NEWS

Glass Expansion Newsletter | June 2012 | Issue 28

APPLICATION SPOTLIGHT

EXAMINING THE BENEFITS OF A CERAMIC TORCH FOR ICP

The classic ICP torch consists of three concentric fused quartz tubes sealed together, creating a single-piece torch. The outer tube of the ICP torch contains a plasma that can reach temperatures in excess of 6000°C. Contaminating impurities can have a detrimental affect on the life of fused quartz material. Alkaline metals, including Na and Li, act as a flux, accelerating devitrification at temperatures around 1000°C. At this temperature, impurities from samples can become imbedded within the quartz, starting the devitrification process. The disadvantage of the single-piece torch is that it is a relatively high cost consumable item that requires regular maintenance and replacement, particularly with more demanding samples, such as hydrofluoric acid (HF), organic solvents and high dissolved solids.

The D-Torch is a revolutionary new torch design, providing the benefits of a demountable torch at a significantly lower cost without sacrificing performance. In this report we will introduce the benefits of the D-Torch and investigate the use of a ceramic outer tube in place of a quartz outer tube for difficult matrices and reduced plasma gas (coolant) flow rates.

The D-Torch is available for a range of ICP-OES and ICP-MS instruments. It provides the analyst with an outer tube which can be replaced when it fails rather than replacing the entire torch. Interchangeable outer tubes made of quartz or ceramic are available for most D-Torch configurations. The ceramic outer tube is of particular benefit for the analysis of wear metals in engine oils and high salt samples, where quartz outer tubes often suffer from short lifetime. It is also beneficial for low level Si determinations, where quartz outer tubes can produce high background signals. In general, the ceramic outer tube has a much longer lifetime, greatly reducing interruptions and downtime due to torch failure. In addition to an interchangeable outer tube, the D-Torch also features an interchangeable injector. This allows the analyst to have a specific injector for each application whether aqueous, organics, high dissolved solids or HF. Injectors made from high quality quartz, alumina and sapphire are available in a variety of internal diameters to suit your application needs. The D-Torch also incorporates a ceramic intermediate tube for greater robustness. An example of the D-Torch and its components is shown in Figure 1.

*Products shown above are available for the Thermo iCAP 6000 series Radial ICP, ceramic outer tube not available for all ICP models.

Figure 1: D-Torch components with a selection of outer tubes and injectors to best suit your application needs.

GE NEWS

JASIS Japan Analytical & Scientific Instruments Show 2012

JASIS 2012

A full range of Glass Expansion products will be on display at JASIS 2012, Tokyo, Japan, September 5 to 7, 2012 and Glass Expansion specialists will be on hand to assist you.

IN THIS ISSUE:

GLASS EXPANSION
Quality By Design

The ceramic outer tube of the D-Torch is made from sialon, which is a ceramic material derived from silicon nitride. Sialon is one of the most durable and robust ceramic materials known and maintains its properties at high temperatures. A combination of high temperature and salt deposit causes a quartz torch to devitrify. Higher concentrations of salt in the samples lead to more rapid devitrification. By contrast, the ceramic outer tube of the D-Torch does not devitrify and is not affected by salt deposits. The quartz torch in Figure 2a, was run for only 6 hours with samples containing 10% NaCl and is already badly degraded. The ceramic D-Torch in Figure 2b was run for the same period and with the same samples as the quartz torch, but shows no degradation at all. In general, the ceramic outer tube has a much longer lifetime, greatly reducing interruptions and downtime due to torch failure. Sialon is also beneficial for low level Si determinations, where quartz outer tubes can produce high background signals.

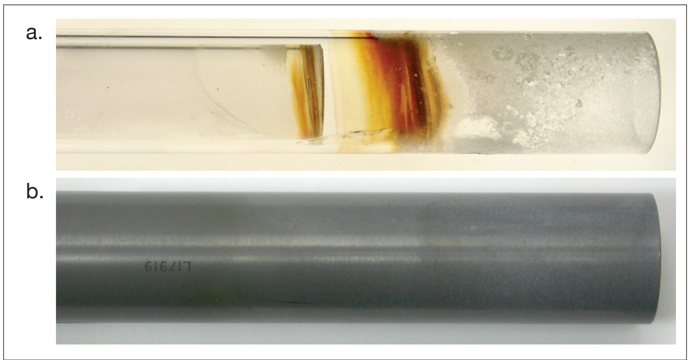


Figure 2: Quartz torch (a) and ceramic torch (b) exposed to 10% NaCl for 6 hours.

The analytical performance of the Thermo Radial EMT quartz torch was compared to the Radial ceramic D-Torch for the analysis of aqueous and high salt samples.[i] The geometry of the two torches is identical, the key differences are the materials used for the outer tube and intermediate tube and that the ceramic D-Torch is demountable. The detection limits in an aqueous matrix for selected elements obtained with the EMT torch and the ceramic D-Torch are compared in Table 1. The results show little difference between the detection limits obtained with the two torches. A key indicator of ICP torch performance is stability. Figure 3 shows a plot of selected elements at 0.5 mg/L in a 3% NaCl matrix. The stability exhibited by the ceramic D-Torch over a period of 5.5 hours in this high matrix sample is excellent. The ceramic D-Torch provides equivalent analytical performance to the standard EMT torch with the added advantage of resistance to devitrification and premature failures with specific sample matrices, including organics and high dissolved solids samples such as fusions.

	Detection Limit µg/L	
Element (λ)	Radial EMT Torch	Radial Ceramic D-Torch
Al 167	1.6	1.1
Ba 455	0.07	0.12
Cu 324	0.88	0.62
K 766	25.5	11.7
Mg 279	0.05	0.05
Mn 257	0.36	0.25
Ni 221	1.6	1.3
P 177	5.1	5.0
Zn 213	0.23	0.28

Table 1: Comparison of detection limits for EMT Torch and Ceramic D-Torch.[i]

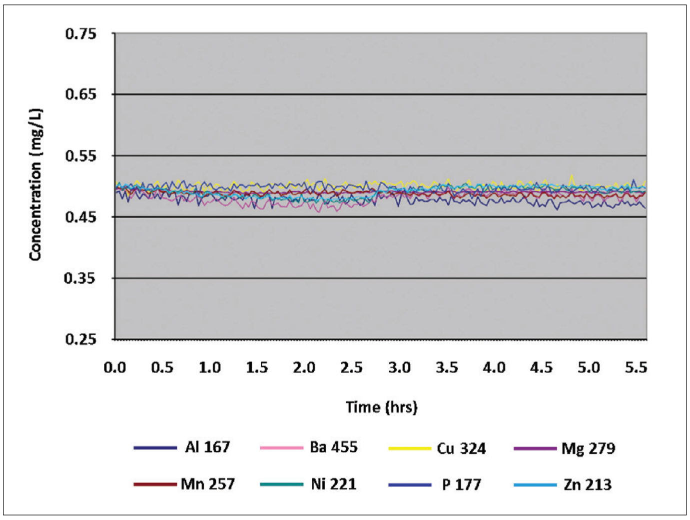


Figure 3: Stability of elements in 3% NaCl solution using ceramic D-Torch.[i]

ARGON CONSERVATION

A stream of argon gas between the outer and intermediate tubes of the ICP torch is required to provide a cooling sheath to prevent the torch from melting in the 6000°C plasma. Quartz can require flow rates as high as 20 L/min in order to provide an adequate cooling sheath. This high consumption of argon can constitute a significant cost of up to several thousand dollars per year. In contrast to quartz which has a lower melting point, sialon has a melting point above 2100°C and therefore needs much less cooling. With a fully ceramic D-Torch in place of the standard quartz torch, argon flow rates can be reduced down to 10L/min. To examine the performance of the D-Torch at a reduced plasma (coolant) gas flow, detection limits were compared at 16L/min and 10L/min in matrices consisting of 2% HF and 2% HNO_3. These experiments were conducted in collaboration with Jayme Curet of Thermo Scientific using an iCAP 6000 Duo series ICP-OES and a fully ceramic D-Torch. For both matrices the iCAP operating conditions were optimized for best signal-to-noise ratio. The operating conditions are listed in Table 2.

ICP Parameter	2% HF		2% HNO_3	
	Standard	Low Flow	Standard	Low Flow
RF Power (W)	750	750	750	750
Auxiliary gas flow (L/min)	0.50	0.50	0.50	0.50
Nebulizer gas flow (L/min)	0.75	0.70	0.65	0.65
Plasma gas flow (L/min)	16	10	16	10
Sapphire injector ID (mm)	2.0	2.0	2.0	2.0
Solution flow rate (mL/min)	2.0	2.0	2.0	2.0

Table 2: iCAP operating conditions for 2% HF and 2% HNO_3 work

The detection limits for both matrices listed in Table 3 were calculated using the standard deviation of 7 replicates and the student T value for a 98% confidence level. The wavelengths examined show little difference in the detection limits obtained between a plasma gas flow rate of 16 and 10L/min. The HF stability data shown in Figure 4 also shows there is no sacrifice in plasma stability running the plasma gas flow rate at 10L/min.

The average RSD for a number of wavelengths collected over 3 hours was less than 1.5%. The results show that an analyst who is not dealing with a difficult matrix such as high dissolved solids, can also benefit from utilizing a fully ceramic D-Torch by greatly reducing argon consumption and costs. Due to the thermal stress on the quartz torch, operating at 10L/min would not be possible. The D-Torch also provides the durability of being able to handle difficult matrices such as HF, high dissolved salts, and organic solvents without sacrificing analytical performance at both standard and low flow plasma gas

	2% HF Detection Limit µg/L		2% HNO_3 Detection Limit µg/L	
Element (λ)	16 L/min	10 L/min	16 L/min	10 L/min
Al 167	1.18	4.90	1.35	1.54
Ba 455	1.21	3.26	0.23	0.05
Cd 214	0.31	0.16	0.12	0.31
Co 228	0.44	0.16	0.31	0.46
Cr 267	0.52	0.40	0.86	0.93
Cu 221	1.03	1.41	0.78	1.57
K 766	1.08	1.23	0.64	1.30
Mg 279	0.26	0.50	0.53	0.64
Mn 257	0.07	0.16	0.15	0.28
Ni 221	0.97	0.70	0.56	2.59
Pb 220	2.42	1.95	1.77	6.88
Zn 213	0.52	1.74	0.23	0.54

Table 3: Detection limits obtained with a fully ceramic D-Torch at 16L/min and 10L/min.

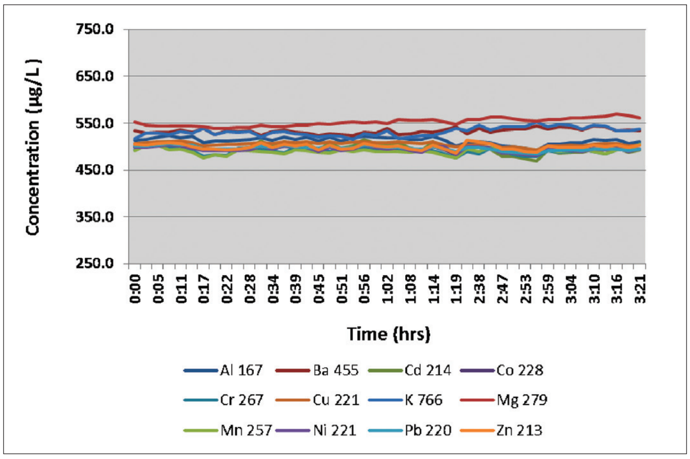


Figure 4: Stability with HF at plasma gas flow rate of 10L/min with fully ceramic D-Torch.

ICP FIGURES OF MERIT

The common ICP figures of merit established by Poussel and Mermet examine plasma robustness, atomization/ionization, excitation and stability.[ii] In our research laboratory we compared the ICP figures of merit at plasma gas flow rates of 15.0L/min and 10.0L/min on a Thermo iCAP Duo and Perkin Elmer Optima ICP. The Mg 280/Mg 285 ratio shown in Figure 5a, is monitored to measure the robustness the plasma. The results show a slight increase in plasma robustness on both the iCAP and Optima at a plasma gas flow rate of 10.0L/min.

The nebulizer efficiency and plasma stability results are summarized in Figure 5b. The Zn 206/Ba 233 ratio is used to measure excitation efficiency of the ICP. As a measure of nebulizer efficiency the RSD for Mg 285 line is monitored and the RSD for Ar 404, Zn 206, and Ba 455 lines are used to measure signal stability, with the lowest RSD being the most efficient and stable. The measurements compared in Figure 5b are virtually the same at 15.0L/min and 10.0L/min, proving that there is little compromise in ICP performance at a lower plasma gas flow.

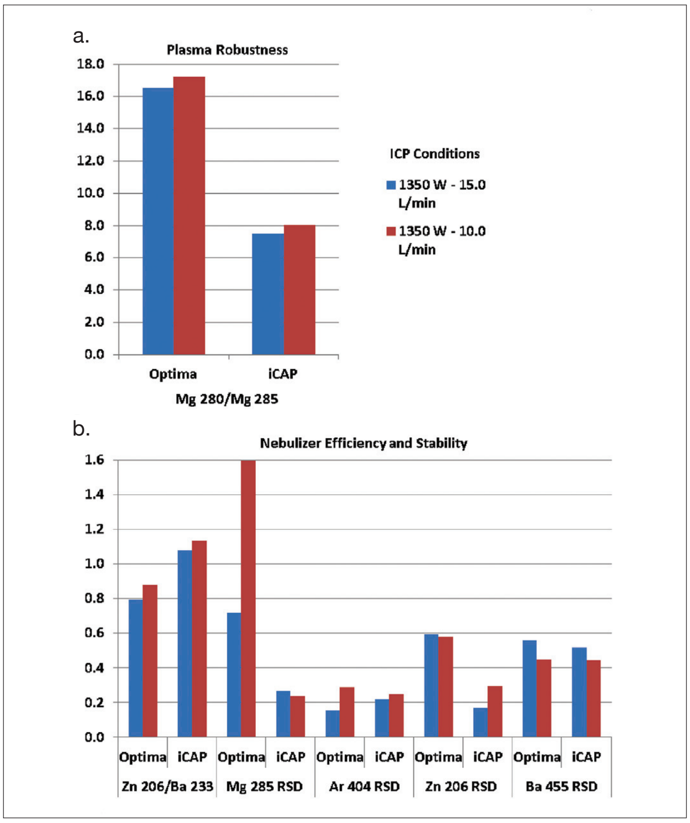


Figure 5: ICP figures of merit examining plasma robustness (a) and nebulizer efficiency and stability (b) at plasma gas flow rates of 10.0 and 15.0L/min with a ceramic D-Torch.

Conclusions

In summary, the ceramic D-Torch, in comparison to quartz, provides the analyst with reduced argon consumption, a more robust plasma, and longer life. The expected lifetime of the ceramic D-Torch is at least 5 times that of a quartz torch when dealing with difficult matrices, making the ceramic D-Torch a cost effective solution to reduce some of the traditional consumable costs associated with ICP. Additionally the ceramic D-Torch provides the analyst with the ability to run the ICP at a reduced plasma gas flow with no loss in performance.

Reference

i. Thermo Scientific Technical Note #43053, *Radial Demountable Ceramic Torch for the Thermo Scientific iCAP 6000 Series ICP spectrometer*, 2010.

ii. E. Poussel and J. M. Mermet, *Simple experiments for the control, the evaluation and the diagnosis of Inductively coupled plasma sequential systems*, Spectrochimica Acta, 1993.

NEW PRODUCTS

Peltier Cooled Cyclonic Spray Chamber for Agilent ICP-MS

The IsoMist Programmable Temperature Spray Chamber is now well-established as the first choice when temperature flexibility or temperature stability are required. However, for many ICP-MS applications, a fixed temperature of around 2°C is used and no flexibility is needed. For these applications, Glass Expansion has released Peltier Cooled Cyclonic Spray Chambers for the Agilent 7700 and 7500 ICP-MS models. This accessory is based on the spray chamber and Peltier system of the Isomist but is coupled to the electronics and water cooling systems of the ICP-MS. Agilent 7700 and 7500 users can therefore get the benefit of a cyclonic spray chamber at an economical price. Compared to the Scott style spray chamber, the cyclonic spray chamber provides faster washout and increased sample throughput.

Part No.	Description
KT-1092	PCC Spray Chamber for Agilent 7700
KT-1109	PCC Spray Chamber for Agilent 7500

The key features are:

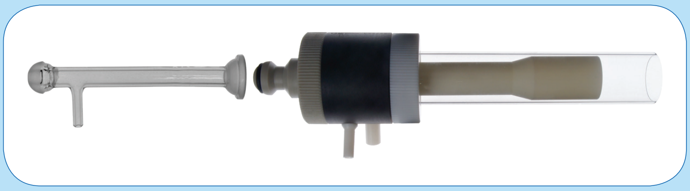
- Interchangeable glass, quartz and PFA cyclonic spray chambers
- Faster washout than standard Scott style spray chamber
- Higher sample throughput than standard Scott style spray chamber
- Temperature 2°C or 5°C
- Temperature controlled from ICP-MS software and electronics
- Uses standard water cooling from ICP-MS unit
- Peltier cooling system
- Supplied with convenient mounting bracket

Click here to view the Pittcon presentation.

D-Torch for Agilent ICP-MS

The D-Torch is a new demountable torch design that provides the benefits of a fully demountable torch at a significantly lower cost. We have previously released the D-Torch for several ICP-OES and ICP-MS models. D-Torches are now available for the Agilent 7700 and 7500 ICP-MS models.

Part No.	Description
30-808-3305	D-Torch for Agilent 7700
30-808-3015	D-Torch for Agilent 7500



The D-Torch is a cost-effective alternative to the standard fixed torch or semi-demountable torch. It will save money for any laboratory with a moderate workload. In most cases, when the torch wears, you will only need to replace the outer tube instead of replacing the entire torch. You will realize a saving after replacing the outer tube three or four times. In addition, interchangeable injectors are available to suit samples with organics, high solids or HF.

Click here to see the full D-Torch range.

ConeGuard Thread Protector

When cleaning cones which have a screw thread, it is important that the thread is not contacted by any corrosive solution. If the thread gets corroded, the cone may not seal correctly or it may bond to the base and be difficult to remove. And with Pt cones, the thread is likely to wear out before the Pt insert.

Comments from the PLASMACHEM discussion group include:

"We noticed that the threads of the Copper based, Pt skimmer cones would wear out long before the Pt insert."

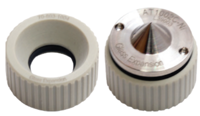
"We tend to clean the cones in dilute acid and judge they are clean when they have a salmon pink "new penny" appearance. It is in this condition that the copper cone is likely to cold weld to the copper threaded insert in the interface assembly, and to the flat thermal transfer area outside the thread."

NEW PRODUCTS

ConeGuard Thread Protector (continued)

The Glass Expansion ConeGuard Thread Protector seals the thread and protects it from corrosion during the cleaning process. The following ConeGuards are available:

Agilent 7500&4500

ConeGuard P/N	Cone P/N	OEM Cone P/N	Cone Description
70-803-1000	AT1001-Ni	G1820-65238	Nickel Sampler Cone for Agilent 4500/7500
	AT1001T-Ni	G1820-65480	Nickel Sampler Cone for Agilent 7500 - T-Mode
	AT1006-Pt	G1820-25239	Platinum Sampler Cone for Agilent 4500/7500
70-803-1002	AT1002-Ni	G1820-65050	Nickel Skimmer Cone for 4500/7500a
	AT1002T-Ni	G1820-65481	Nickel Skimmer Cone for Agilent 7500 - T-Mode
	AT1008-Pt	G1820-65237	Platinum Skimmer Cone for Agilent 4500/7500
70-803-1004	AT1002C-Ni	G1833-65497	Nickel Skimmer Cone - 7500c
	AT1002CE-Ni	G3270-65024	Nickel Skimmer Cone - 7500ce
	AT1008C-Pt	G1833-65092	Platinum Skimmer Cone - 7500c
	AT1008CS-Pt	G1833-65132	Platinum Skimmer Cone, Copper Base - 7500cs, 7500ce
	AT1008CS-Pt/Ni	G3270-60106	Platinum Skimmer Cone, Nickel Base - 7500cs

Agilent 7700

ConeGuard P/N	Cone P/N	OEM Cone P/N	Cone Description
70-803-1004	AT7702S-Ni	G3280-67066	Nickel Skimmer Cone for Agilent 7700s
	AT7702S-Cu	G3280-67067	Copper Skimmer Cone for Agilent 7700s
	AT7708S-Pt	G3280-67064	Platinum Skimmer Cone for Agilent 7700s
	AT7708S-Pt/Ni	G3280-67065	Platinum Skimmer Cone with Nickel Base for Agilent 7700s
70-803-1008	AT7702X-Ni	G3280-67041	Nickel Skimmer Cone for Agilent 7700x
	AT7708X-Pt	G3280-67060	Platinum Skimmer Cone for Agilent 7700x
	AT7708X-Pt/Ni	G3280-67063	Platinum Skimmer Cone with Nickel Base for Agilent 7700x

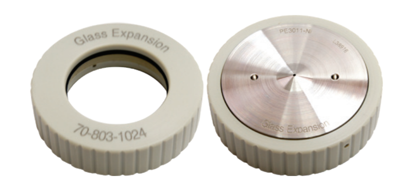
PerkinElmer Elan

ConeGuard P/N	Cone P/N	OEM Cone P/N	Cone Description
70-803-1022	PE2012-Ni	WE021137	Nickel Skimmer Cone for Elan
	PE2012-Al		Aluminum Skimmer Cone for Elan
	PE2014-Pt	WE027803	Platinum Skimmer Cone for Elan

NEW PRODUCTS

ConeGuard Thread Protector (continued)

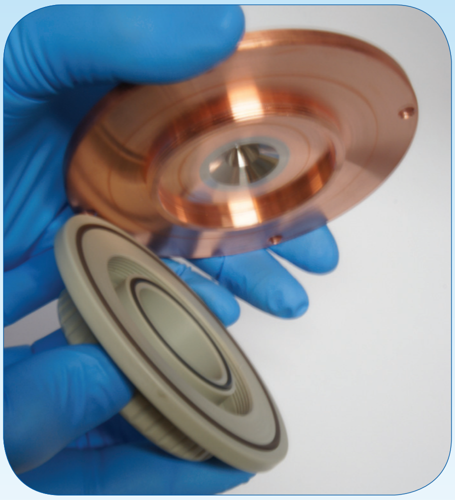
PerkinElmer NexION

ConeGuard P/N	Cone P/N	OEM Cone P/N	Cone Description
70-803-1024	**PE3011-Ni**	W1033612	Nickel Sampler Cone for NexION
	**PE3013-Pt**	W1033614	Platinum Sampler Cone for NexION
70-803-1026	**PE3012-Ni**	W1026356	Nickel Skimmer Cone for NexION
	**PE3014-Pt**	W1026907	Platinum Skimmer Cone for NexION

HINTS FOR THE OPERATOR

Safeguard your ICP-MS cones with Glass Expansion's NEW ConeGuard

Some ICP-MS cones are clamped to the base and others have a screw thread and are screwed onto the base. With the threaded cones, it is very important to look after the threaded part of the cone. One potential problem is corrosion of the thread when the cone is placed in a corrosive solution for cleaning. The new ConeGuard Thread Protector seals the thread and protects it from exposure to the cleaning solution. To clean your cone without damaging the thread, the most effective procedure is:



1. Screw the ConeGuard onto your cone.

2. Place the Cone and ConeGuard in a ziplock plastic bag half filled with your cleaning solution.

3. Float the ziplock bag in an ultrasonic bath filled with water and sonicate for 5 to 10 minutes. The use of the ziplock bag prevents the cone from contacting the hard surfaces of the bath and also reduces the amount of cleaning solution required.

For full details of cone cleaning procedures, please refer to the **Care of ICP-MS Cones** section of our website.

INSTRUMENT NEWS

From HORIBA Jobin Yvon – Rare Earth Elements – Unrivalled performance with High Resolution ICP-OES

In the last decades Rare Earth Elements (REEs) have become uniquely indispensable in many electronic, optical, magnetic and catalytic applications. Huge extraction activity exists worldwide but alternative resources are also explored such as recycling of lamps or electronic wastes. Purification of extracted REEs has to be done and final product purity has to be determined before their commercial or R&D use. ICP-OES is the most adequate technique to analyze traces of REEs in a REE matrix due to its multi-element analysis capability and its tolerance to high concentrations of total dissolved solids. Due to line-rich spectra emitted, high resolution is mandatory to achieve high performance and accurate analysis.

Find out how the HORIBA Jobin Yvon ULTIMA 2 ICP-OES spectrometer offers unrivalled performance in the new application note "Analysis of Traces of Rare Earth Elements in a Rare Earth Element Matrix using High Resolution ICP-OES". In this application note you will read:

- How high resolution ICP-OES solves the analytical problem of very rich line spectra.
- How torch design offers stability and accuracy for final results.

Download this application note at **www.horiba.com/scientific/products/atomic-emission-spectroscopy/application-notes/geology/** and visit **www.horiba.com/scientific/products/atomic-emission-spectroscopy/application-notes/** for other ICP Application Notes.

From SPECTRO – Determination of Platinum Group Elements by Laser Ablation ICP-MS

As a seemingly safe financial investment, the precious metals have been traded at high prices on stock exchanges. The focus of this interest has been, in addition to gold and silver, the so-called platinum group elements. The result: Mining companies around the world are focussing on even the smallest deposits of platinum, ruthenium, osmium, rhodium, iridium and palladium and the options to rework mine tailings. The decision as to whether or not development of such minimal deposits is worthwhile is usually made in the analytical laboratory. Here high performance instruments determine the precious metal contents in this kind of samples.

SPECTRO has released a **new application report** that documents the use of the SPECTRO MS simultaneously measuring ICP mass spectrometer for this demanding application. In the report you'll discover:

- Why a mass spectrometer with laser ablation is the perfect technology for the analysis of the platinum group elements
- Why lower spectral interferences between the sample material and argon plasma occur with the SPECTRO MS than with other mass spectrometers – and what influence this has on the measurement results
- How you can permanently increase your sample throughput with simultaneous analysis using the SPECTRO MS and achieve more exact, precise and reproducible results at the same time.

Interested? Then request the new application report **"Determination of Platinum Group Elements (PGE) in Solid Samples by Laser-Ablation-ICP-MS"** today – and convince yourself of the exceptional performance that the SPECTRO MS offers in this area.