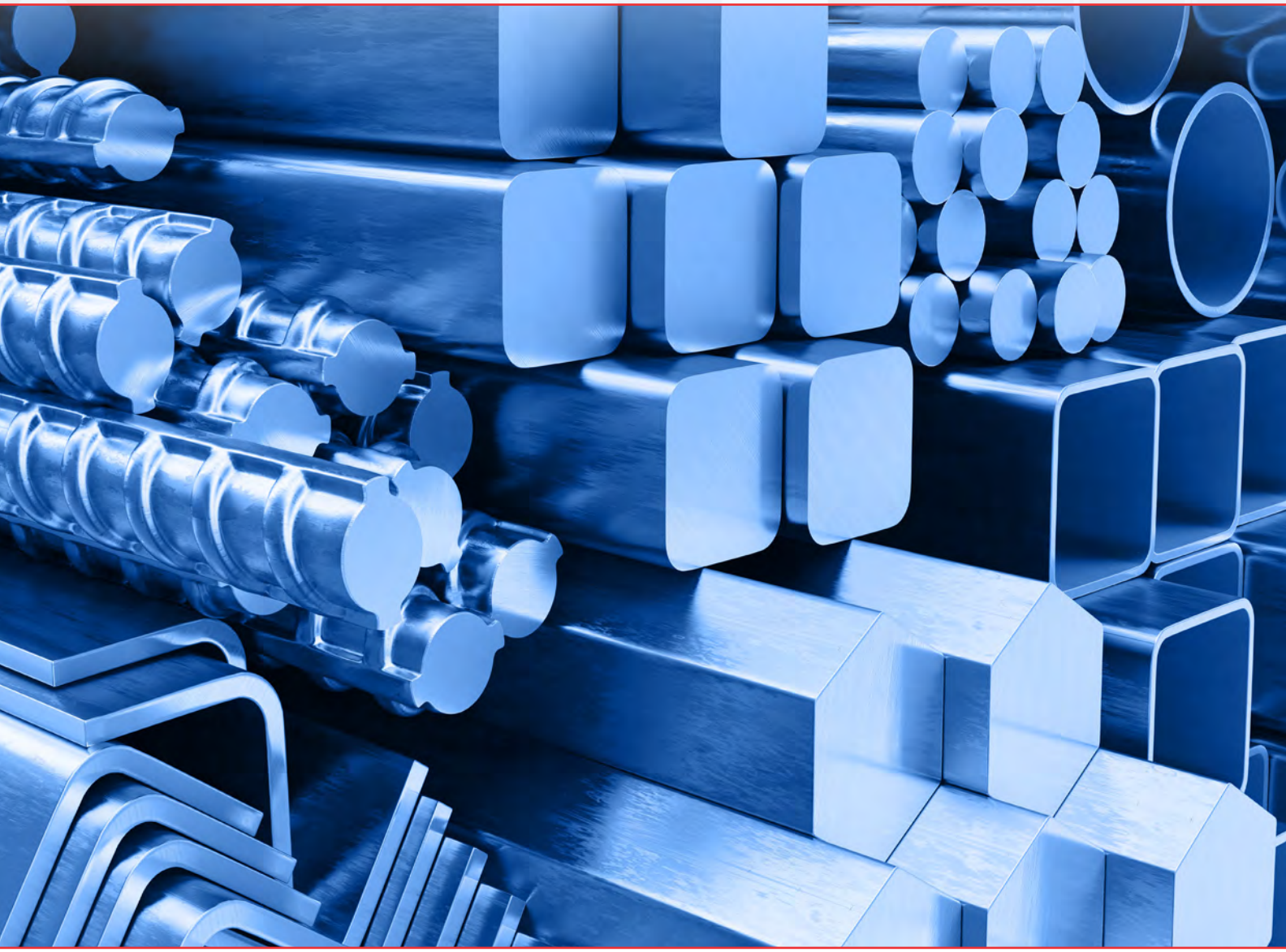
thermo scientific

Redefining quality standards

for the analysis of solid samples

Element GD Plus Glow Discharge Mass Spectrometer



ThermoFisher SCIENTIFIC

Redefine your quality standards for the elemental analysis of solid samples

The Thermo Scientific™ Element GD Plus™ GD-MS redefines the analysis of advanced high purity materials directly from the solid. Extra low ppb level detection limits are provided with minimum calibration and sample preparation effort, making GD-MS the most convenient and powerful tool for bulk metal analysis and depth profiling in routine and research applications.



The extraordinary analytical robustness of the method is applicable to conductive as well as many non-conductive materials with the same level of sensitivity and data quality. Analysis of low melting point metals such as gallium are made easy with a dedicated work-flow for sample preparation and analysis. This makes GD-MS the reliable standard for any metal analysis.

The Element GD Plus GD-MS is designed to serve the needs of high purity material manufacturers and their customers in industries such as:

Aerospace—nickel super alloys, depth profiling of coatings and diffusion layers
Microelectronics—copper, alumina powder, sputter targets
Renewable energy—silicon blocks, wafers, solar cells
Medical/pharmaceutical/food—stainless steel, alloys
Nuclear—uranium, nuclear fuel



Outstanding speed, sensitivity, and accuracy

The Element GD Plus GD-MS features the latest technology to deliver the benefits of outstanding analysis speed for high sample throughput, sensitivity and accuracy of results.

Sample handling has been designed with special care to ensure ease of use with the benefit of fast sample change-over, for routine operation and high throughput.



Technology overview

- Micro second pulsed, fast flow, high power glow discharge ion source
  - Conductive and non-conductive materials using secondary electrode techniques
  - Short analysis time due to comparatively high sputter rates
  - Superior sensitivity
  - Low level of polyatomic interferences compared to static GD sources
  - Widely adjustable working range for pulsed mode operations
  - Uniform crater shape, flexible anode diameter
  - Enhanced cooling enabling the analysis of low melting point metals such as gallium
- State of the art double focusing mass spectrometer
  - Outstanding signal to noise ratios resulting from high ion transmission combined with a low background, leading to sub-ppb detection limits
- High mass resolution
  - Maximum level of selectivity and accuracy
  - Indisputable analytical results
- Resolution switching time <1 second
- 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
- Excellent abundance sensitivity
  - Minimum contribution of high matrix signals on neighboring analyte peaks
- State-of-the-art software suite for productivity and ease-of-use
  - Fully automated analysis and data evaluation
  - LIMS connectivity with automatic data transfer
- Quantitative multi-element analysis across the periodic table
- Less than 10 minutes sample turn-around for many applications
- Matrix to ultra-trace detection capabilities in a single scan
- Depth profiling from sub-ppm to 100% with nanometer depth resolution
- Minimum matrix effects for straightforward semiquantitative quantification
- Workflow solution for routine analysis of gallium samples including sample preparation and pre-defined software methods

High throughput and routine operation



The Element GD Plus GD-MS ion source including its 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 switching time. The sample itself is placed in a vacuum chamber, eliminating any risk of leakage between the sample and the GD cell.

The sample can quickly and easily be removed from the ion source, simply unloaded and re-loaded, and repositioned for the next measurement. Opening and closing of the ion source manifold is fully automatic.

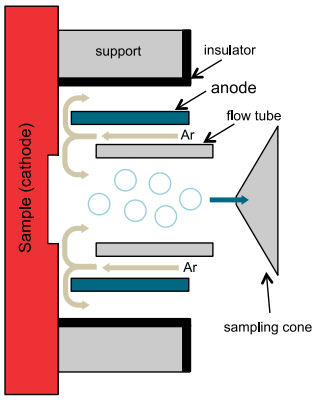


Determine 50 elements at low ppb level within 5 minutes

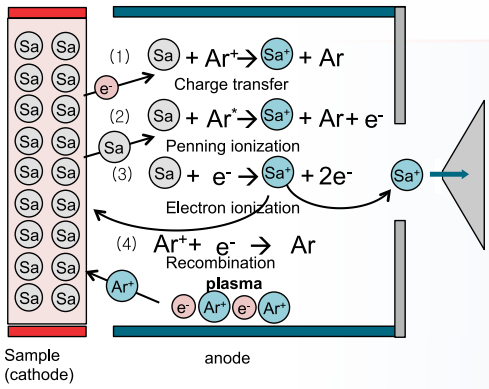
The ion source

A glow discharge occurs when a potential difference is applied between two electrodes in a cell filled with gas 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 particles, mostly neutral atoms, are ionized downstream in the plasma. Because the processes of sputtering and ionization are separated, especially in pulsed mode operation, 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.

High throughput is additionally supported by electronic (Peltier) sample cooling (or heating), eliminating the need for cooling with cryogenic gases as required in other GD-MS instruments, enabling the analysis of low melting point metals such as gallium. There is a much reduced requirement for perfectly flat samples because the sample is not used as a vacuum seal.



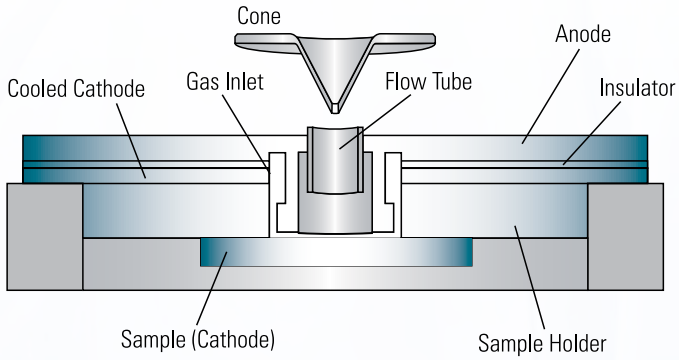
<Plate sample cell>



<Ionization mechanism>

The Element GD Plus GD-MS ion source offers generally high, although widely adjustable sputter rates and a simple and fast sample change-over, providing routine operation and high throughput without any compromise in performance. Pulsed mode operation results in significantly higher ionization efficiency at lower sputter rates, reducing the amount of deposits in the source.





Characteristics of the glow discharge source

- High sensitivity for short analysis times
- Fast and simple sample to sample switching
- Low level of polyatomic interferences without the need for cryo-cooling
- Complete set of consumables for ultra-high purity and medium purity analysis
- Flexible cell for flat samples, pressed powders and pin samples (optional sample holder)
- Plug-in cone and anode parts for quick exchange eliminating the risk of cross contamination
- Sputter rates widely adjustable for bulk analysis or depth profiling
- Large sputtered sample area for representative surface sampling, minimizing inhomogenities in the material
- Flexible anode diameter for advanced depth profiling applications
- Enhanced Peltier cooling for low melting point metal analysis



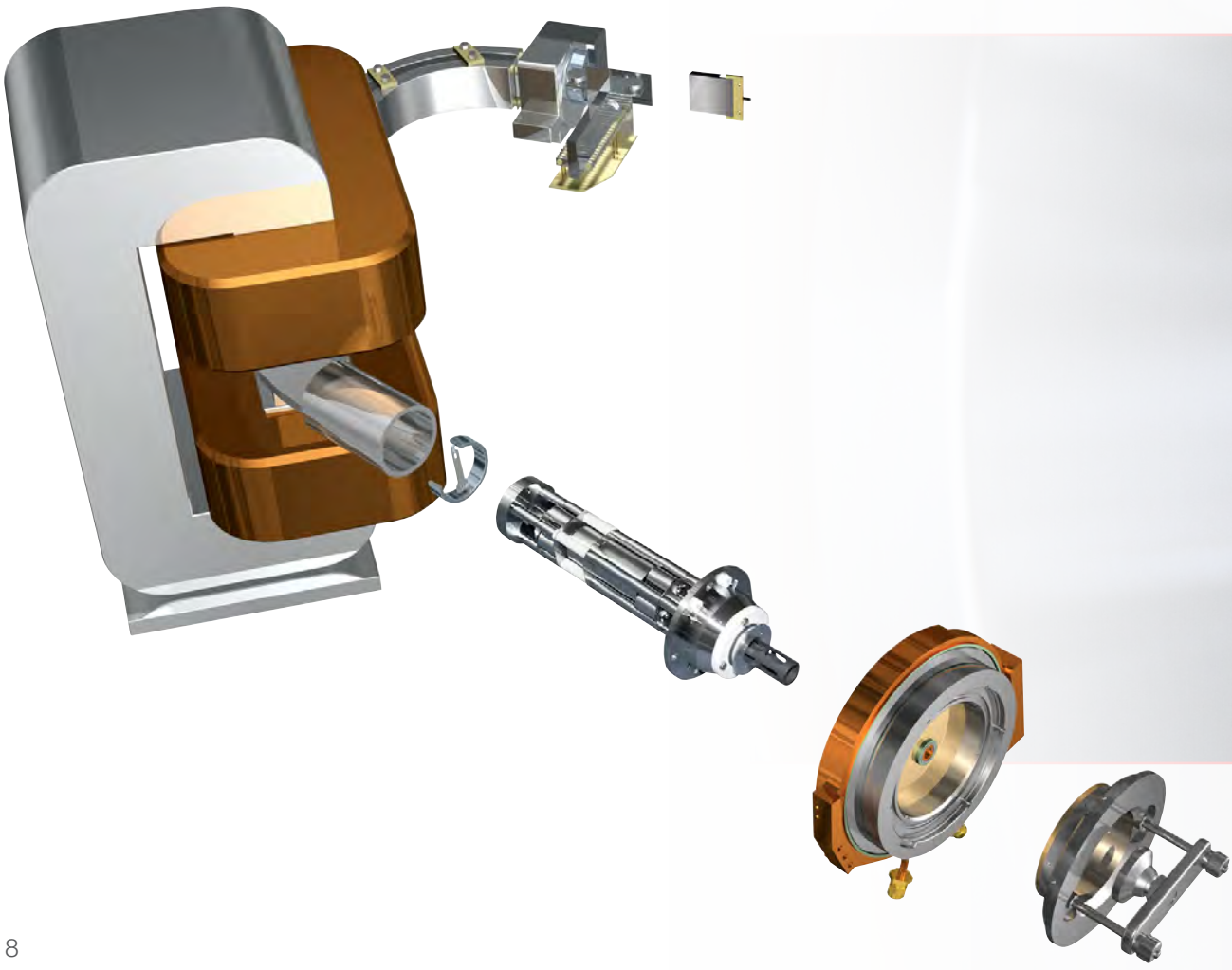
High mass resolution to overcome spectral interferences

The Element GD Plus GD-MS 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.

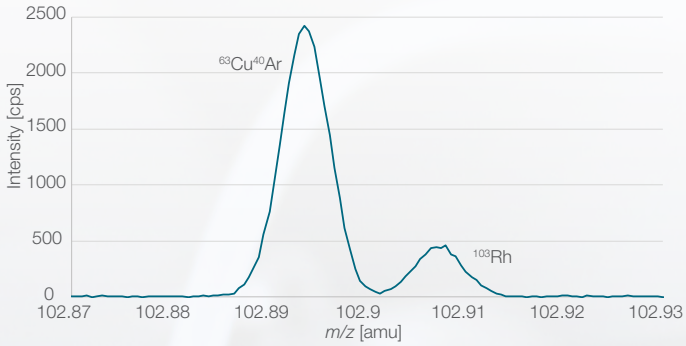
The Element GD Plus GD-MS provides interference free measurements, resulting in simple linear calibration curves for quantification. Three fixed resolution settings, with switching times of <1 s, ensure optimum conditions to reliably remove spectral interferences.

Any combination of resolution setting can be performed within a single analysis. The fixed-slit design guarantees maximum stability and reproducibility.

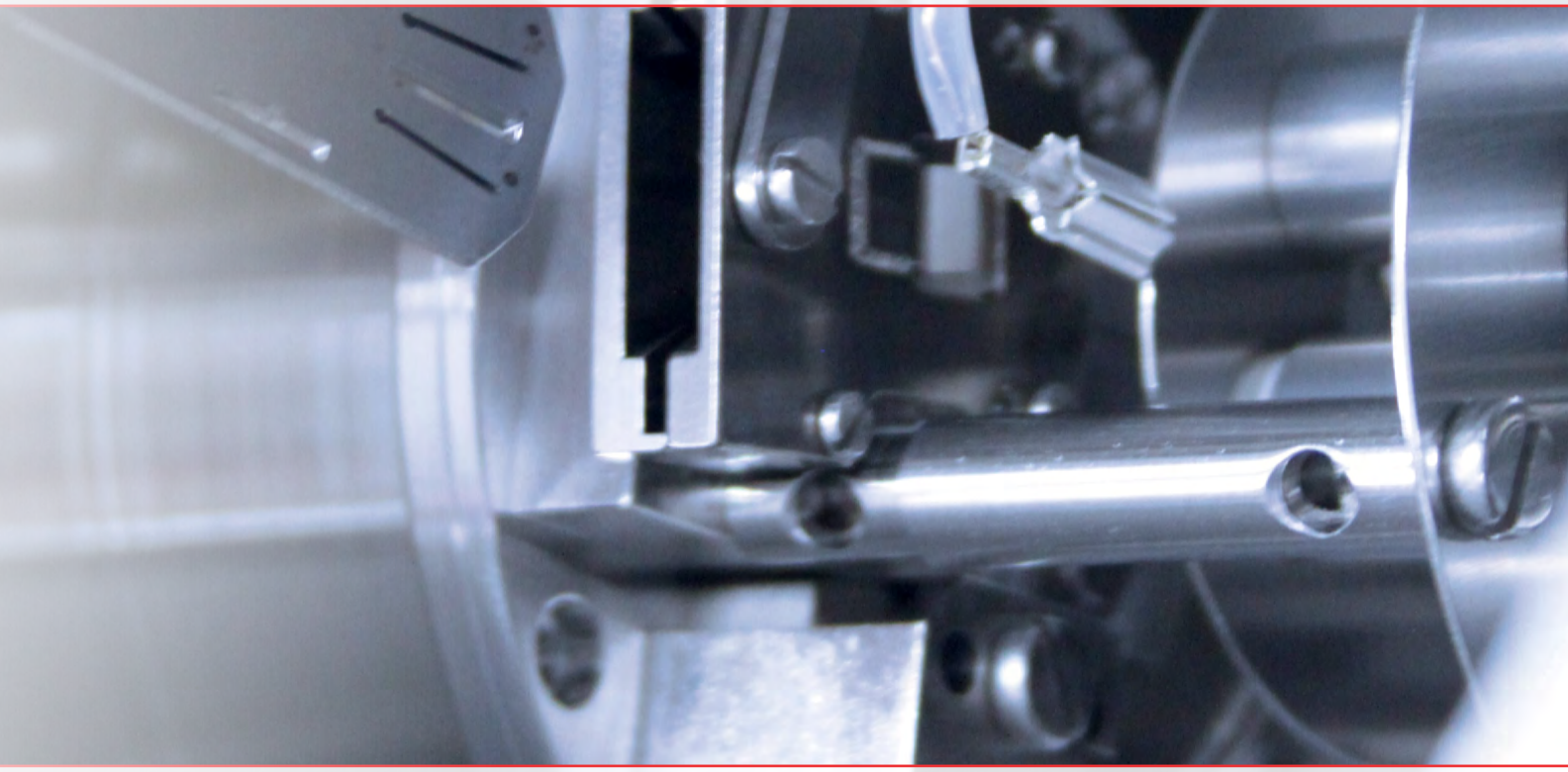
The reverse Nier-Johnson sector geometry ensures excellent abundance sensitivity. The analyzer is optimized for speed and mass stability. The magnet is designed for a mass range of 1–260 u, just right for the demands of elemental analysis. It is relatively small, highly laminated, water cooled and driven by a sophisticated high power regulator, resulting in minimum magnet switching and settling times.



High precision and accuracy of the mass calibration is vital for short analysis times, allowing precise peak top jumping. Due to the fully automatic mass locking process, mass calibration is no longer a regular procedure. Due to the fast-flow GD source the formation of polyatomics is significantly low and trimeric interferences are virtually not existing, giving clean spectra that are easy to integrate.



Resolving ^{103}Rh from $^{63}Cu^{40}Ar$ interference in high resolution (R = 10,000). Sample containing 600 ppm Cu and ca. 0.16 ppm Rh.

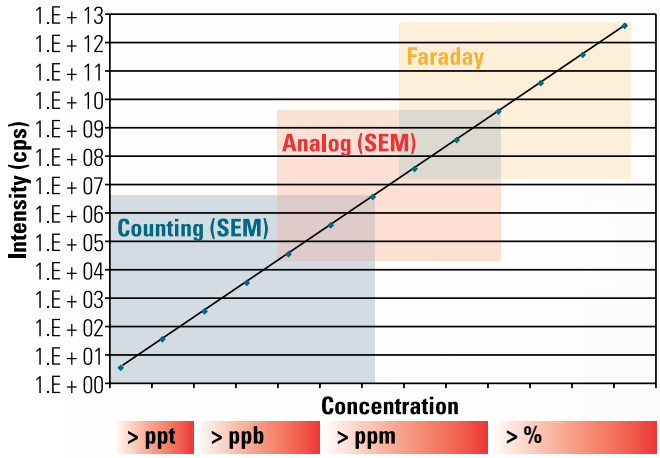


Dynamic range >12 orders of magnitude

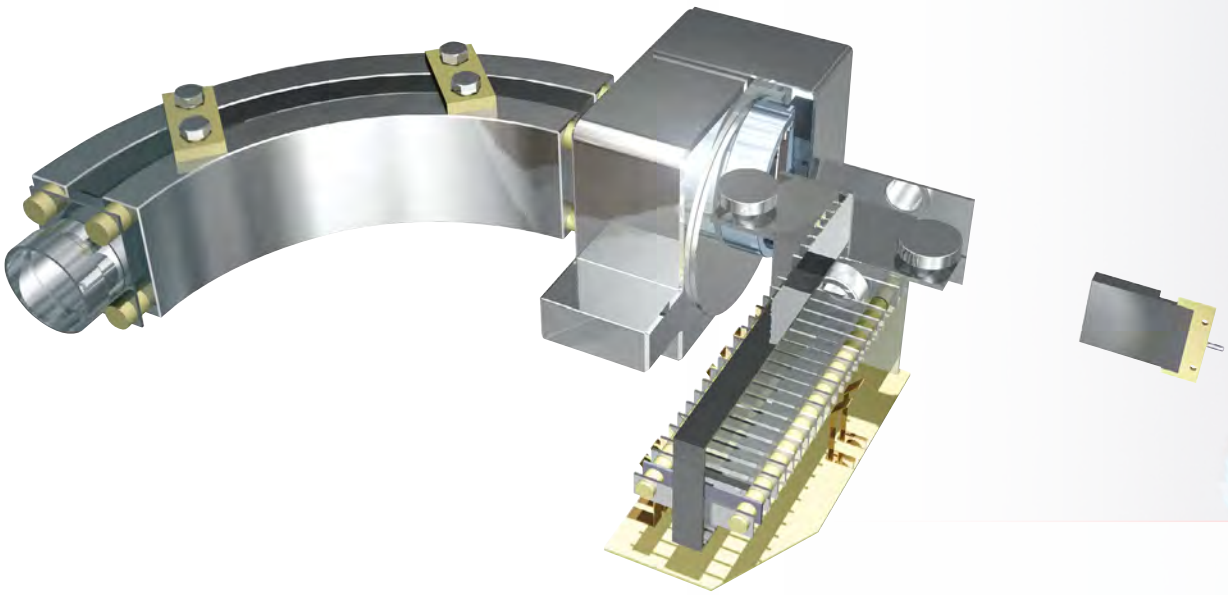
Detection system

Typical applications involve the simultaneous analysis of matrix elements (%), traces (ppm) and ultra-traces (ppb). To achieve this, the detection system offers:

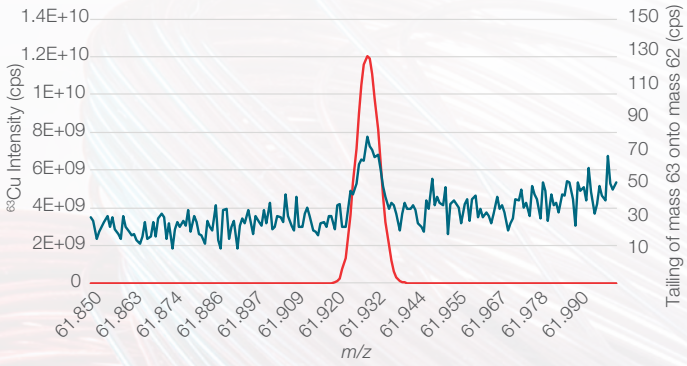
- Wide dynamic range: 0.5 cps to >10^{12} cps
- High speed: down to 1 ms integration time
- Automatic, fast switching between different detection modes
- Automatic cross calibration between different detection modes



Detector ranges for the Element GD mass spectrometer



In the Element GD Plus GD-MS instrument this is achieved through the use of a unique combination of a dual mode secondary electron multiplier (SEM) and a Faraday collector. The filter lens enables excellent abundance sensitivity. The fast detection electronics of the Faraday detector allows for integration times down to 1 ms.



Peak tailing from ^{63}Cu onto *m/z* 62 (blue trace, right Y-axis). The ^{63}Cu beam is shown for reference (red trace, left Y-axis).



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Our complete portfolio for surface and bulk metal analysis.

For your analytical challenges we offer a complete portfolio of solutions. Whether you need to determine thin layer compositions or ultra trace metals in bulk material, we can support you with expertise and technology, offered by our global sales network and service support.



Find out more at **thermofisher.com/GD-MS**

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