Varian 810-MS and 820-MS

Innovative High Sensitivity 90-degree Reflecting ICP-MS Ion Optics for Routine Sample Analysis

Shane Elliott, Iouri Kalinitchenko and Thorsten Hoss
Varian, Inc.

Introduction

The new patented 90 degree reflecting ion optics system in the Varian 810/820-MS delivers exceptional sensitivity—more than 1 Gcps per mg/L (1000 million cps per mg/L). This extreme sensitivity is achieved without sacrificing oxide interferences (CeO^+/Ce^+ <3%). The Varian 810/820-MS also allows flexibility to choose the sensitivity mode that is most useful for the sample type, or application, at hand.

This Advantage Note outlines some of the performance capabilities of the new system for routine sample analysis. Recovery and stability results from reference materials are shown.

Ion Mirror Optics for ICP-MS

Ions are reflected and focused at 90 degrees by the parabolic electrostatic field produced by the ion mirror (Figure 1). The ion mirror has a hollow structure so that photons and neutrals pass through, and contamination of ion optics is reduced. The vacuum pump mounted behind ion mirror removes unwanted particles, and creates a highly efficient vacuum.

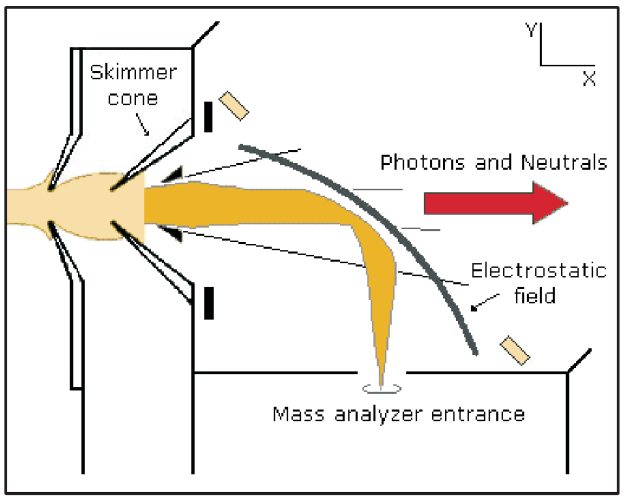

Figure 1. 90 degree reflecting ion optics system

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Tunable Gigahertz Sensitivity

'High Sensitivity' Mode Hot Plasma

The ion mirror is highly efficient, delivering >1 Gcps per mg/L and <3% CeO^+/Ce^+ under high sensitivity mode conditions.

By selecting 'normal mode' 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 modes.

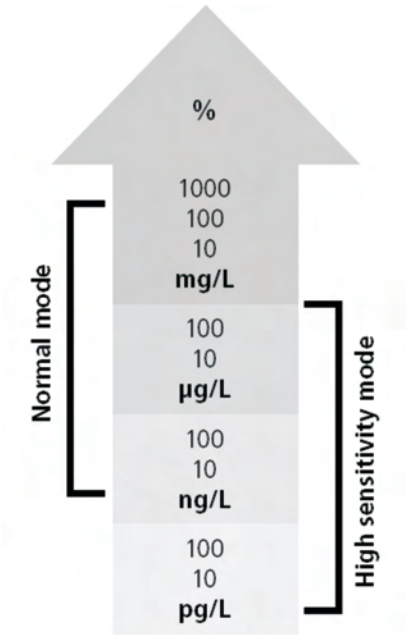

Figure 2. **Normal Mode** Best suited to heavy matrices, ideal for trace level determination. **High Sensitivity Mode** Ideal for ultra-trace level determination, well suited to semi-conductor applications.

Reference Material Results

'Normal' Mode

- 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% HNO_3
- Internal standards added to all solutions: ^{6}Li, ^{89}Y, ^{115}In, ^{159}Tb, ^{209}Bi
- 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 % RSDs (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
^{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

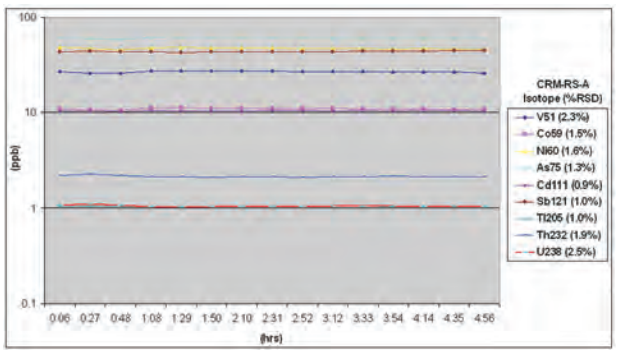

Figure 3. Stability chart for CRM-RS-A

Summary

Tunable Gigahertz sensitivity allows the flexibility to choose instrument conditions to suit the sample and the desired analyte concentration range.

Good recoveries were achieved on a Certified Reference Material for a range of elements using aqueous calibration standards under 'Normal' sensitivity mode 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.