MASS SPECTROMETRY INSTRUMENTS LIMITED

GD90 TRACE

glow discharge mass spectrometry

MSI

HIGH PERFORMANCE MASS SPECTROMETER MANUFACTURER

Mass Spectrometry Instruments Ltd (MSI) specialises in high performance magnetic sector double-focusing mass spectrometer instruments designed to meet the needs of both the organic and inorganic analysis markets. Our roots extend back to 1957 and the early pioneers in commercial sector mass spectrometers. Since then the need for high precision, high resolution instruments has risen exponentially. At MSI we are making great strides in taking this technology to the next level by investing in new developments and applications including the introduction of the latest GD90 Trace glow discharge mass spectrometer.

HR-GDMS

HIGH RESOLUTION GLOW DISCHARGE MASS SPECTROMETRY

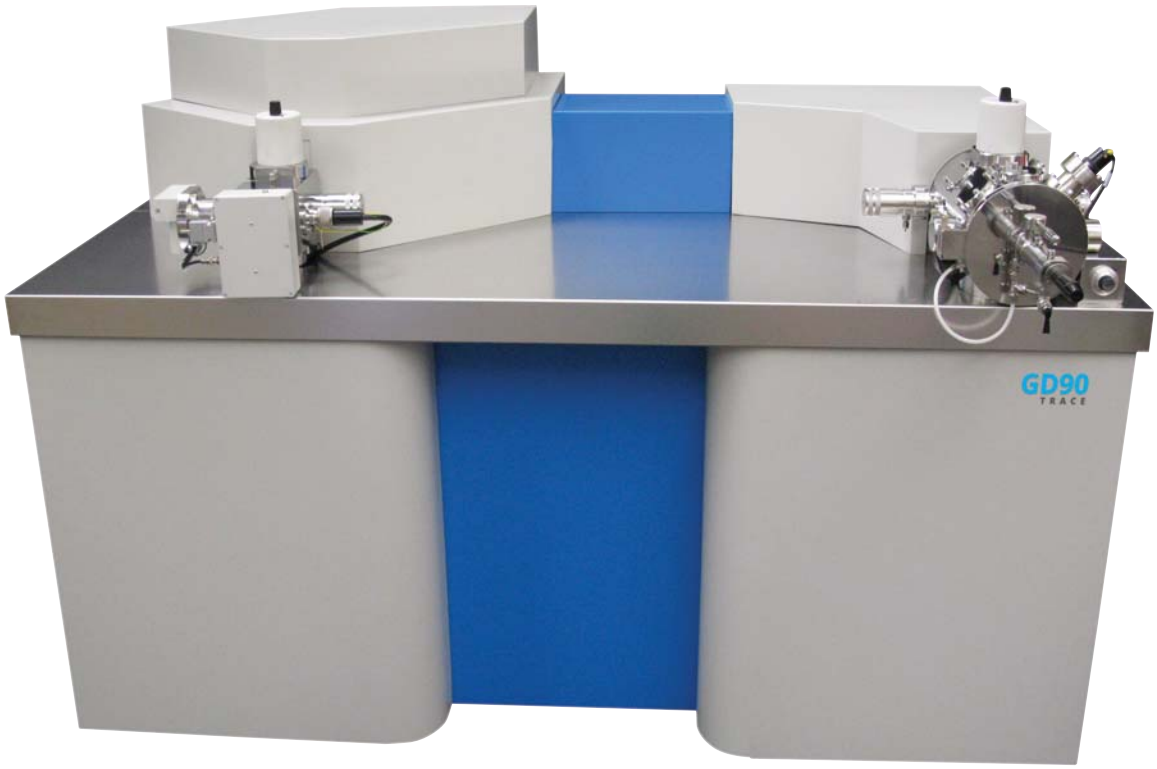
The main focus of MSI is high resolution glow discharge mass spectrometry (GDMS); a mature, versatile technique for the direct determination of elemental content (matrix to sub-trace) in a variety of materials.

Features of HR-GDMS

- Full elemental analysis of major (wt%) to ultra-trace (ppb to sub-ppb) elements within a single scan
- Direct solid sampling technique alleviating the need for chemical digestion
- Continuously variable high resolution capabilities from <400 to >10,000 RP (10% valley definition)
- Dual collectors allowing up to 12 orders of linear dynamic range
- Proven technique for high sensitivity depth-dependent distribution analysis of trace elements in coatings and other multi-layered advanced materials
- Minimal matrix effects allow calibration without matrix matched standards by using Relative Sensitivity Factors (RSF)

GD90 Trace

TAKING MASS SPECTROMETRY TO THE NEXT LEVEL



The GD90 Trace from MSI is capable of many different types of analyses, and can accommodate almost any sample purity, matrix and geometry.

Unsurpassed Glow Discharge Mass Spectrometry

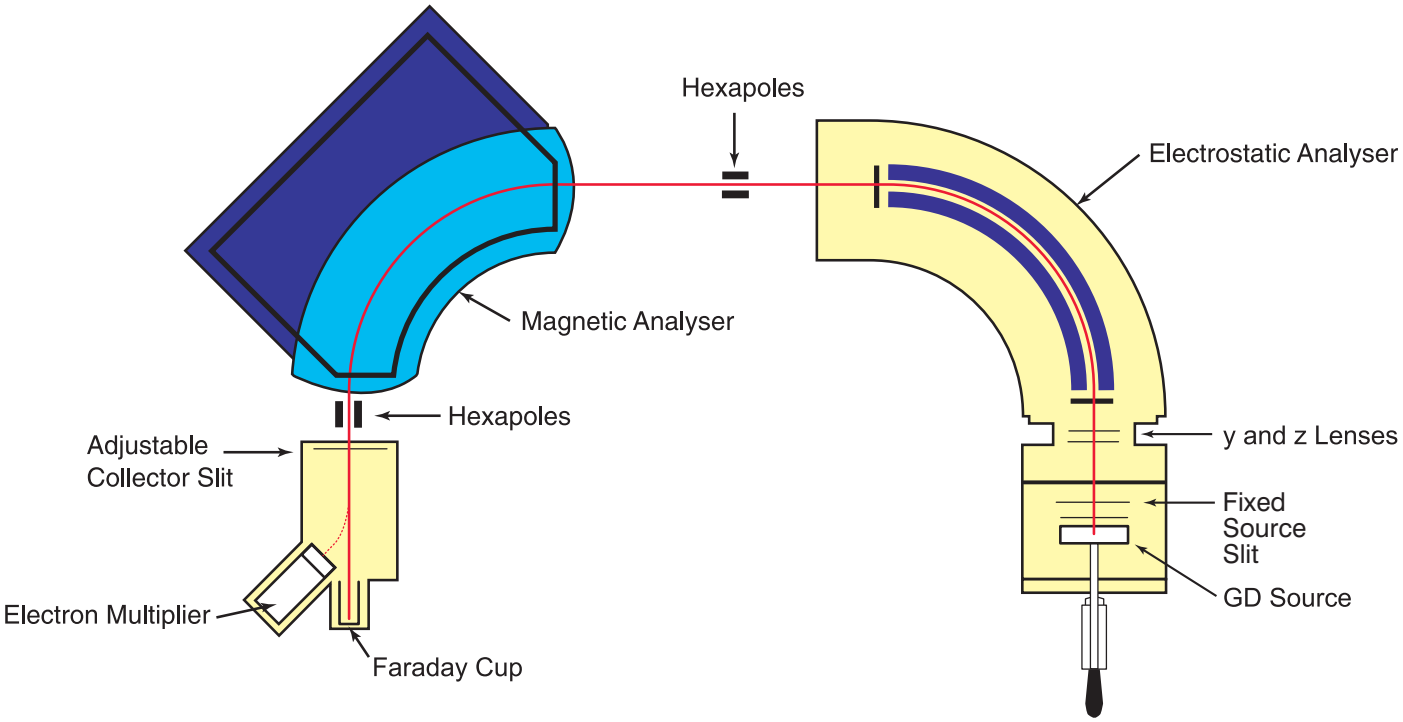
The GD90 Trace features a proven optical platform with innovative modern stable electronics and control.

The ion optics are based on the high performance MSI AutoConcept instrument. With its high stability and ultra-low detection limit capabilities, the GD90 Trace outperforms most instruments in its class.

All voltages are under computer control providing unsurpassed ease of use with a simple USB interface to the control, acquisition and processing PC. Remote control of the instrument and hardware control of acquisition are also incorporated.

GD90 Trace Key Features

- Tantalum cell and source construction for ease of cleaning
- Availability of cryo-cooling of the GD cell to minimise gas backgrounds
- Accommodates both pin and flat cell geometries
- No mass bias for light/heavy elements
- Calibration consists of a quick check of ^{180}Ta and ^{181}Ta to ensure that the IC and Faraday detectors are in agreement
- Low gas flow allows for cost-effective use of an alternate ionisation gas such as krypton
- Ability to analyse a wide range of samples ranging from alloys to high purity materials (both conductive and non-conductive) in a plethora of sample geometries
- Low sputter rate – at normal analytical conditions the sputter rate ranges from 150 nm/minute (conductive) to 100 nm/minute (non-conductive); lowering operational conditions allows sputter rate to be slowed by at least 5x
- RSFs and Detection Limit determinations are derived from published, readily sourced methods
- Front end assembly allows for the fitting of a custom-designed glove box for nuclear applications

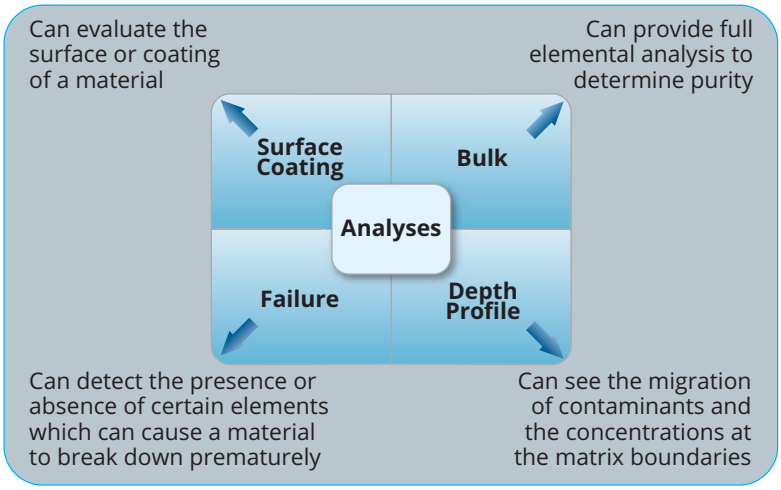


ANALYSES

WITH GD90 TRACE GLOW DISCHARGE MASS SPECTROMETER

Materials Characterisation

The GD90 Trace from MSI is capable of many different types of analyses, and can accommodate just about any sample purity, matrix and geometry.



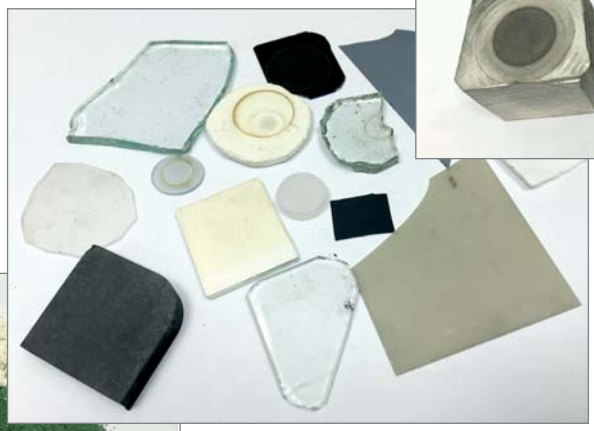
The samples that are analysed on the GD90 Trace are typically pins 2mm x 2mm x 20mm (or ~3mm ø x 20mm) or flat blocks ~15mm x ~15mm x >1mm, but many other types of sample geometries can be accommodated by mounting them on a secondary binder.

All types of materials can be analysed:

- Alloys to high purity (9N+)
- Conductive and semi-conductive
- Non-conductive
- Unconventional sample types
- Waste products

Alloys to High Purity (9N+)

Ability to clean the cell and source means there is no contamination from matrix carryover. Thus both alloy and high purity materials can be analysed routinely and quickly on the same instrument.



Conductive, Semi-conductive and Non-conductive

Both conductive and semi-conductive samples can be analysed in direct current (DC) mode without a conductive binder. Non-conducting materials require a conducting binder to begin sputtering in direct current (DC) mode, but this only involves manually pressing the analyte onto a high purity binder, typically indium.

Due to cryo-cooling of the GD cell, low melting point materials such as tin (Sn), antimony (Sb), indium (In) and gallium (Ga) can be analysed.

Unconventional Sample Types

As the GD90 Trace can accommodate various types of sample geometries, unconventional materials such as wires, ball bearings and powders can be analysed. Minimal sample preparation is needed for these unconventional sized materials. For example, a binder may be required to allow them to act as a flat sample using indium as for non-conductive samples.

TIME RESOLVED ANALYSIS

OR DEPTH-DEPENDENT ANALYSIS

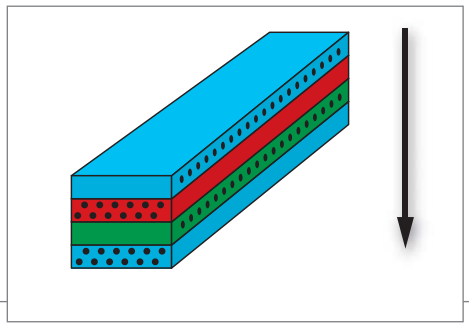
Time Resolved Analysis (TRA) or Depth-Dependent Analysis involves sputtering through different matrix layers in a composite material to gain elemental data for both the matrix and trace components.

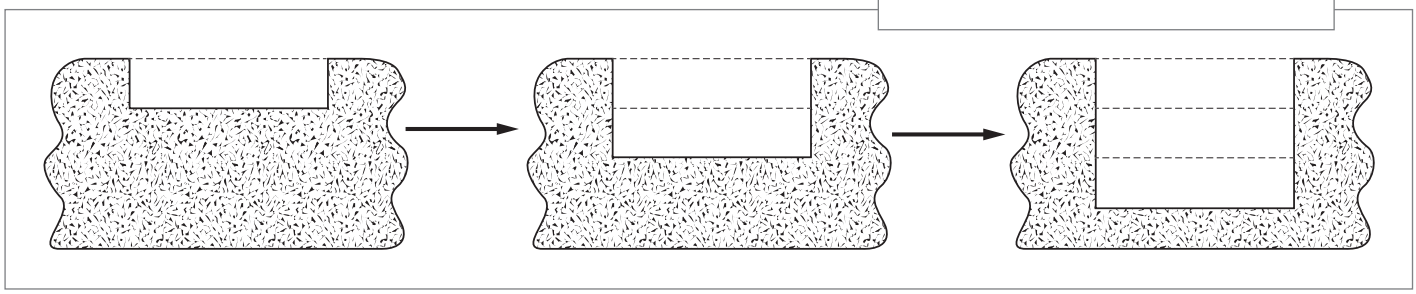
By means of a flat geometry GD source configuration, the GD90 Trace is a perfect candidate for high sensitivity depth-dependent distribution analysis of trace elements in coatings and other multi-layered advanced materials and offers some significant advantages over other instrumentation frequently used for depth profile work.

Flat-Bottomed Crater

As the analyte is sputtered away, a crater is created by the void.

It is necessary that this crater be flat-bottomed to maintain data collection at a uniform depth. The GD90 Trace uses optimum current and voltage configurations to ensure this flat-bottomed crater.



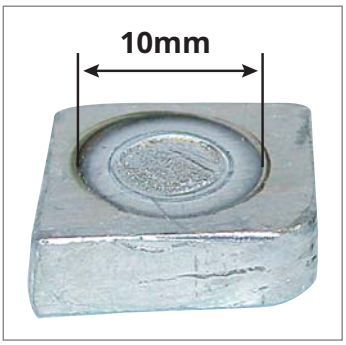


By measuring the crater with a profilometer, the depth can be entered into the software to evaluate elements according to position in the layers

Matrix-Independent RSFs

As the GD90 Trace does not rely on matrix matched standards, the time needed and possible errors generated for this matrix-dependent step are eliminated.

Matrix-independent RSFs (Relative Sensitivity Factors) are beneficial as the matrix will change according to the layer being sputtered. As these RSF values are matrix-independent, the same standard RSF data set can be used throughout each time-dependent study to achieve full elemental quantitative results directly.



Size and Depth of Analysis

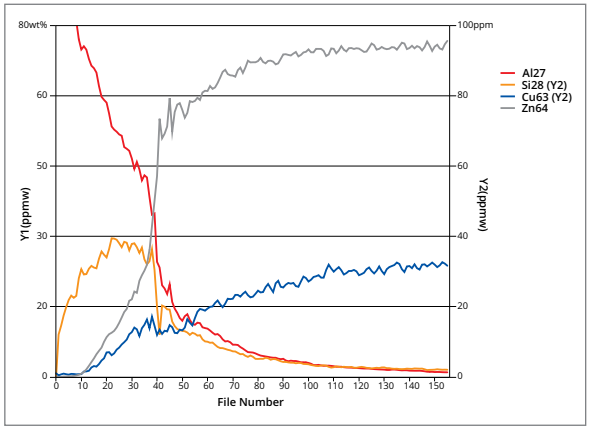
Standard spot size is 10mm ø, making the GD90 Trace a useful tool for analysing thin films and coatings or in determining failure factors.

Optimum depth for the GD90 Trace is between 0.1 – 20 µm, but the range can be increased or decreased by raising or lowering conditions making the GD90 Trace an effective tool for analysing composite materials, including nanocomposites.

Composite Material Analysis

With GD90 Trace, surface coatings or thin films on a substrate can be analysed with ease.

This result illustrates the analysis of an aluminium coating on a zinc substrate (red and grey traces). The matrix-independent RSFs allow for the analysis of the matrix components as well as trace contaminants within the coating and/or substrate. Here silicon (orange) has been evaluated as a trace contaminant within the aluminium coating, and copper (blue) evaluated as a trace contaminant within the zinc substrate.



The GD90 Trace offers some significant advantages over other instrumentation frequently used for depth profile work.

SOFTWARE

FOR GLOW DISCHARGE MASS SPECTROMETRY

The GD90 Trace control, acquisition and data processing system is designed for Windows 10 using the latest version of Microsoft Visual Studio. It is backwards compatible with older Windows systems.

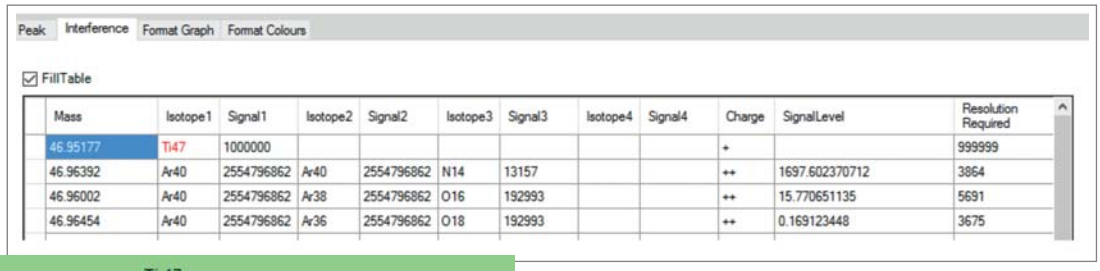
Using the 64 bit architecture allows the use of more memory for very large data sets and an easy to read dashboard gives instant access to the state of the instrument during operation.

The analysis software itself can be installed on additional Windows PCs for offline processing and validation. This option also includes a 32 bit version for older versions of Windows if required.

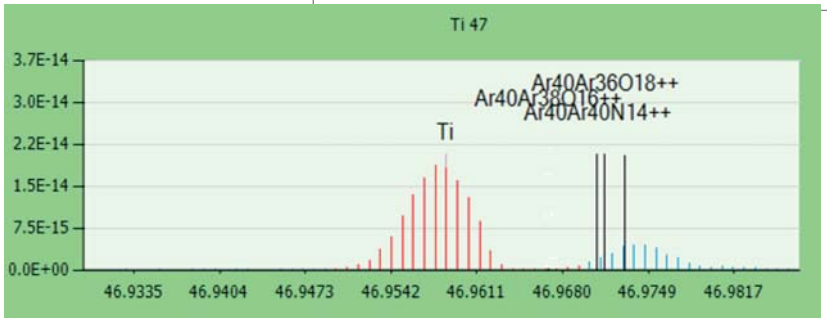
The data itself is stored in simple text based data file format allowing users further processing access including the ability to export in a variety of ways to Microsoft Excel.

Interference Program

The Interference Program is populated according to signal and gases. The resultant table shows possible interferences and the resolution required for their adequate separation.



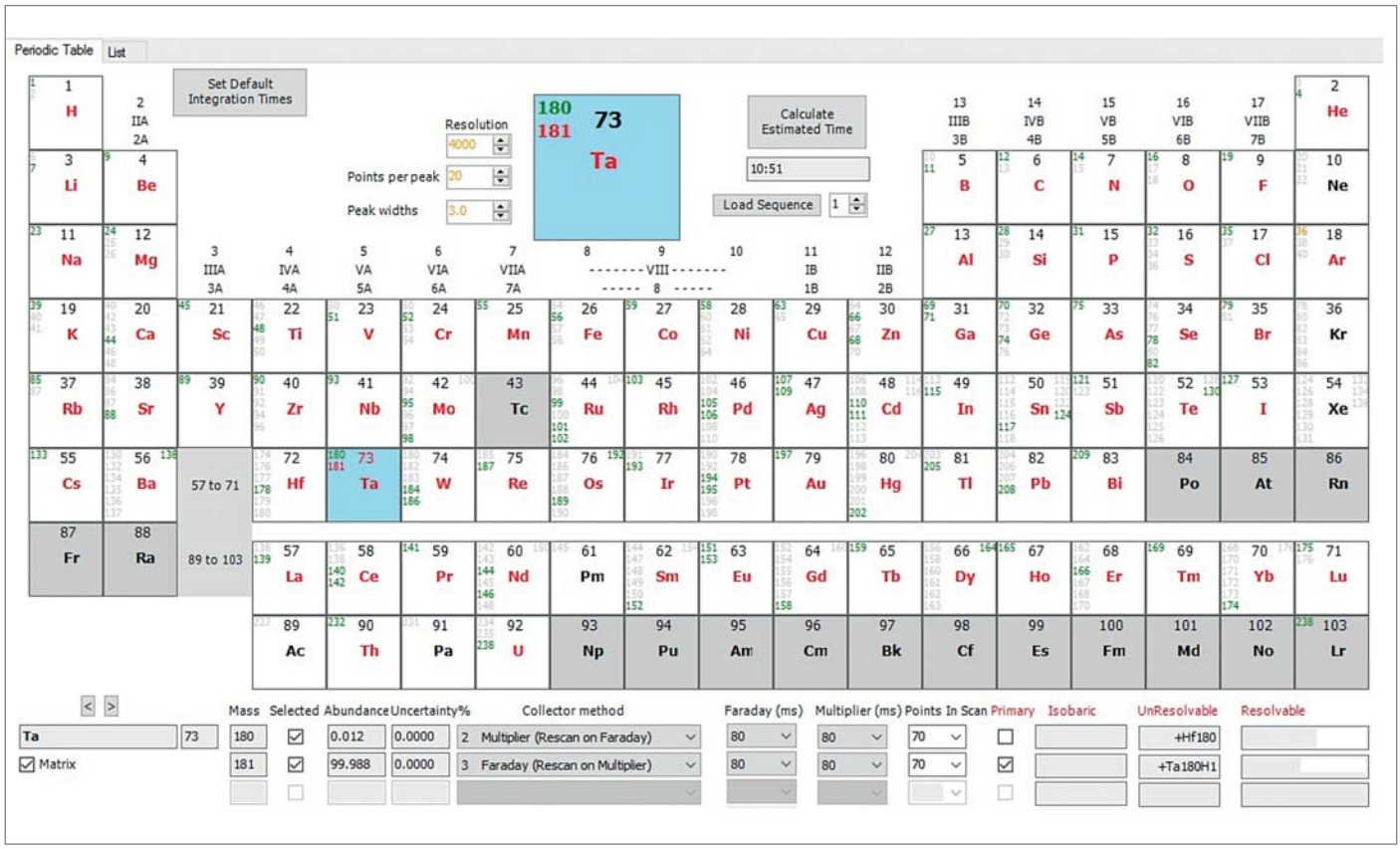
Mass	Isotope1	Signal1	Isotope2	Signal2	Isotope3	Signal3	Isotope4	Signal4	Charge	SignalLevel	Resolution Required
46.95177	Ti47	1000000							+		999999
46.96392	Ar40	2554796862	Ar40	2554796862	N14	13157			++	1697.602370712	3864
46.96002	Ar40	2554796862	Ar38	2554796862	O16	192993			++	15.770651135	5691
46.96454	Ar40	2554796862	Ar36	2554796862	O18	192993			++	0.169123448	3675



Example results for argon molecular interferences

Procedure File Editor

The intuitive Procedure File Editor allows the user to select matrix, isotopes, integration times and points per peak, displaying abundance, isobarics and interferences in a concise, easy to read manner.



MSI is a small company dedicated to GDMS. We offer the flexibility to suit each customer while also providing uncompromised service and support after the sale.

GD90
TRACE

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