

thermo scientific



Clean up your spectra  
Make your analysis easy

Thermo Scientific Element 2  
& Element XR High Resolution ICP-MS

**ThermoFisher**  
SCIENTIFIC

# Clearer Insight. Cleaner Spectra. See Beyond the Complexity.

The Thermo Scientific™ Element 2™ and Element XR™ High Resolution ICP-MS provide class-leading elimination of interferences for the highest level of confidence. With ultra-sensitive and reliable multi-element analyses at trace-level concentrations, there's no need for complicated sample preparation and method development.

In mass spectrometry, spectral interferences occur when the mass-to-charge ratio ( $m/z$ ) of interfering ions overlap with analyte ions. These interferences are the primary limitation of ICP-MS.

Fortunately, there's a better way. The high mass resolution potential of a sector-field mass spectrometer can physically distinguish and separate an analyte from interferences by exploiting small differences in mass-to-charge. Therefore, high resolution (HR) ICP-MS can quantify concentrations and determine precise isotope ratios for elements across nearly the entire periodic table, regardless of sample matrix.

The simplicity of high-resolution ICP-MS allows the most advanced performance, without compromising on straightforward and reliable method development.

This makes the Element series the platform of choice in top-level research and metrology institutions, as well as advanced routine analysis laboratories across the globe.



## What is high resolution (HR) ICP-MS?

The unequivocal separation of analyte ions from spectral interferences is a prerequisite of reliable and accurate multi-element and isotope analysis. High mass resolution is the universally accepted means to separate spectral interferences.

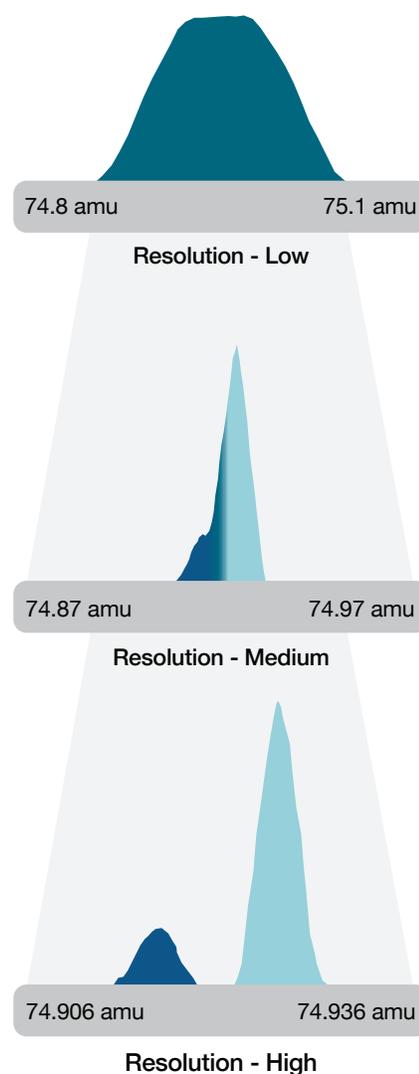
Precise and stable high mass resolution is a feature unique to the Thermo Scientific Element 2 and Element XR HR-ICP-MS systems.

With a visible physical separation between the analytes and the interferences from the matrix, the analyst doesn't require knowledge of the sample matrix prior to analysis.

## The power to reveal what you can't see.

High mass resolution ( $R = 10,000$ ) takes advantage of slight mass differences to analyze elements in the most challenging sample matrices. Arsenic ( $^{75}\text{As}$ ) in a chlorine matrix is masked by argon chloride ( $^{40}\text{Ar}^{35}\text{Cl}$ ,  $^{38}\text{Ar}^{37}\text{Cl}$ ) without using high resolution. Selenium (Se) is another key element that benefits from high resolution in common matrices. Beyond chloride matrices, high resolution is frequently applied to separate oxide, argide and nitride interferences, as well as multiply charged ions.

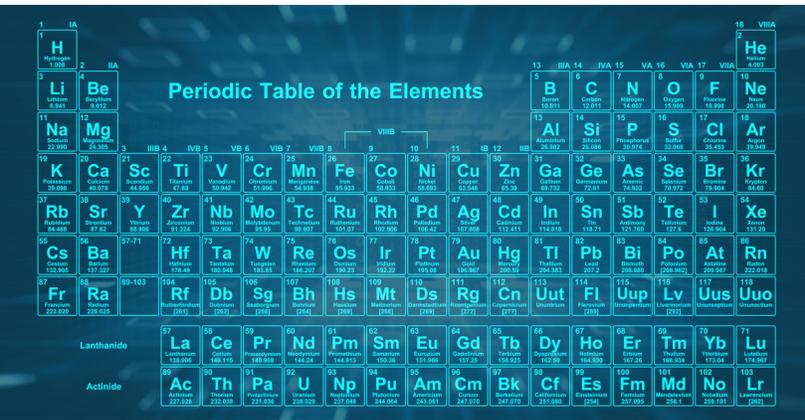
- **Low resolution** analyzes non-interfered isotopes with the highest sensitivity.
- **Medium resolution** guarantees interference-free analysis for most elements in the majority of matrix types.
- **High resolution** provides unequivocal separation of analytes and interferences in the most challenging matrices.



**Figure 1: High Resolution**

High mass resolution ( $R = 10,000$ ) takes advantage of slight mass differences to analyze elements in the most challenging sample matrices. As an example, Arsenic ( $^{75}\text{As}$ ) in a chlorine matrix is masked by argon chloride ( $^{40}\text{Ar}^{35}\text{Cl}$ ,  $^{38}\text{Ar}^{37}\text{Cl}$ ) without using high resolution.

# Experience the difference.



Power and flexibility at your fingertips.

The entire periodic table, in virtually any matrix

## Features & Benefits

- High mass resolution: Accurately measure isotope signals separate from spectral interferences and produce clean elemental spectra while retaining flexibility.
- Straightforward analytical methods: Providing visual confirmation of accurate measurements.
- Interference removal: no use of reactive gases
- High sensitivity: Get accurate and precise multi-element analysis down to  $\text{pg}\cdot\text{L}^{-1}$  concentrations for all resolutions. The Element XR HR-ICP-MS increases the linear dynamic range by an additional three orders of magnitude for maximum flexibility.
- Ideal for transient multi-elemental signals, such as laser ablation, HPLC, GC, CE, FFF.
- High-precision isotope ratios.
- An advanced research tool with the reliability and robustness to serve in 24/7 production control.

## Measure everything in everything

With the highest sensitivity of any ICP-MS, the extended linear dynamic range of the Element XR ICP-MS makes it the ideal tool for multi-element determination of unknown samples containing major, minor and trace elements in a wide range of sample types. Liquid samples can be either waters, digests, acids or solvents, as the nature of the matrix composition is of minor importance when using high mass resolution.

The high-performance ion detection system of the Element XR HR-ICP-MS automatically switches between three detection modes to handle signals ranging from ultra-trace to 100% of the sample matrices. With it you can assess any sample matrix.

- Sedimentary and rock geo science
- Biogeochemistry
- Cosmochemistry
- Waters and particulates
- Age dating of minerals
- Ice cores

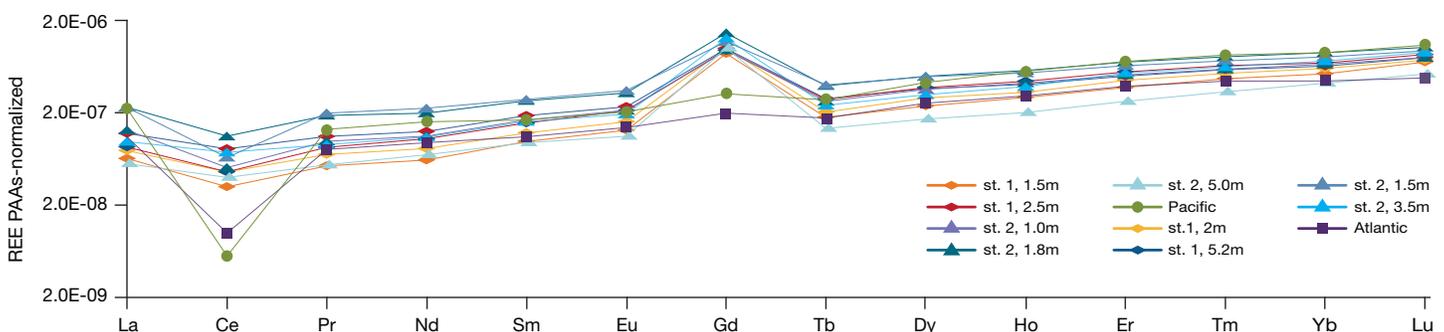
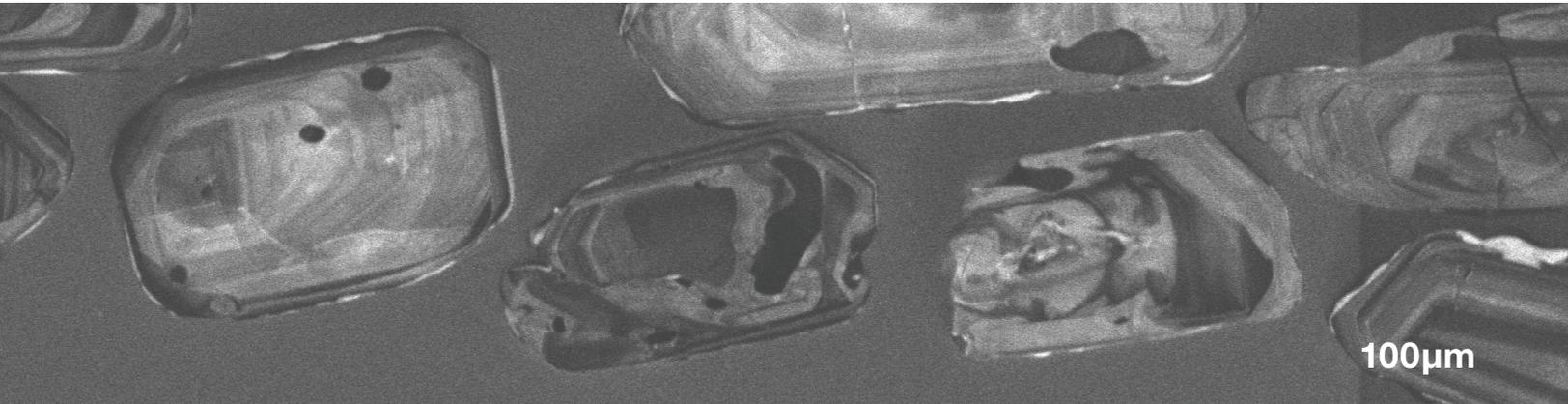


Figure 2: Geochemical ultra-trace analyses of Rare Earth Element distributions showing evidence of anthropogenic Gd enrichment in coastal pore waters.



## Laser ablation and laser ablation split stream (LASS)

### The complete solution for zircon age dating and quantification

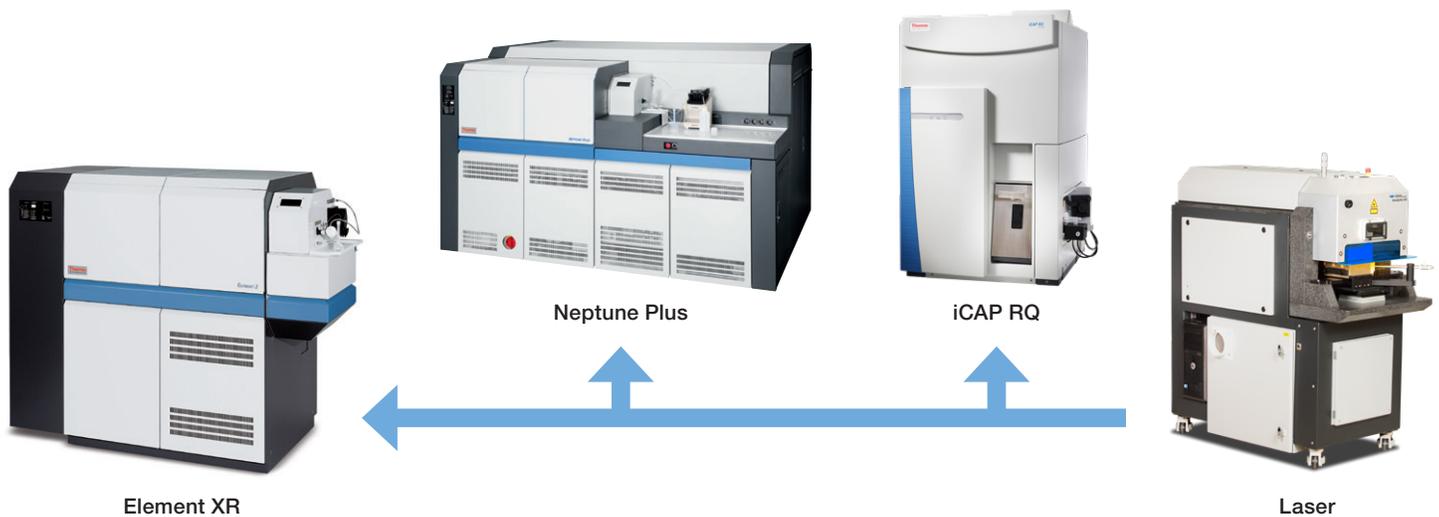
The coupling of laser ablation to the Element XR HR-ICP-MS is used routinely to determine the geochronological age of zircons by measurements of the U-Pb isotopic system.

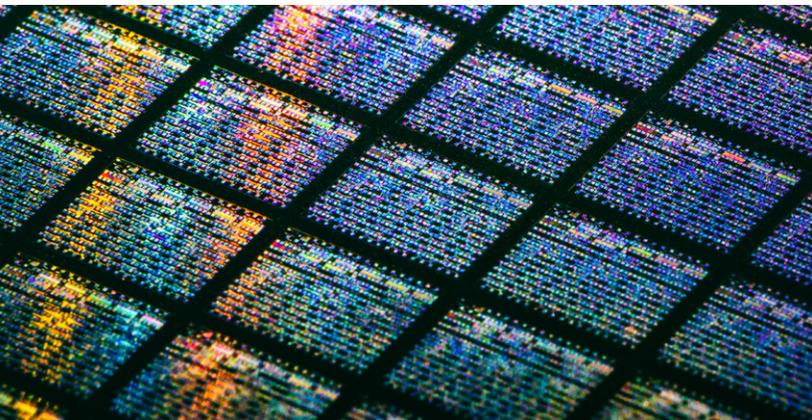
By splitting the aerosols ablated by the laser to other Thermo Scientific ICP-MS systems, you can simultaneously obtain:

- Most precise Lu-Hf data on the Thermo Scientific™ Neptune Plus™ multicollector ICP-MS

- Full elemental composition information on the Thermo Scientific™ iCAP RQ™ ICP-MS
- Excellent U-Pb geochronological ages on the Element XR HR ICP-MS

In low resolution, the Element XR ICP-MS combines a flat peak shape with the highest sensitivity, which together, results in precise isotope ratios and a precise age determination.





## Semiconductor grade chemicals analysis

### High resolution, high selectivity

The Element 2 HR-ICP-MS system is ideally suited for the demands of semiconductor laboratories:

- Direct elemental analysis of nearly every element in the periodic table, including phosphorous and sulfur.
- Ultra-pure water, mineral acids, inorganic chemicals, organic solvents, silanes and VPD samples with minor method development effort.
- Rapid switch between cold and hot plasma operation.
- Less than 0.1 ng·L<sup>-1</sup> detection limits for a majority of elements.
- No sample preparation other than dilution.
- Jet interface with platinum-tipped cones for highest sensitivity.
- Robust technology is an equally effective tool for top-end research and 24/7 production control.

## Ultratraces of uranium

### Flat top peaks for highest precision

The Element series ICP-MS instruments are excellent tools for a wide range of isotopic analyses:

- Superior sensitivity, low noise, and a stable signal combined with good matrix tolerance.
- Jet Interface option for the highest sensitivity: Sub ppq detection limits and high precision isotope ratios at <10 ng·L<sup>-1</sup> concentrations.
- The Element XR HR-ICP-MS can measure precise isotope ratios, even when one isotope is of extremely low abundance, by employing its Faraday detector to extend its linear dynamic measurement range by three orders of magnitude.



Figure 4: Element 2 ICP-MS with glove box adaption



## Speciation analysis

### Greater simplicity for complex challenges

Because of its high sensitivity and ability to reliably resolve spectral interferences even in heavy solvent gradients, the Element series ICP-MS are ideally suited for speciation analysis:

- HPLC and UHPLC coupling (e.g., for As, Se, Cr, P, S speciation).
- GC coupling with heated transfer line (e.g., for speciation of Sn [see figure], Hg, Pb).
- IC coupling (e.g., for As speciation).

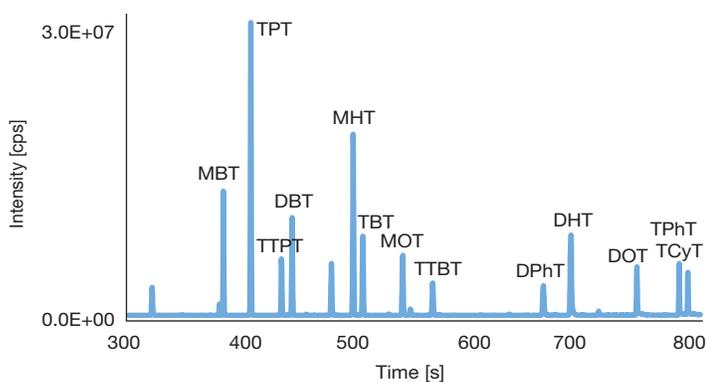


Figure 5: Tin speciation performed by Element XR ICP-MS with GCI-200 interface

## Nanoparticle analysis

### Highest sensitivity for the smallest particles.

The high sensitivity of the Element series ICP-MS enables it to detect the smallest nanoparticles:

- Standard applications for Au and Ag nanoparticles (see Figure 6 for 20 nm reference material).
- Higher mass resolution enables analysis of nanoparticles that show spectral interferences, like  $\text{TiO}_2$ .

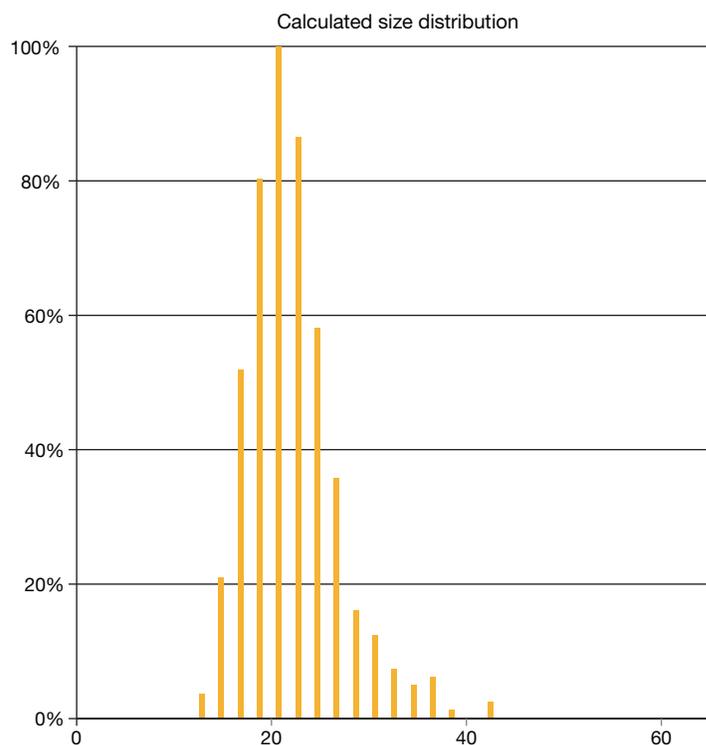


Figure 6: Silver nanoparticle determination by the Element XR ICP-MS



High-Resolution ICP-MS: The most flexible and reliable analyses, for the best analytical results.

Perform accurate and reliable quantitative multi-element analyses at trace level, with the highest sensitivity and without complicated sample preparation.

The Thermo Scientific Element 2 and Element XR High Resolution ICP-MS systems cover the mg/L to sub pg/L concentration range—making them especially suitable for semiconductor, geological and material science laboratories.

#### **Element 2 HR-ICP-MS**

*The workhorse for semiconductor applications*

The high performance, double-focusing magnetic sector field Element 2 HR-ICP-MS is optimized for ease-of-use, stability and productivity. Get access to a powerful technique for solving specific problems with excellent sensitivity and signal-to-noise ratio.

#### **Element XR HR-ICP-MS**

*The gold standard for full elemental screening in high dynamic range laser ablation and solution work, and for large isotope ratios applications*

The combination of a dual-mode SEM with a Faraday detector increases the linear dynamic range by an additional three orders of magnitude. This enables analysis of any matrix element straight without further dilution or precautions to avoid detector damage from inadvertently measuring high level elements.

#### **References:**

1. Paffrath, R., Pahnke, K., Schnetger, B., Brumsack H.-J. (in preparation), Rare earth element behavior in a sandy subterranean estuary of the North Sea. Manuscript in preparation

Find out more at [thermofisher.com/HR-ICP-MS](https://thermofisher.com/HR-ICP-MS)