NEWS

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Application Spotlight

Inert-High Performance ICP Sample Introduction System

Abstract

This report highlights the superior performance of an inert Glass Expansion ICP sample introduction system compared to two alternative sample introduction systems. The Glass Expansion configuration consisted of the DuraMist nebulizer coupled with a PTFE Twister spray chamber, whereas the alternative configuration consisted of two different non-concentric nebulizers coupled with a Scott-type spray chamber.

Figure 1. Glass Expansion DuraMist nebulizer and PTFE Twister spray chamber

GE News

Upcoming Trade Shows

A wide selection of Glass Expansion products will be on display and a Glass Expansion specialists will be on hand to answer your questions at the following trade shows:

GEOANALYSIS 2018

Sydney, Australia
July 8th - 13th, 2018.
Please visit us at Booth #15.
http://ccfs.mq.edu.au/Geoanalysis2018/

Cannabis Science Conference

Oregon Convention Center in Portland, OR.
August 27 – 29th, 2018
Please visit us at Booth #320.
www.cannabisscienceconference.com

JASIS 2018

Makuhari Messe, Japan,
September 5th - 7th, 2018.
Please visit us at Booth #4A-306.
https://www.jasis.jp/en/

Gulf Coast Conference

Moody Gardens Convention Center in Galveston, TX
October 16 – 17th, 2018
Please visit us at Booth #919 & 921.
www.gulfcoastconference.com

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GLASS EXPANSION
Quality By Design

Introduction

For ICP sample digestions that require hydrofluoric acid (HF) and/or if the final sample matrix contains trace amounts of HF, a glass or quartz ICP sample introduction system is unsuitable. Glass or quartz is also unsuitable for the ultra-trace determination of some elements by ICP-MS (e.g. silicon or boron). For these types of ICP analyses, an inert sample introduction system, consisting of a spray chamber and nebulizer made from various plastic materials, are used.

Common polymers used in the manufacture of inert spray chambers and nebulizers include:

- Polytetrafluoroethylene (PTFE)
- Perfluoroalkoxy alkane (PFA)
- Polyphenylene sulfide (PPS)
- Polypropylene (PP)
- Polyether ether ketone (PEEK)
- Polyimide (PI)

A common problem with these materials is they do not wet completely and large droplets collect on the inside walls. The formation and collection of droplets degrades ICP performance, leading to erratic drainage, poor precision (RSD), and poor signal stability.

Inert Spray Chamber Design

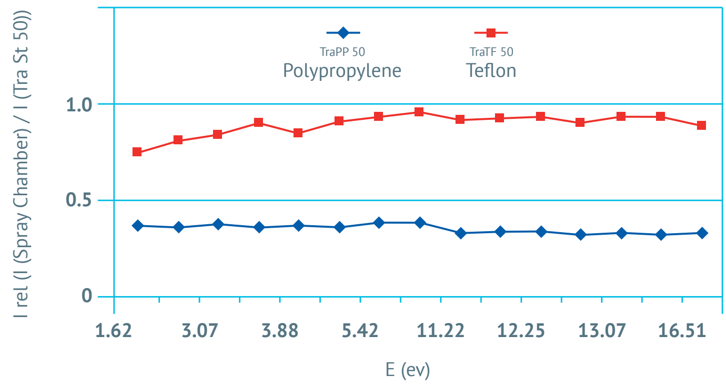
A major breakthrough in the performance of inert spray chambers came with the introduction of the proprietary Stediflow surface treatment by Glass Expansion in 2006.[1] The Stediflow treatment (shown in Figure 2) improves the wettability of the surface, ensuring efficient drainage, and delivering sensitivity and precision comparable to those achieved with a glass cyclonic spray chamber.

Figure 2. Glass Expansion's proprietary Stediflow surface treatment

In previous work,[1] the sensitivity of the a Glass Expansion PTFE Tracey cyclonic spray chamber with Stediflow surface treatment and a PP cyclonic spray chamber with a sandblasted surface were both compared to a Tracey glass cyclonic spray chamber (Figure 3). Sandblasting of the plastic is a common surface treatment technique used to improve performance. However, that improvement still only provides about 50% of the sensitivity of the glass spray chamber, whereas the sensitivity of the Stediflow treated PTFE spray chamber was nearly equivalent to the glass spray chamber.[1]

In a 2014 application spotlight,[2] Glass Expansion highlighted the advantages of a cyclonic spray chamber versus a Scott-type. A combination of the cyclonic design and Stediflow treatment provides the ICP analyst with sensitivity gains and reduced washout times that are not possible with inert Scott-type spray chamber designs. Furthermore, the baffled Twister spray chamber provides a smaller particle size and narrower distribution compared to a single pass cyclonic (Tracey). Smaller droplet sizes reduce matrix effects and improve short-term precision, making the PTFE Twister the most suitable choice for high matrix samples containing HF.

Figure 3. Sensitivity of inert spray chambers relative to glass spray chamber (relative sensitivity = 1)



Inert Nebulizer Design

Choosing an inert nebulizer is just as important as the type of spray chamber selected. Key categories to review when choosing an inert nebulizer are: chemical resistance to HF, purity of the raw material, tolerance to particulates and overall performance (sensitivity and precision). This way the best nebulizer is chosen for the application and sample matrix.

Glass Expansion currently offers two inert concentric nebulizer designs, the OpalMist and DuraMist. Other popular inert nebulizer models include the cross-flow and a polymeric, parallel path, "v-groove" nebulizer referred to as NPCN throughout the remainder of the discussion. The CrossFlow and NCPN provide tolerance to HF and particulates, but suffer from poorer analytical precision, reduced sensitivity and enhanced matrix effects compared to the concentric nebulizer design. These nebulizers typically produce an aerosol that has larger droplets with a wider droplet size distribution. Larger droplets can pass through the plasma without desolvating and incomplete evaporation, which results in poor precision, reduced nebulization efficiency, increased matrix effects and reduced plasma robustness. Smaller droplet size provides higher transport efficiency (sensitivity) and improved precision (RSD).

The DuraMist nebulizer (Figure 4), released by Glass Expansion in 2011,[3] is a concentric, self-aspirating inert nebulizer that consists of a PEEK body and PEEK capillary insert. At the time of its release, the DuraMist was compared to Glass Expansion's SeaSpray, OpalMist, and a non-Glass Expansion NCPN. Characteristics studied included sensitivity, precision, stability, robustness and tolerance to high TDS (total dissolved solids).[3] In this report the DuraMist nebulizer had only slightly lower sensitivity than the SeaSpray and outperformed the NCPN in both precision and sensitivity.

Figure 4. DuraMist DC nebulizer with PerkinElmer® Avio gas fitting

The goal of this new study is to examine the performance of Glass Expansion's PTFE Twister cyclonic spray chamber and DuraMist concentric nebulizer for those ICP laboratories that require the utmost sensitivity and precision in an inert sample introduction kit.

Experimental

A Perkin Elmer® Avio 200 sequential ICP-OES was used for this work; the experimental conditions are listed in Table 1. Without relying on the Auto integration feature, integration times were manually set to 2 seconds for each analyte wavelength in order to maintainconsistency for all sample introduction systems tested. A multielement test solution containing 0.5ppm Cu and Mn, and 1ppm As, Se, Mg, Na and K was used. Each sample introduction system was evaluated based on the measured sensitivity, signal-to-root background ratio (SRBR), and precision. For sensitivity and SRBR calculations, net signal counts per ppm was used. Precision of the net signals were estimated by analyzing the multielement test solution 10 times as samples and calculating the average % RSD.

Table 1. Experimental conditions

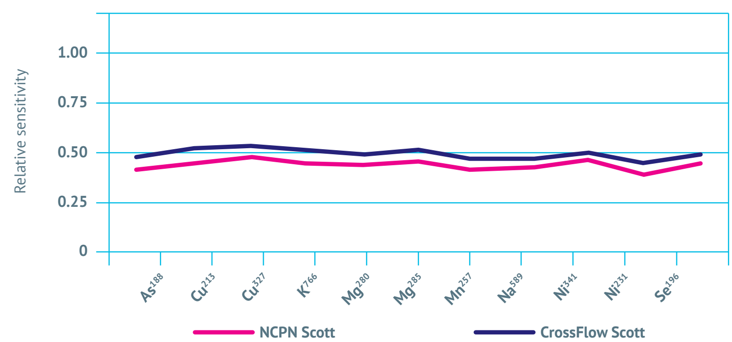
Experimental Parameter	Setting
RF power	1.2 kW
Nebulizer gas flow rate	0.7 L/min
Plasma gas flow rate	12.0 L/min
Auxiliary gas flow rate	1.0 L/min
Read time	2 sec
Replicates	3
Viewing mode	Axial
Pump speed	0.7mL/min & 1.4mL/min
Pump tubing	Black-Black, 0.76 mm ID
Torch	Fully ceramic D-Torch

The Glass Expansion inert sample introduction system consisted of the DuraMist DC nebulizer and PTFE Twister cyclonic spray chamber. The Glass Expansion sample introduction system was compared to a CrossFlow nebulizer paired with a PPS Scott-type spray chamber and a NCPN paired with a PPS Scott-type spray chamber. The NCPN was operated at the recommend liquid flow rate of 1.4mL/min, whereas the DuraMist and CrossFlow nebulizers where run at 0.7mL/min. Although a range of nebulizer gas flows were examined, in order to simplify the data comparison, the results presented were collected at a nebulizer gas flow rate of 0.7 /min.

Results

Figure 5 depicts the sensitivity obtained with the NCPN paired with the PPS Scott-type and CrossFlow paired with the Scott-type, relative to the sensitivity of the DuraMist DC nebulizer paired with the PTFE Twister. The combination of the DuraMist and PTFE Twister provides an increase in sensitivity by 50% or more for all elements examined.

Figure 5. Sensitivity of NCPN with Scott-type and CrossFlow with Scott-type relative to DuraMist and PTFE Twister (relative sensitivity = 1)



The best indicator of analytical detectability for ICP-OES using a solid-state detector , is determined by measuring the SRBR. Similar to what was observed when comparing sensitivity, the DuraMist DC nebulizer and PTFE Twister spray chamber provided close to a 50% improvement in SRBR when compared to the other two inert sample introduction systems, as shown in Figure 6 (Next page).

The final merit of performance examined was short-term analytical precision. The precision results (Figure 7 Next page) also indicate that the DuraMist DC nebulizer and PTFE Twister provide superior %RSD, well below 1.0%.

Figure 6. SRBR of NCPN with Scott-type and CrossFlow with Scott-type relative to DuraMist and PTFE Twister (relative SRBR = 1)

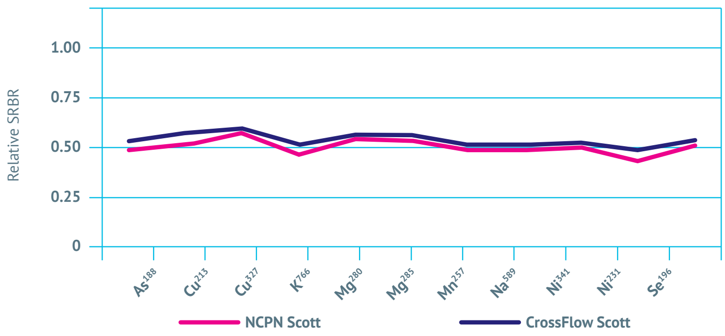
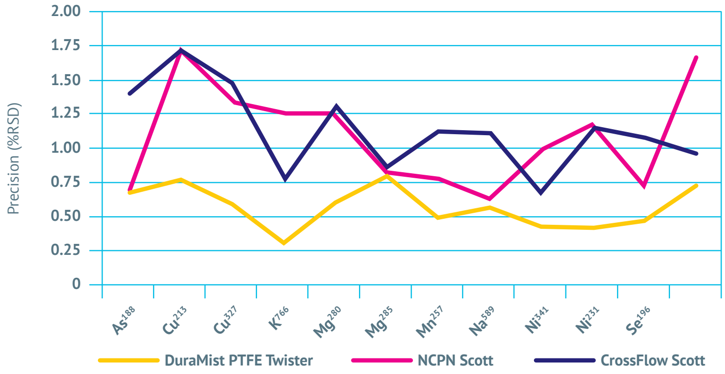


Figure 7. Precision (%RSD) comparison of NCPN with Scott-type CrossFlow with Scott-type and DuraMist with PTFE Twister



Conclusions

A comparative evaluation of a Glass Expansion sample introduction system consisting of the DuraMist DC nebulizer coupled with the Twister PTFE spray chamber against the NCPN and CrossFlow nebulizers coupled with a PPS Scott-type spray chamber indicates that the Glass Expansion sample introduction system yields the best sensitivity, SRBR and precision.

References

1. Glass Expansion Newsletter, February 2006, *Improving the Performance of ICP Spectrometers.*
2. Glass Expansion Newsletter, October 2014, *ICP Spray Chamber Update.*
3. Glass Expansion Newsletter, October 2011, *Evaluation of a New High Performance Inert Nebulizer.*

Customer Comments

1. Thank you for your great products! Every day when I run the Arcos with the TFE spray chamber, the ceramic D-torch and DuraMist nebulizer, I say Thanks, GE!
   Chemical supplier - USA
2. The Duramist Nebulizer performs very well. The Si background is as low as they have ever seen, and the stability of the Duramist has proven excellent.
   ICP company - USA
3. Not all ceramic injectors are the same. Some of them are completely unacceptable for measuring Si in HF solutions. We had a lot of trouble with them until we tried one from Glass Expansion.
   University - USA
4. I just replaced my HF spray chamber with yours and used it with your OpalMist nebulizer. I am now getting twice the signal as before and my nebulizer no longer clogs.
   QC laboratory - USA

Glass Expansion Products for the PerkinElmer® Avio 200 & 500 ICP-OES

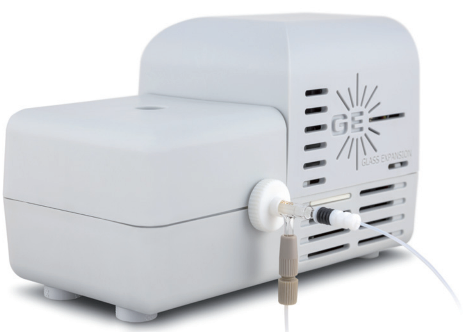
Glass Expansion offers a complete range of nebulizers, spray chambers, D-Torch, peristaltic pump tubing, autosampler probes and other accessories for the new Avio 200 & 500 ICP-OES from PerkinElmer®. Our high performance sample introduction components will reduce your instrument running costs, enhance its performance and improve usability.

The D-Torch replaces the standard Avio torch. It has the option of a patented long-life ceramic outer tube that is ideal for analysis of difficult samples such as brines or organics. The IsoMist XR temperature programmable cyclonic spray chamber simplifies analysis of volatile organics.

For samples containing HF acid, Glass Expansion has a range of high performance inert nebulizers such as the DuraMist and PTFE cyclonic spray chambers. Don't compromise your instruments performance just to run samples containing HF acid.

For more information on improving your PerkinElmer® Avio 200 & 500 ICP-OES contact us at Glass Expansion or go to the Avio product page on the Glass Expansion web site.

IsoMist XR



D-Torch

DuraMist DC Nebulizer

PTFE Twister Spray Chamber

Ordering Information

Product	Product Number
IsoMist XR for PE AVIO 200 & 500	KT-1147-XR
D-Torch for PE AVIO 200	30-808-3800
D-Torch for PE AVIO 500	30-808-3882
DuraMist DC for PE AVIO 200 & 500	A21-07-DM1
PTFE Twister for Avio 200 & 500	20-809-3452

Glass Expansion's New D-Torch for the PerkinElmer® Avio 200 & 500 ICP-OES

Features and Information

Glass Expansion offers it's popular D-Torch for a wide range of ICP-OES and ICP-MS models and is pleased to release a version for PerkinElmer's® Avio 200 & 500 ICP-OES. The new D-Torch for the PerkinElmer® Avio is a direct replacement for the instrument's standard torch. It incorporates the same easy to use, selfaligning feature of the PerkinElmer® Avio 200 & 500 torch. The D-Torch is designed to reduce running costs associated with torch wear when analyzing challenging samples such as organic solvents, fusions or samples containing high total dissolved solids (TDS) or hydrofluoric acid (HF).

The revolutionary D-Torch design uses Glass Expansion's acclaimed high precision engineering capabilities to provide a demountable torch without sacrificing performance or usability. The Glass Expansion D-Torch incorporates an alumina intermediate tube, a demountable injector and outer tube. It is no longer necessary to have multiple torches in your lab, as a single D-Torch with the right alumina, quartz or sapphire injector of the appropriate internal diameter can be used for any application from drinking waters through to organics, high TDS or even HF containing solutions. The replaceable outer tube is much more economical to replace than having to replace the complex quartz assembly of the standard torch. Furthermore, when analyzing really difficult sample types, the quartz outer tube can devitrify in a few hours of operation, whilst the optional ceramic outer tube can last years under the same conditions.

The Major Benefits of the D-Torch are:

- An alumina intermediate tube which resists wear and is tolerant to high temperatures
- A low cost demountable quartz outer tube so just the outer tube can be replaced when worn or damaged
- An optional ceramic outer tube which does not devitrify like quartz, giving a much longer lifetime and significantly lower running costs
- Interchangeable injectors with a choice of internal diameters and materials such as quartz, alumina, and sapphire are available for a wide range of applications and sample types
- O-ring free torch body for simpler maintenance and improved reliability
- Compatible with all commonly used spray chamber configurations

A demountable torch also makes routine cleaning and maintenance easier and the o-ring free torch body also ensures a longer life and lower maintenance costs and downtime. Switching to the D-Torch is a cost-effective alternative to the standard torch that will reduce running costs in any laboratory. For more information on the new D-Torch for the PE AVIO 200 & 500 ICP-OES visit www.geicp.com/D-Torch

PerkinElmer® Syngistix Automated Method Validation Software Module

Validation of analytical methods is a requirement for many types of labs and is a critical step as these labs seek to obtain national or international accreditation. The challenge is in satisfying regulatory compliance while significantly improving data traceability. An example of such regulatory need for method validation is in USP Chapter <233>, which specifies the various tests that a lab should conduct to validate an ICP-MS method for the analysis of elemental impurities in pharmaceutical products.

Manual method validation is time-consuming and prone to errors, negatively impacting productivity. PerkinElmer's Syngistix™ Automated Method Validation module, an extension of Syngistix for ICP-MS software and NexION® ICP-MS instruments, is designed to eliminate inefficiencies by streamlining the workflow and avoiding potential human error of traditional method validation.

The Syngistix Automated Method Validation module replaces traditional paper-based method validation where technical data resides in protocols, notebooks, forms, unprotected spreadsheets, and technical reports. By centralizing all instrument validation data, this improves data traceability and integrity. If installed along with Syngistix for ICP-MS Enhanced Security™ software, the user access control, audit trail, and electronic signatures functions are provided, helping the lab comply with 21 CFR Part 11.

The Syngistix Automated Method Validation module streamlines your method validation and improves compliance by eliminating transcription errors, delivering data traceability and reducing process inefficiencies.