

**Thermo Scientific ELEMENT GD  
Glow Discharge Mass  
Spectrometer**



*Reset Your Expectations*

## Thermo Scientific ELEMENT GD

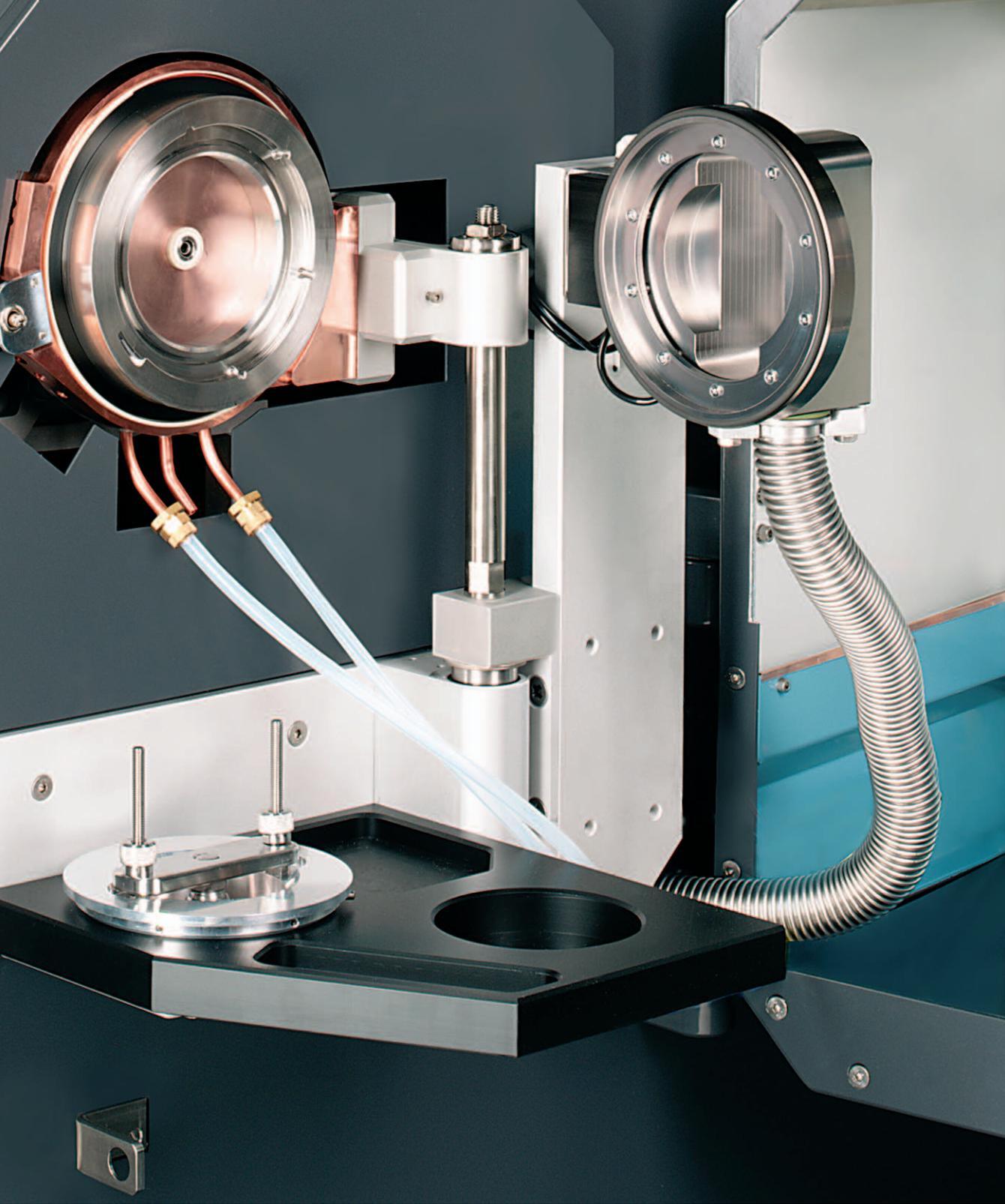
Glow Discharge Mass Spectrometer

The ELEMENT GD, a combination of a glow discharge ion source with a high resolution mass spectrometer, is the ultimate tool for the direct analysis of conductive materials. Almost all elements present in a solid sample, including carbon, can be detected and routinely quantified. Many elements can be analyzed down to the ppt (parts per trillion) range.

The ELEMENT GD is tailored to serve high purity metal manufacturers as well as their customers in industries such as:

- Microelectronics
  - Copper, Aluminum, Sputter Targets
- Aerospace
  - Aluminum, Stainless Steel, Alloys
- Medical/Pharmaceutical/Food
  - Stainless Steel, Alloys
- Nuclear
  - Uranium, Nuclear Fuel





**Reset your expectations  
for the elemental analysis  
of solid samples**

## Technology

The Thermo Scientific ELEMENT GD combines components with superior attributes in an instrument incomparable in speed, sensitivity and accuracy.

### Overview

- Fast flow, high power glow discharge cell
    - Short analysis time due to high sputter rates
    - Superior sensitivity
  - State of the art double focusing mass spectrometer
    - Incomparable signal to noise ratios resulting from high ion transmission combined with a low background leading to sub-ppb detection limits
    - Maximum level of selectivity and accuracy due to high mass resolution: a prerequisite for indisputable analytical results
  - More than 12 orders of magnitude automatic detection system
    - Determination of ultra-traces and matrix elements within a single scan, due to a fully automatic detector with > 12 orders of linear dynamic range
    - Direct determination of the matrix elements for IBR (Ion Beam Ratio) quantification
  - State-of-the-art software suite for productivity and ease-of-use
    - Full computer control of all parameters
    - Fully automated tuning, analysis and data evaluation
    - LIMS connectivity with automatic data transfer
    - Remote control and diagnostic
    - Microsoft® Windows® XP Operating System
- Quantitative multi-element analysis across the periodic table
  - Less than 10 minutes sample turn-around
  - Matrix to ultra-trace detection capabilities in a single scan
  - Depth profiling
  - Minimum matrix effects for straightforward quantification



The ELEMENT GD ion source and sample holder is designed for easy sample change-over, offering routine operation and high throughput.

### Easy Sample Handling

The ingenious and yet simple design of the Glow Discharge Source reduces sample to sample switching to a fraction of the time it used to be. The sample itself is placed in a vacuum chamber, completely eliminating any risk of leak between the sample and the GD cell (Figure 1). The sample holder can quickly and easily be removed from the ion source, simply unloaded and re-loaded, and repositioned for the next measurement (Figure 2). Opening and closing of the ion source manifold is fully automatic.

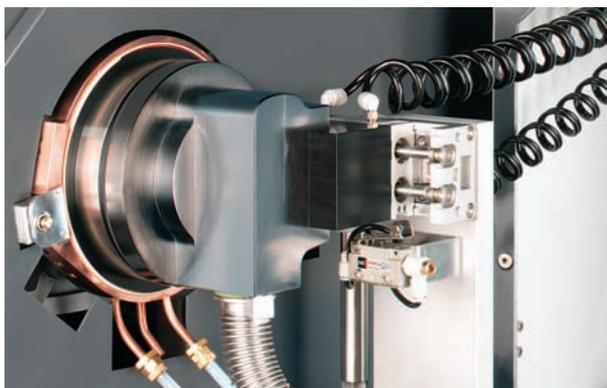


Figure 1: Evacuation of the vacuum manifold requires a few seconds



Figure 2: Placement of the sample holder in the GD source



## The Ion Source

Thermo Scientific ELEMENT GD - The Power to do More: No more than 5 minutes are required to analyze 50 elements in the low ppb range.

### The Ion Source

A glow discharge occurs when a potential difference is applied between two electrodes in a cell filled with gas (in most cases Ar) at reduced pressure. In a configuration for elemental analysis the sample acts as the cathode, and its surface is sputtered by impacting gas ions. The sputtered neutral atoms are ionized downstream in the plasma. Because the processes of sputtering and ionization are separated, minimal non-spectral matrix effects are observed. Therefore, perfect conditions can be achieved for the establishment of Relative Sensitivity Factors (RSF), enabling quantitative analysis or using simple Ion Beam Ratios (IBR) for semi-quantitative analysis.

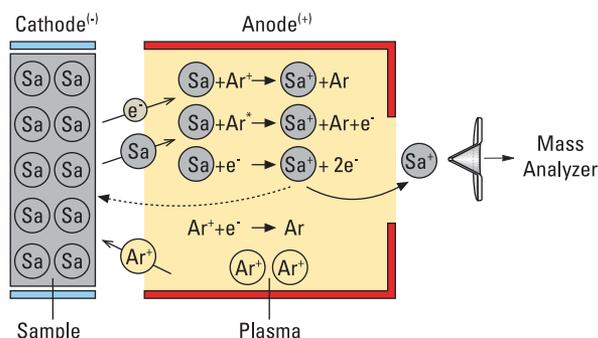


Figure 3: The Glow Discharge process

The new ELEMENT GD ion source takes full advantage of the intrinsic features of a glow discharge ion source, delivering RSF stability and high sputter rates. At the same time it offers a simple and fast sample change-over, providing routine operation and high throughput without any compromise in performance.

High throughput is additionally supported by electronic (Peltier) sample cooling (or heating), eliminating the need for cooling with cryogenic gases. There is a much reduced requirement for perfectly flat samples because the sample is not used as a vacuum seal. Proper vacuum condition is guaranteed by a separate vacuum manifold employing an optimized sealing mechanism. This, due to its negligible leak rate, enables the measurement of oxygen, nitrogen and carbon at low concentrations.

### ELEMENT GD DISCHARGE PARAMETERS

Discharge gas flow (typically): 300 - 500 mL/min
Voltage: 500 - 1400 V
Current: 5 - 75 mA
Intelligent matching of parameters ensures controlled sample sputtering

### Characteristics of the ELEMENT GD Glow Discharge Source

- 2-3 minutes data acquisition time at ppb concentrations
- High sensitivity for short analysis times
- Fast and simple sample to sample switching
- No cryo-cooling
- Flexible cell for flat samples or pressed powders
- Disposable flow tubes to eliminate the risk of cross contamination
- Easy and fast changeable anode
- Variable sputter rates for bulk analysis or depth profiling
- Large sputtered sample area for representative surface sampling

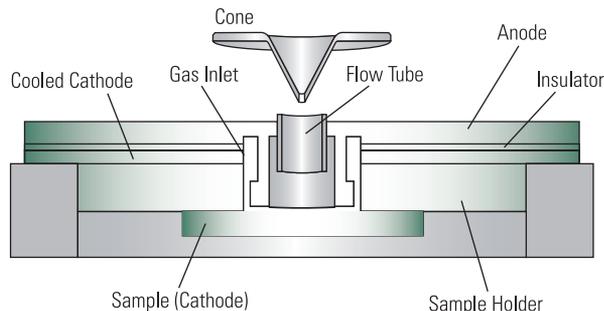


Figure 4: Schematic of the Glow Discharge Ion Source



# The Mass Spectrometer

High mass resolution is a prerequisite for accurate interference-free analysis.

## The Mass Spectrometer

The ELEMENT GD glow discharge mass spectrometer uses advanced high resolution magnetic sector field technology. The primary limitation of GD-MS is the presence of spectral interferences arising from the combination of matrix elements and the discharge gas with other species in the plasma. Consequently high mass resolution is a prerequisite for the accurate determination of analytes, separated from the majority of possible interferences.

The ELEMENT GD provides interference free measurements resulting in simple linear calibration curves for quantification. Three fixed resolution settings, with switching times of < 1 s, ensure optimum conditions to reliably remove spectral interferences. Any combination of resolution setting can be performed within a single analysis. The patented fixed-slit design guarantees maximum stability and reproducibility.

The analyzer of the ELEMENT GD is optimized for speed and mass stability. The magnet is designed for the mass range 2-260 u, just right for the demands of elemental analysis. It is relatively small, highly laminated, water cooled and driven by a sophisticated high power regulator: Magnet switching and settling times do no longer slow down the analysis.

High precision and accuracy of the mass calibration is vital for short analysis times, allowing precise peak top jumping. Due to an ingenious, fully automatic mass locking process, mass calibration is necessary only once per several months.

### ELEMENT GD

Mass stability: 25 ppm / 8 hour

Scan speed: < 150 ms from m/z 7 to 238 to 7

Resolutions:  $\geq 300$ ,  $\geq 4000$ ,  $\geq 10000$  with < 1 s switching times

Sensitivity (peak height, total ion current):  $> 1 \times 10^{10}$  cps, ( $1.6 \times 10^{-9}$  A) for copper in medium resolution ( $R \geq 4000$ )

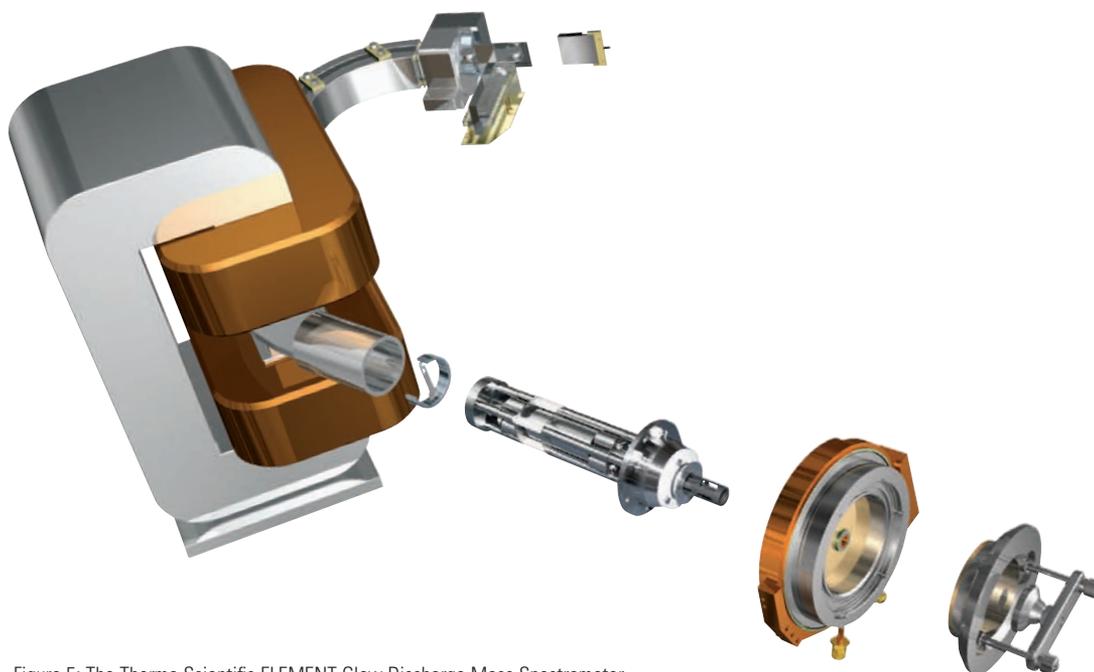


Figure 5: The Thermo Scientific ELEMENT Glow Discharge Mass Spectrometer

# Thermo Scientific ELEMENT GD: Measure 50 elements at low ppb within 5 minutes

## Detection System

A sophisticated detection system completes the refined design of the ELEMENT GD.

### Detection System

Since matrix elements (%), traces (ppm), and ultra-traces (ppb to ppt) need to be analyzed simultaneously, the detection system offers:

- Wide dynamic range: 0.5 cps to  $> 10^{12}$  cps
- High speed: down to 1 ms integration time
- Automatic, fast switching between different detection modes
- Automatic cross calibration between different detection modes

In the ELEMENT GD this is achieved through the use of a unique and novel combination of a dual mode (dark noise  $< 0.5$  cps) secondary electron multiplier (SEM) and a Faraday collector (maximum current  $> 10^{12}$  cps). The Faraday detector does not lengthen analysis time: due to its fast detection electronics it does not suffer decay times and allows integration times down to 1 ms.

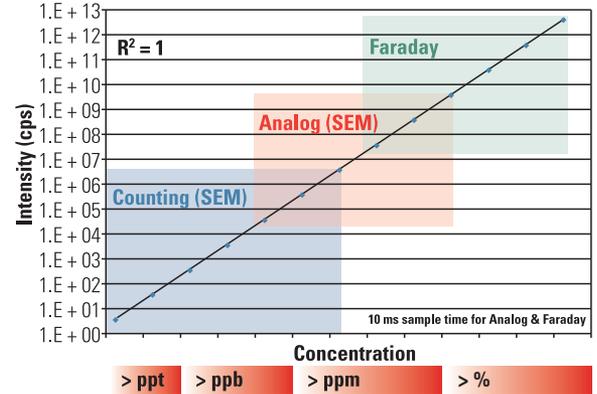


Figure 7: Dynamic range of the ELEMENT GD Detection System

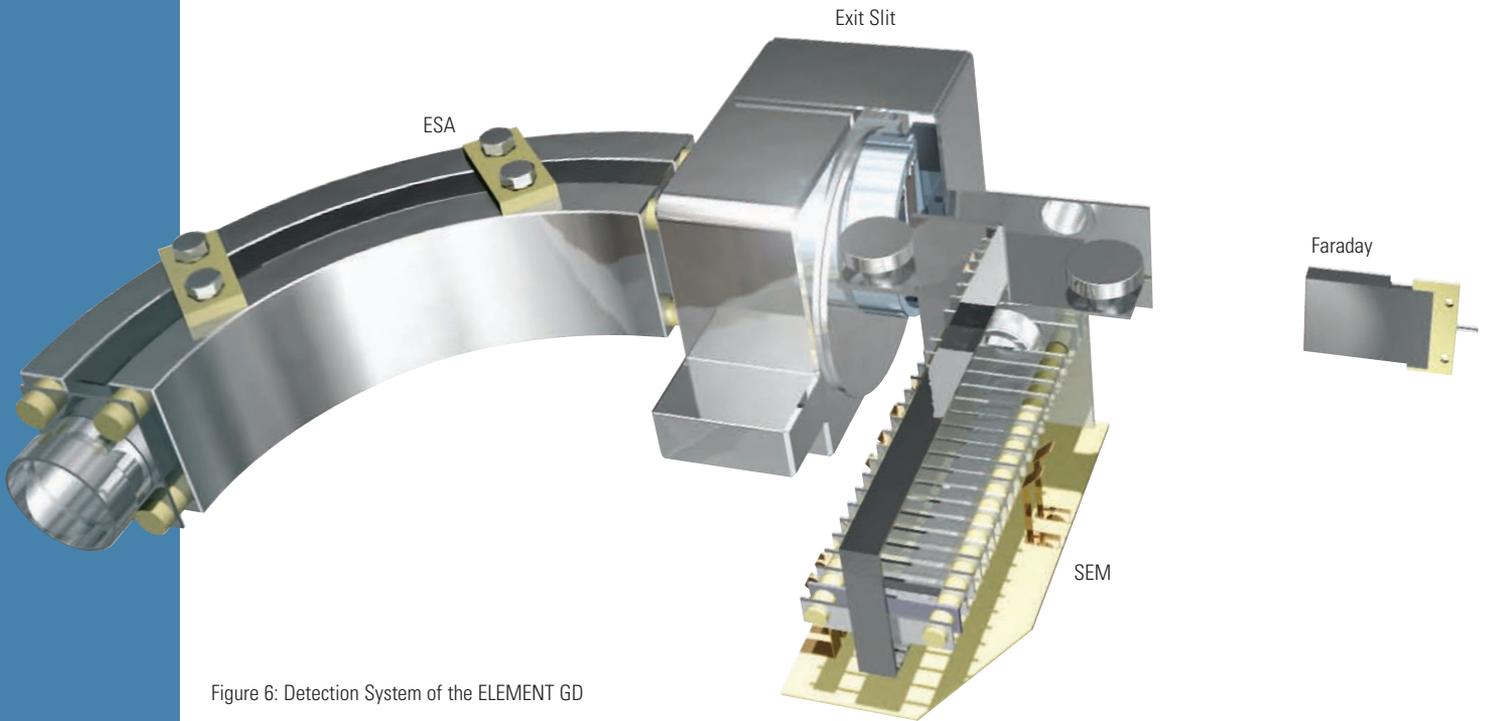
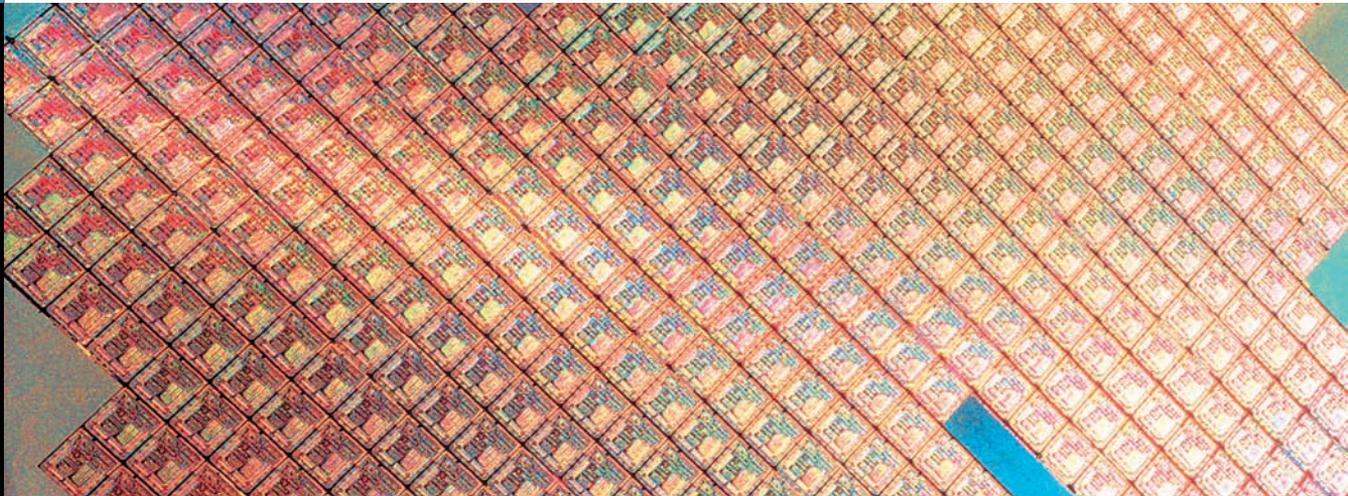


Figure 6: Detection System of the ELEMENT GD



# Product Specification

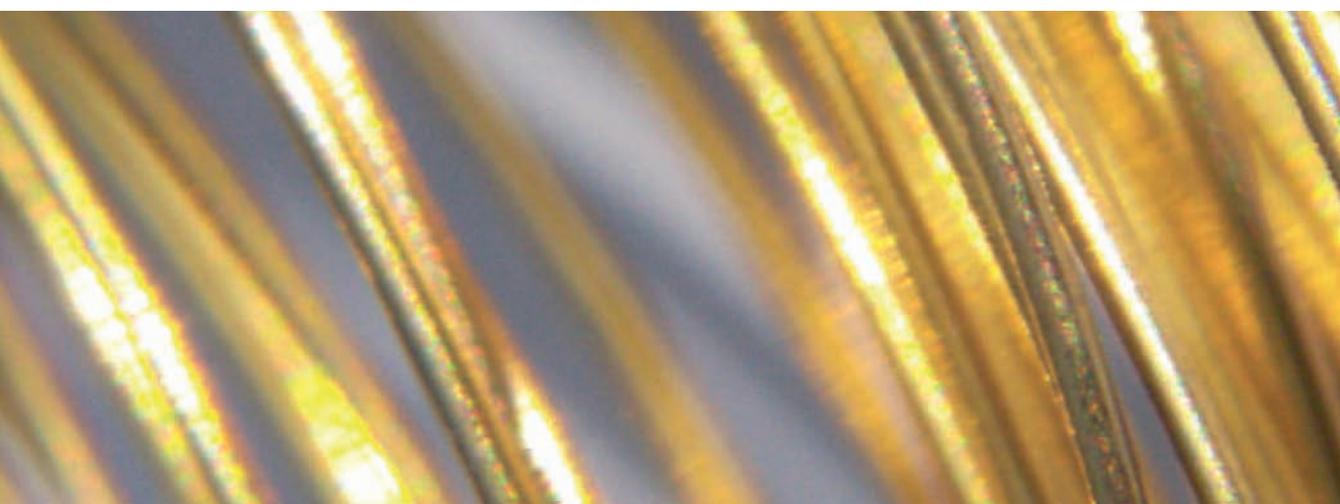
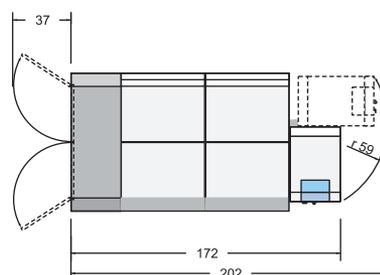
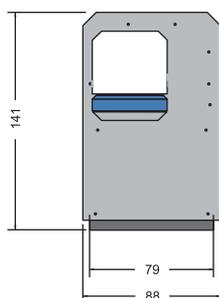
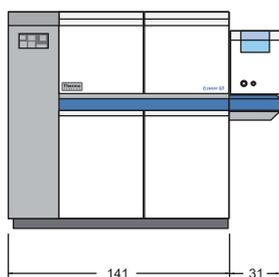
The mass spectrometer of the ELEMENT GD is proven in more than 500 Thermo Scientific ELEMENT High Resolution ICP-MS installations worldwide.

## Specifications and Installation Requirements

### ELEMENT GD

Sensitivity (peak height, total ion current)	> $1 \times 10^{10}$ cps, ( $1.6 \times 10^{-9}$ A) for copper in medium resolution ( $R \geq 4000$ )
Dark Noise	$\leq 0.5$ cps
Dynamic Range	> $10^{12}$ linear with automatic cross calibration
Minimum integration times	Counting mode: 0.1 ms, analog mode: 1 ms, Faraday mode: 1 ms
Mass Resolution	3 fixed resolutions: $\geq 300$ ; $\geq 4.000$ ; $\geq 10.000$
Resolution Switching Times	< 1 s
Mass Stability	25 ppm / 8 hour
Scan Speed (magnetic)	< 150 ms from m/z 7 to 238 to 7
Scan Speed (electric)	1 ms/jump, independent of mass range
Power	3-phase, 230/400 V $\pm$ 10%, 50/60 Hz fused 32 A per phase
Power Consumption	max. 8 kVA
Temperature	18 - 24 °C (64 - 75 °F)
Humidity	50 - 60 %, non-condensing, non-corrosive
Cooling Water	~200 L/h Temperature 10 - 20 °C 4 - 6 bar (43 - 65 psi)
Argon	1 L/min Argon 5.0 (or higher); 5 L/min Argon 4.6
Regulated pressure	8 - 10 bar (116 - 145 psi)
Pump Exhaust	1 x 25 mm, 1 L/min
Electronic Exhaust	1 x 150 mm, 400 m <sup>3</sup> /h

### ELEMENT GD, Footprint and Dimensions in cm



## The Software Suite

The Thermo Scientific ELEMENT GD software is a state-of-the-art, simple to use software suite.

### Optimized Laboratory Software

The software package is optimized for the needs of a routine laboratory, providing a simple to use interface to fully utilize the power of the ELEMENT GD.

Using Microsoft Windows XP Professional as the operating system and standardized programming assures a flat learning curve, easy network connection for data transfer as well as remote control and diagnostic. The software is based upon that used in the ELEMENT High Resolution ICP-MS, proven in more than 500 installations worldwide.

- Intuitive and easy creation of methods and analysis sequences
- Real time display of spectra, time resolved data and results
- Automatic data export to LIMS systems
- Effortless autotuning of instrument parameters
- Microsoft Windows XP OS

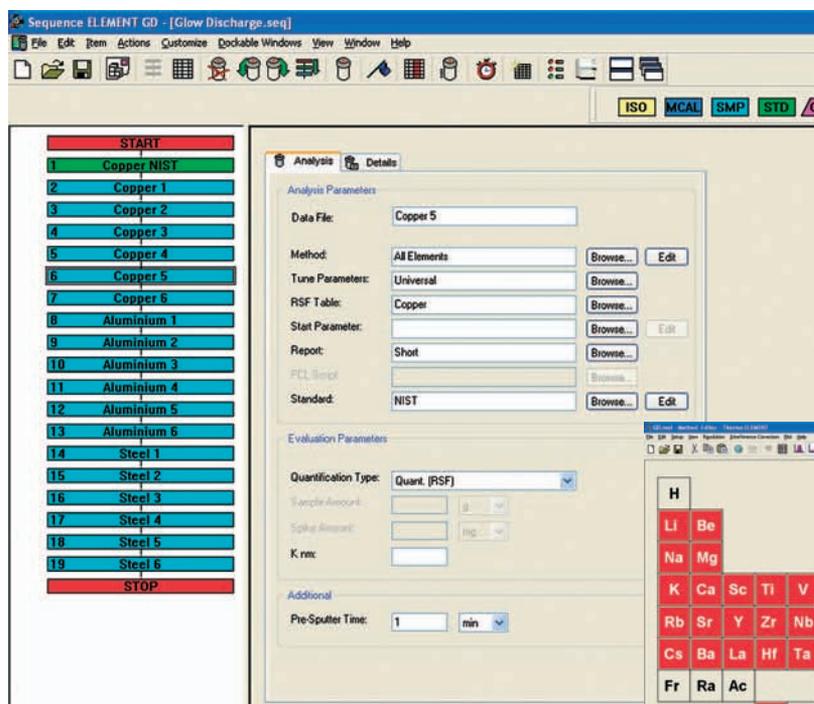


Figure 8: Concise and easy analysis configuration

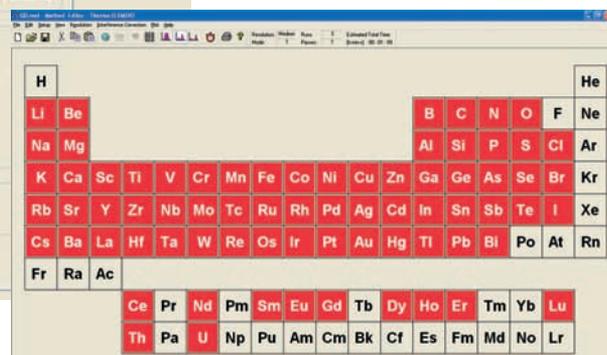


Figure 9: Intuitive method creation



The software package is optimized for the needs of the routine analyst, providing ease of use for basic operation as well as flexibility for advanced operation.

### Software for a high level of transparency

The Element software suite controls and monitors all instrument functions for GD-MS analysis and data evaluation. Real time display of mass spectra, time resolved data, calibration curves and comprehensive reports guarantee a high level of transparency and therefore easily traceable results. Full and flexible support for LIMS connectivity ensures convenient, automatic and safe data management.



Figure 11: Glow Discharge Ion Source software control

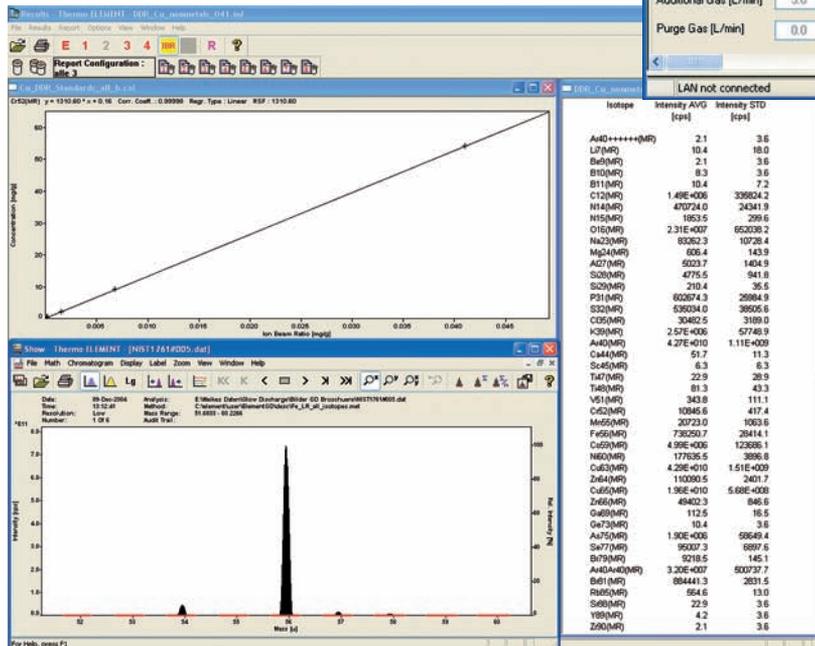


Figure 10: Real time display of calibration curves, spectra and results

The Element software package offers full quantitative analysis using Relative Sensitivity Factors (RSF) obtained from standard materials or semi-quantitative analysis using Ion Beam Ratios (IBR). Since the ELEMENT GD detection system is capable of measuring traces and the matrix within one analysis, the ratio between the analyte and the matrix (100%) is used for quantification.

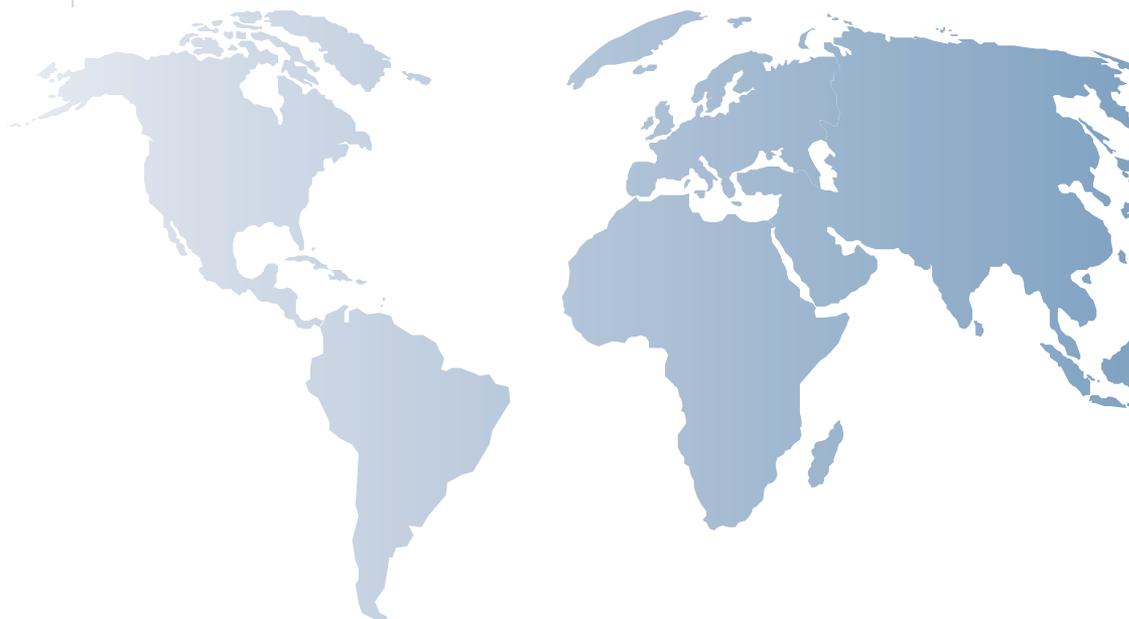
- Intelligent and straightforward quantification strategies
- User definable report configuration
- Traceable data management
- Remote control & diagnostic

# Proven in > 400 ELEMENT High Resolution ICP-MS installations worldwide

## Laboratory Solutions Backed by Worldwide Service and Support

Tap our expertise throughout the life of your instrument. Thermo Scientific Services extends its support throughout our worldwide network of highly trained and certified engineers who are experts in laboratory technologies and applications. Put our team of experts to work for you in a range of disciplines – from system installation, training and technical support, to complete asset management and regulatory compliance consulting. Improve your productivity and lower the cost of instrument ownership through our product support services. Maximize uptime while eliminating the uncontrollable cost of unplanned maintenance and repairs. When it's time to enhance your system, we also offer certified parts and a range of accessories and consumables suited to your application.

To learn more about our products and comprehensive service offerings, visit us at [www.thermo.com](http://www.thermo.com).



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