

Tech Note

PlasmaQuant MS Series: ReflexION

ReflexION: Reflecting Ion Optics Design for Tunable Sensitivity and Efficient Routine Sample Analysis

Introduction

The PlasmaQuant MS is equipped with the unique ReflexION, an ion mirror that reflects ions by 90 degrees. This allows for exceptional sensitivity – more than 1.5 Gcps per mg/L (1500 million cps per mg/L) without sacrificing oxide interferences ($\text{CeO}^+/\text{Ce}^+ < 2\%$). The PlasmaQuant MS also provides the flexibility to choose the optimum sensitivity for each sample type and application.

ReflexION ion mirror optics for ICP-MS

The ReflexION produces a parabolic electrostatic field that reflects and focuses ions by 90 degrees (Figure 1). This concept allows for controlling the ion beam along x, y and z-axis (3 D), disregarding the energy spread of the ions. As a result, a sharply focused, round shaped ion beam (\varnothing 1 mm) enters the mass analyzer guaranteeing the highest possible sensitivity. Its hollow structure allows photons, neutrals and particles to pass straight through. These unwanted species are removed by the vacuum pump which is mounted behind the ion mirror.

Your Benefits

- Superior sensitivity as the ion beam is reflected by 90° and tightly focused before entering the quadrupole
 - Easy optimization for optimum sensitivity across the entire mass range, expanding the linear dynamic range thanks to full 3D ion beam control
 - Low background as photons and neutrals pass straight through
 - No contamination – no maintenance
 - Excellent long term signal stability
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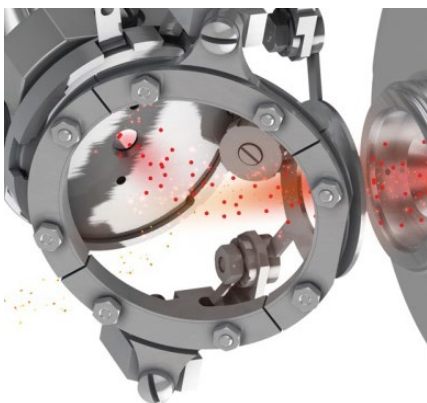


Figure 1: 90 degree reflecting ion optics system with ReflexION

The ReflexION is engineered to prevent all parts from contamination. This guarantees a maintenance free operation of all components in the high vacuum area of the PlasmaQuant MS.

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Tunable sensitivity

The ion mirror is highly efficient, delivering >1500 Mcps per mg/L with <2% CeO⁺/Ce⁺ under high sensitivity conditions. Voltages applied to the ion mirror lenses allow for a three dimensional control of the focal point. This enables an optimization of the instrument sensitivity appropriate to particular applications. The ReflexION can be tuned for optimum sensitivity across the whole mass range, typical for multi-element applications. This tuning can be applied for routine sample analysis in environmental applications as well as for multi-element characterization of food and agricultural samples. For targeted applications in various types of research fields the optimization can be focused on high sensitivity for a certain mass range. Isotope ratio analyses, single particle characterization and solid sample analyses using laser ablation benefit from a high sensitive optimization capability.

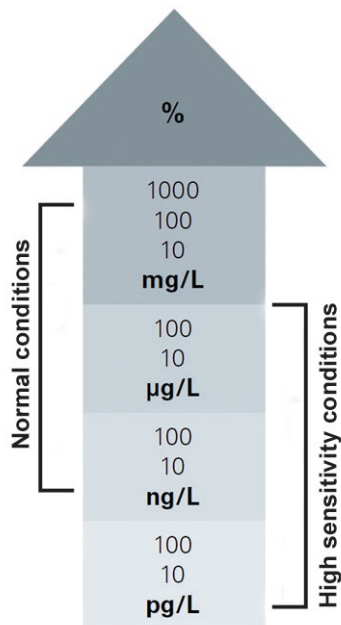


Figure 2: Normal conditions: Best suited to heavy matrices ideal for trace level determination. High sensitivity conditions: Ideal for ultra-trace level determination well suited to semi-conductor applications.

By selecting 'normal' conditions with reduced sensitivity the concentration range can be extended into the hundreds of mg/L, while maintaining robust conditions for high matrix samples. No hardware changes are required to switch between 'normal' and 'high sensitivity' conditions.

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Recovery and stability test for reference materials

- Certified reference materials (High Purity Standards)
- Equivalent of 1 g solid sample digested into 100 mL
- Diluted x10 for analysis
- Aqueous calibration standards in 1% HNO³
- Internal standards added to all solutions: ⁶Li, ⁸⁹Y, ¹¹⁵In, ¹⁵⁹Tb, ²⁰⁹Bi
- Each measured in duplicate
- Soil Solution A: CRM-SOIL-A
- River Sediment Solution A: CRM-RS-A

Table 1 shows the high recoveries achieved on the Certified Reference Material CRM-SOIL-A. Figure 3 shows the Stability Chart for CRM-RS-A. CRM-RS-A was run for 5 hours and good stability was achieved as shown by the good relative standard deviation values (typically <3% for a range of elements) over the 5 hour analysis time.

Table 1: SOIL-A recoveries

Isotope	Measured (ppb)	Certified (ppb)
⁵¹ V	10.6	10
⁵⁵ Mn	12.5	10
⁶⁰ Ni	30.5	30
⁶⁵ Cu	30.9	30
⁶⁶ Zn	104.1	100
⁷⁵ As	20.6	20
⁸² Se	1.0	1

Isotope	Measured (ppb)	Certified (ppb)
¹¹¹ Cd	0.3	0.3
¹²¹ Sb	3.1	3
¹³⁷ Ba	459.6	500
^{206,7,8} Pb	39.5	40
²³² Th	10.6	10
²³⁸ U	1.1	1

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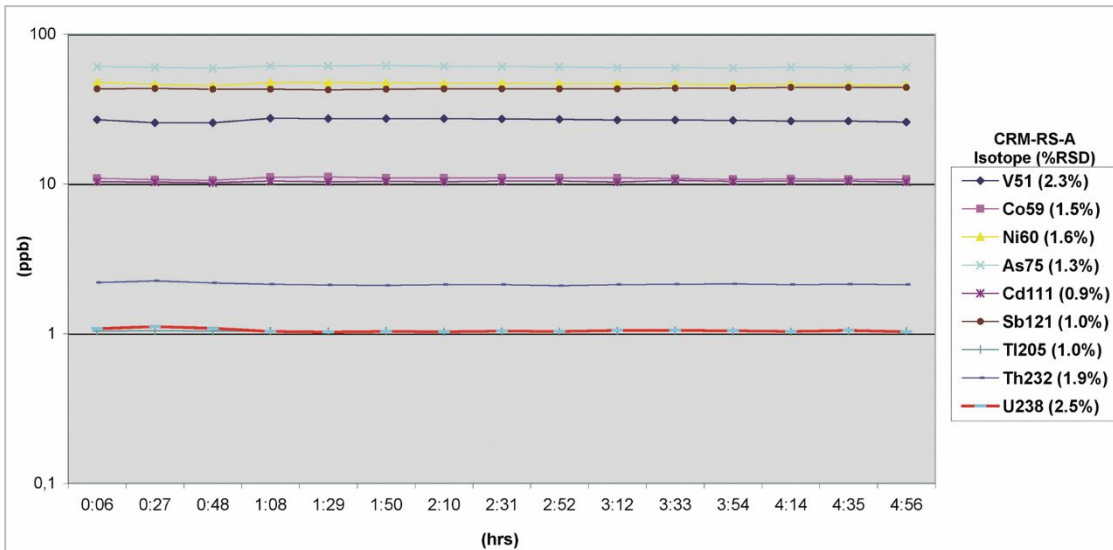


Figure 3: Stability chart for CRM-RS-A

Summary

Tunable Gigahertz sensitivity provides the flexibility to choose instrument conditions that suit the sample and the expected analyte concentration range.

The analysis of a Certified Reference Material shows good match for the concentrations of a range of elements using aqueous calibration standards under 'Normal' conditions.

Good long term (5 hour) stability was achieved for a variety of elements in a Certified Reference Material, with no sign of interface blockage or ion lens contamination.

The tunable sensitivity of the ReflexION ion optic design offers an unmatched flexibility in ICP-MS analysis.

Further information

For further updates, applications and other literature, please visit the Analytik Jena website at www.analytik-jena.com.

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