – available June 1, 2015
- **White paper:** Characterization of nanoparticles in aqueous samples by ICP-MS, 5991-5516EN
- **Application note:** Automated, high sensitivity analysis of single nanoparticles using the Agilent 7900 ICP-MS with Single Nanoparticle Application Module, 5991-5891EN
- **Application note:** Sub-ppt detection limits for hydride gas contaminants using GC-ICP-QQQ, 5991-5849EN

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