Mass Spectrometers for Residual Gas Analysis

RGA

For Applications in a Vacuum Environment

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Residual Gas Analysis

- Mass range options to 5000 amu
- Single and Triple filter options
- 6, 9 or 20 mm diameter rods
- Networking interface
- Ioniser options including:
  Cross beam
  Platinum
  Vacuum Fired



RGA Overview

The Hiden RGA Series is suitable for vacuum fingerprint analysis, leak detection and trend analysis.

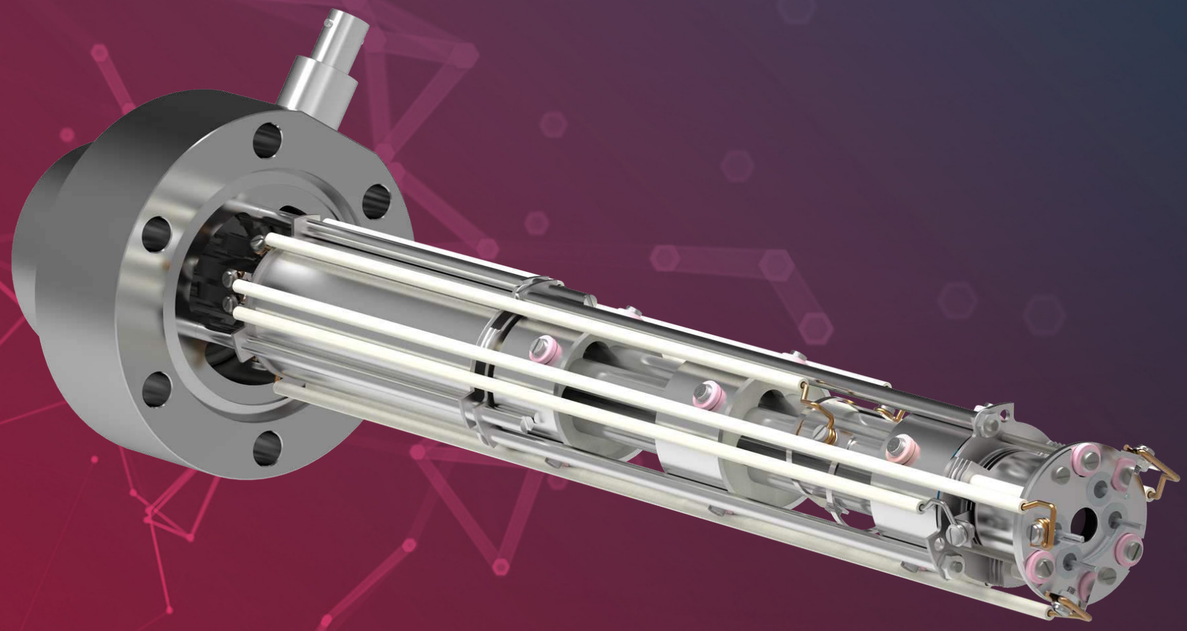
Features include:

- High sensitivity helium leak detection
- Advanced analysis capability for complex gas interpretation
- Ultra fast data acquisition - up to 1000 measurements per second
- Twin burnout-resistant oxide coated iridium filaments
- Real-time background subtract
- Industry best 3-year warranty and lifetime service support

RGA Applications

The Hiden Residual Gas Analyser can be used for a wide variety of applications, including:

- Vacuum Diagnostics
- Leak detection
- Contamination analysis
- Semiconductor production
- Vacuum process analysis
- Reactive sputtering closed loop control
- Vacuum furnace monitoring
- Molecular beam studies, MBE
- UHV/XHV surface science
- UHV TPD



Specification Levels

HALO: Single filter mass spectrometer for multi-purpose HV/UHV applications

3F: Triple filter mass spectrometer for precise analytical capability

3F-PIC: Triple filter mass spectrometer with pulse ion counting detector for fast event



Hiden RGA-HALO Features



- Interchangeable gauge heads and control modules reduce operational and aftersales support costs
- Mass range options 100, 200 and 300 amu
- Dual Faraday / Electron Multiplier detector with partial pressure range $1x10^{-4}$ mbar to $2x10^{-14}$ mbar
- DN-35-CF (2¾"/70mm O.D. Conflat-type)
- Insertion length: 204mm
- Ultra fast data acquisition - up to 1000 measurements per second

3F -Triple Filter Mass Spectrometer

Why have a triple filter?

Two main advantages:

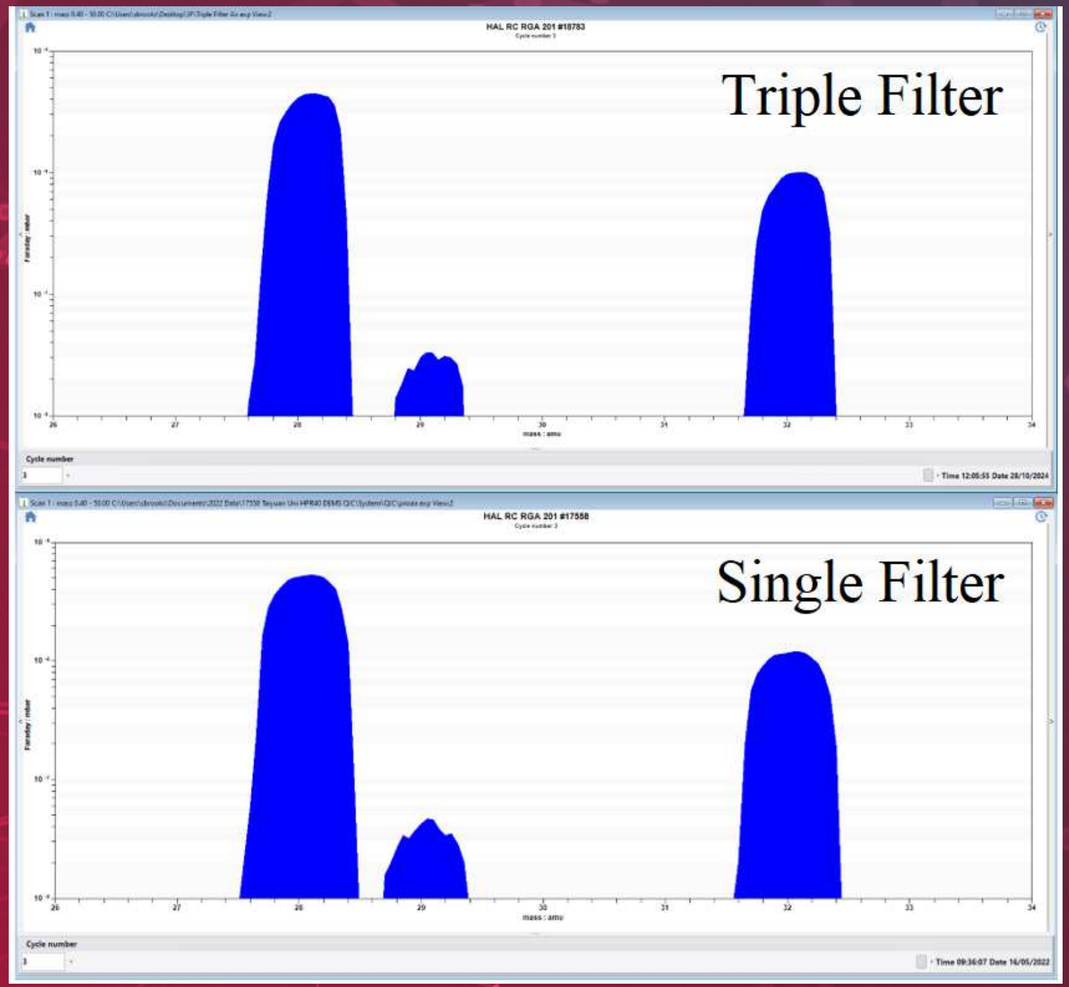
1.Strict control over the quadrupole entrance and exit fields provides enhanced sensitivity for high mass transmission and
increased abundance sensitivity

2.Enhanced long-term stability.
The bulk of the deselected ions from the quadrupole ioniser deposit harmlessly on the RF-only pre-filter stage, minimising contamination on the mass selective primary filter.



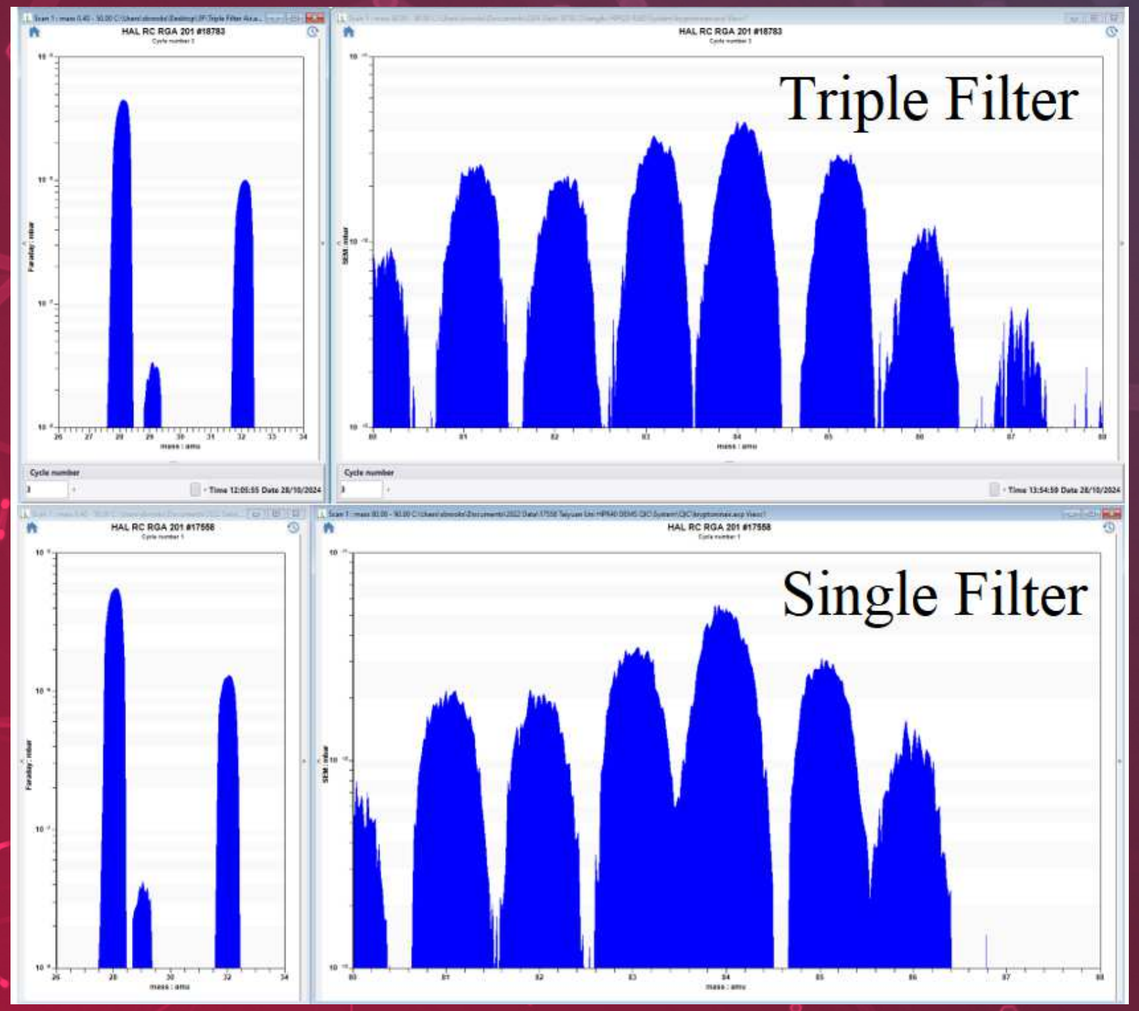
Triple Filter –Enhanced Resolution

For applications where you wish to measure a low intensity peak next to a high intensity peak.



Triple Filter –Enhanced Sensitivity

Triple filter system will also give an increase in sensitivity with increasing mass.



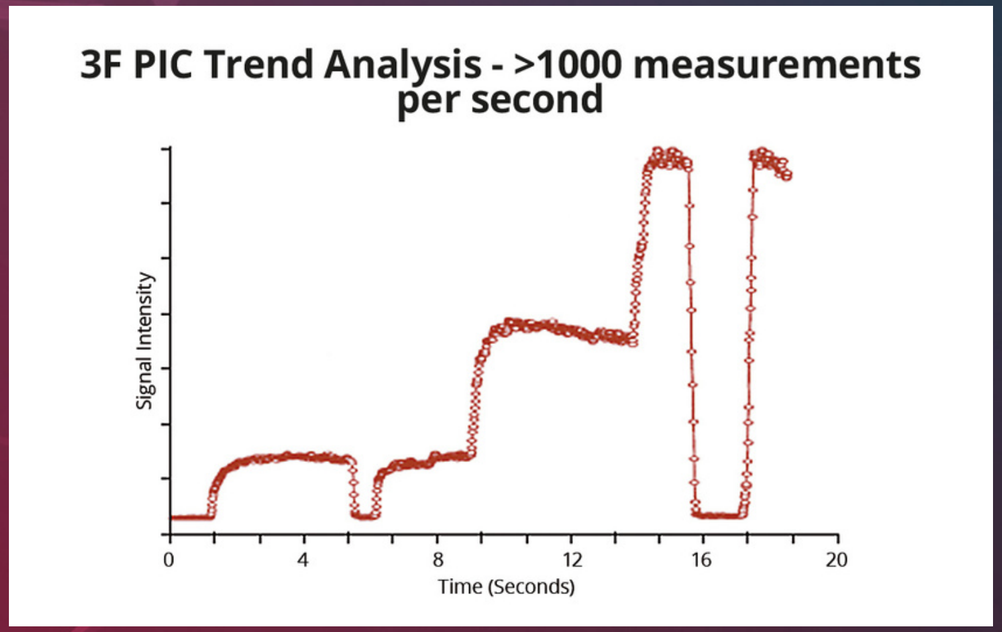
Hiden RGA-HAL 3F Features

- Mass range options 100, 200, 300 and 510amu
- Dual Faraday / Electron Multiplier detector with partial pressure range $1x10^{-4}$ mbar to $5x10^{-16}$ mbar
- DN-63-CF(4½"/114mm O.D.Conflat-type)
- Insertion length: 308mm
- Ultra fast data acquisition - up to 1000 measurements per second



Hiden RGA-HAL 3F PIC Features

- Mass range options 100, 200, 300 and 510 amu.
- High speed PIC detector with 7 decade continuous dynamic range.
- Maximum operating pressure: $5x10^{-6}$ mbar.
- Detection limit $5x10^{-16}$ mbar.
- DN-63-CF (4½"/114mm O.D.Conflat-type).
- Insertion length: 308 mm.
- > 1000 measurements per second.



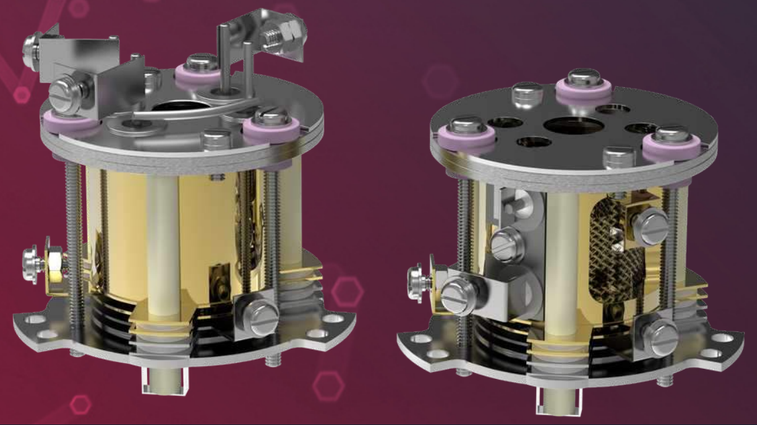
High quality transient data acquisition at PPM/PPB levels. Ideal for UHV TPD.

Hiden RGA Configuration Options

Product Title	Mass Range (amu)	Detector	Maximum Operating Pressure	Minimum Detectable Partial Pressure	Application
HALO 100	100	Faraday	$1x10^{-4}$ mbar	$1x10^{-11}$ mbar	RGA
HALO 201	200,300	Channelplate	$1x10^{-4}$ mbar	$2x10^{-14}$ mbar	RGA
HAL 200	200	Faraday	$1x10^{-4}$ mbar	$5x10^{-12}$ mbar	RGA
HAL 201	100,200,300	Channeltron	$1x10^{-4}$ mbar	$1x10^{-15}$ mbar	RGA
HAL 3F RC	50,200,300,510	Channeltron	$1x10^{-4}$ mbar	$5x10^{-16}$ mbar	RGA
HAL 3F PIC	50,200,300,510	Pulse Ion Counter	$5x10^{-6}$ mbar ($1x10^{-4}$ mbar with Faraday)	$5x10^{-16}$ mbar	UHV-TPD
HAL 1001-9 RC	50,300,510,1000	Channeltron	$1x\ 10^{-4}$ mbar	$3x10^{-16}$ mbar	High Mass or High Resolution
HMT 100	100	Faraday	$5\ x10^{-3}$ mbar	$2x10^{-11}$ mbar	RGA
HMT 101	100	Channelplate	$5\ x10^{-3}$ mbar	$2x10^{-14}$ mbar	RGA

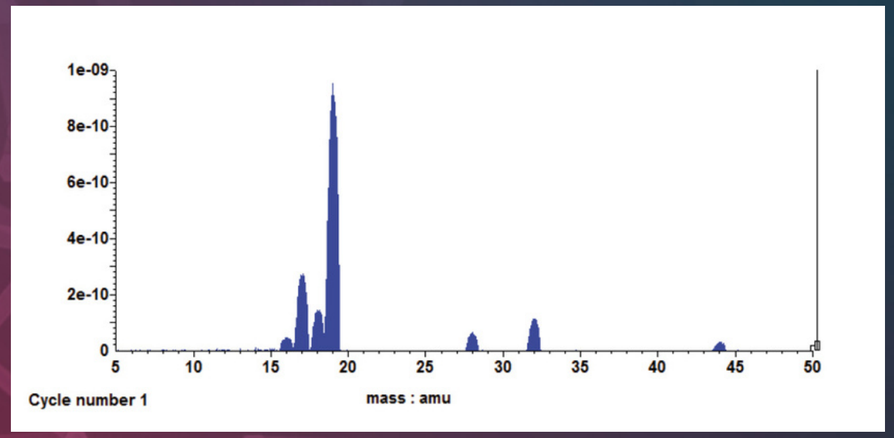
Ion Source Options

- **Standard RGA** –A radially symmetric configuration for general applications.
- **UHV Low Profile** –Optimised for UHV TPD studies enabling closer proximity of the ion source to the evolution surface.
- **Closed Source** –For high pressure studies with direct gas input used in conjunction with a differential pumping stage for the analyser.
- **Basic Cross Beam Source** - The Basic Cross Beam source is used for analysis of molecular beams, where the beam may be liable to condense on ioniser surfaces
- **Platinum Ion Source** -Configured for improved operation in reactive atmospheres.
- **Gold Plated Ion Source** -Configured to minimise the effects of source outgassing.
- **XBS Cross Beam Source** –Configured specially for MBE deposition rate monitoring and control.
- **Laser Cross Beam Source.**
- **4 Lens Ion Optics with Integral Ioniser**.
- **Vacuum Fired Source**- For UHV applications. Very low outgassing.

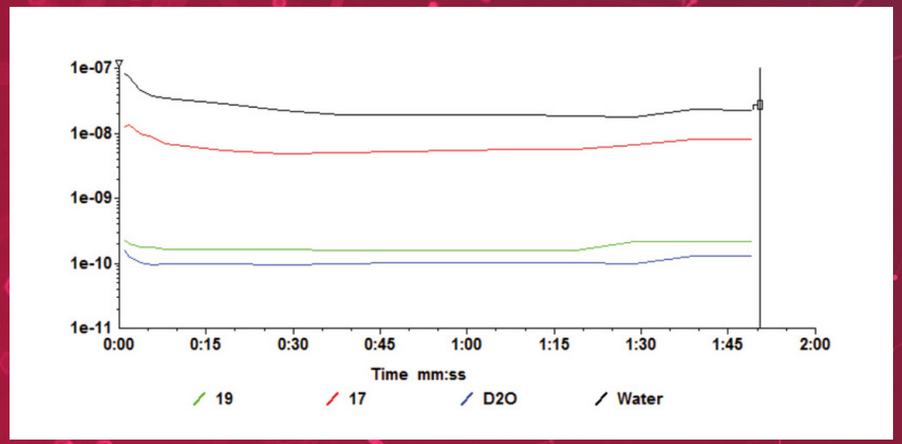


HMT –High Pressure RGA

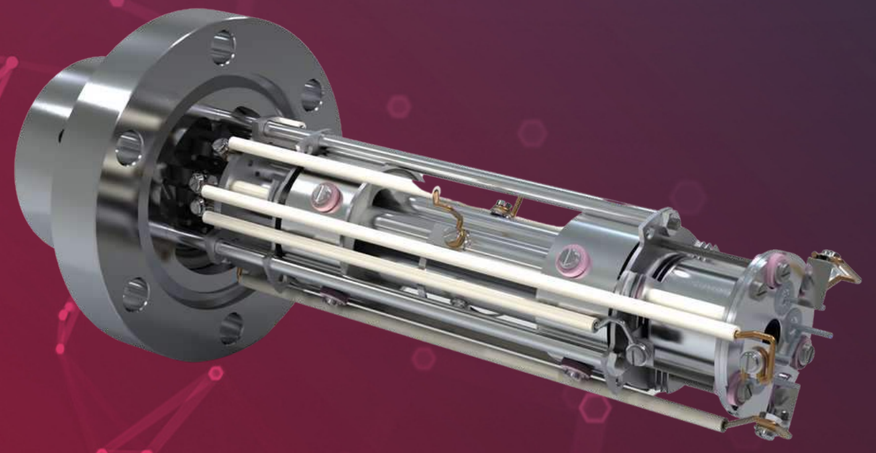
- HMT mode for high pressure operation to $4x10^{-3}$ mbar
- RGA mode for high sensitivity operation to $2x10^{-14}$ mbar
- Stability better than ±1% over 24 hours
- Fast access mixed mode scanning
- Real time background subtraction
- Mass range:100 amu



Profile mass scanning in RGA high sensitivity mode.



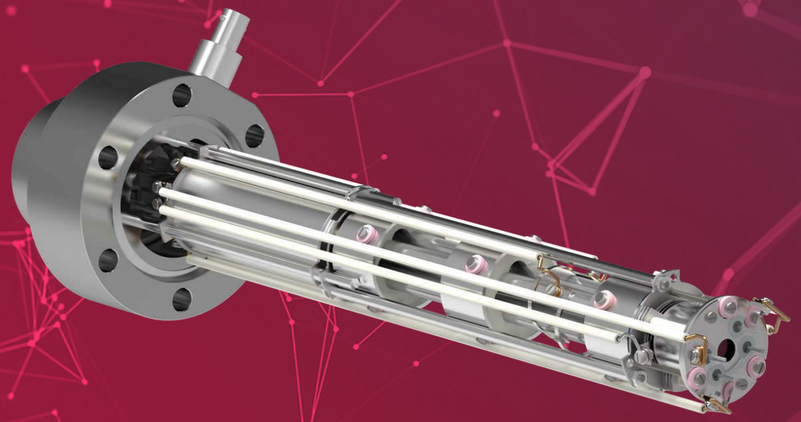
Multi-component trend analysis.

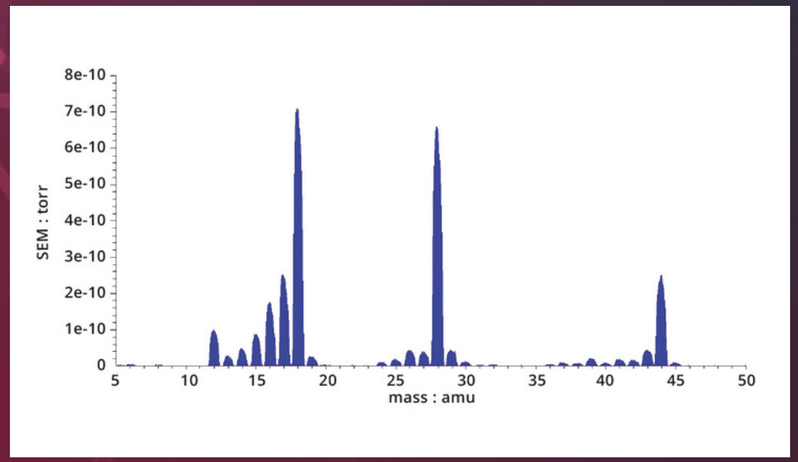


HAL for Demanding UHV and XHV Applications

- Minimum detectable partial pressure of $1x10^{-15}$ mbar
- Vacuum fired ion sources to minimise source outgassing
- EPICS is the standard instrument control software and Hiden HAL system is fully compatible with EPICS software driver.
- Based on the RGA supplied to the Brookhaven National Laboratory in the US (over 100 of these types of RGA system supplied) and CERN in Europe (over 90 of these types of RGA system supplied)
- Suitable for use with:

- Tokamaks/Torus Facilities
- Beam Lines
- Particle Accelerators
- Synchrotrons
- UHV Chambers

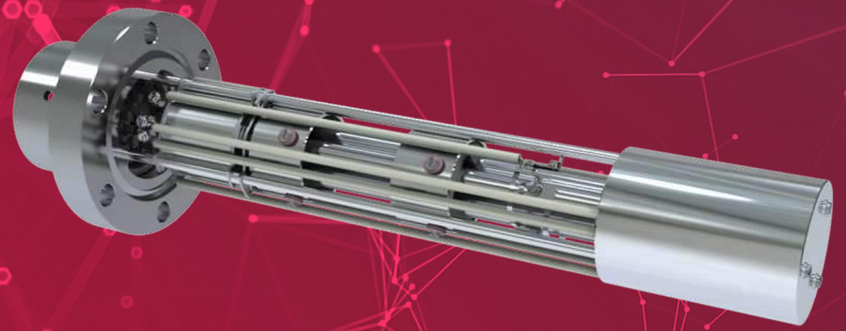


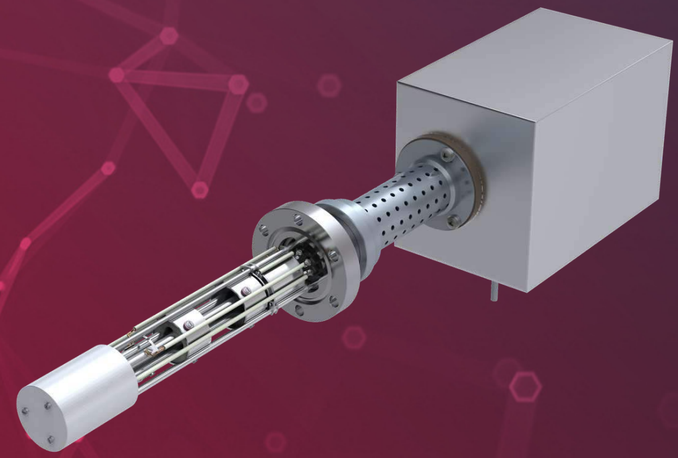


Typical profile spectrum for HAL system.

RGA for MBE: HALO 201 MBE

- Constructed from compatible materials and designed for prolonged use in MBE environments
- Includes molybdenum wiring in place of copper and a contamination resistant ion source shroud
- Applications include semiconductors, solar cells, oxides, nitrides.
- Thermal extender option for RGA operation during bakeout

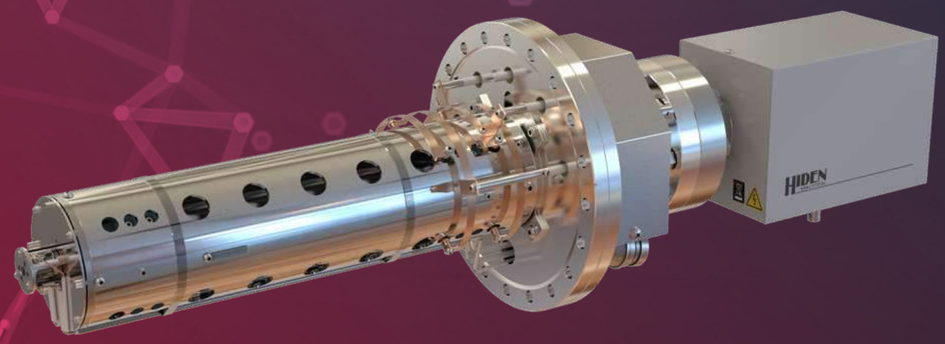




DLS Series- for the Study of Hydrogen Isotopes and Applications in Nuclear Fusion Research

DLS-20

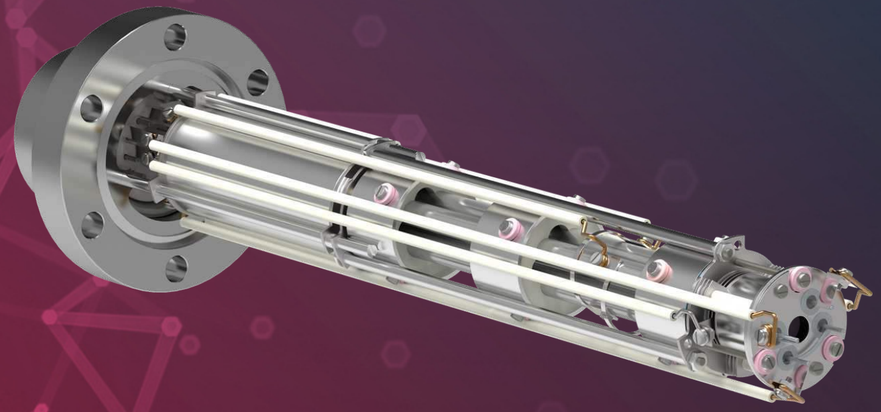
- Industry first 20 mm rod diameter quadrupole mass filter for ultra-high mass resolution
- Software switchable dual-zone RF power supply for Zone H ultra-high resolution 1-22.5 amu operation and Zone I ultra-high stability 1-200 amu operation
- 0.006 amu mass separation in real time
- Sensitivity of both He in D_2 and D_2 in He is 1 ppm
- ^3He quantification in HD



DLS Series- for the Study of Hydrogen Isotopes and Applications in Nuclear Fusion Research

DLS-1

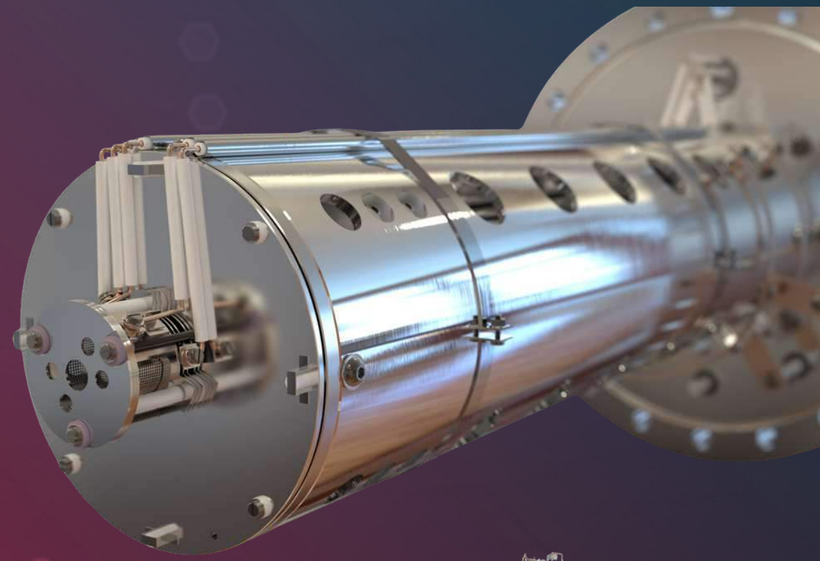
- 1-100 amu mass range
- Software driven recipes using threshold ionisation mass spectrometry (TIMS) for the real-time quantification of hydrogen and helium isotopes and deuterated hydrocarbons
- Sensitivity of D_2 in He of 100 ppm



DLS Series- for the Study of Hydrogen Isotopes and Applications in Nuclear Fusion Research

DLS-2 / DLS-2X

- Two available configurations.
- High Resolution Zone H up to 22.5 amu (0.02 amu real-time mass separation) + Standard
- Resolution Zone 1 up to 100 amu
- Ultra-high Resolution Zone H up to 10 amu (0.0065 amu real-time mass separation) + Standard Resolution Zone 1 up to 44 amu
- Sensitivity of both He in D_2 and D_2 in He is 10 ppm
- DLS-2X: Remote analyser mounting up to 140m from sensitive electronics, for fusion applications and harsh operating environments.



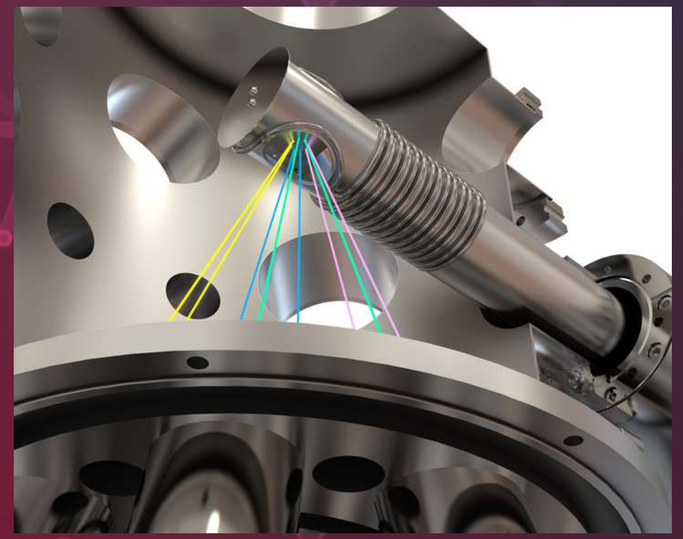


XBS Deposition Rate Monitor

A quadrupole mass spectrometer designed for monitoring multiple sources simultaneously.

- monitor and control in MBE processes
- molecular beam studies
- multiple beam source analysis
- photoionisation studies
- desorption/outgassing studies
- monitoring and diagnostics of contaminants in the process chamber
- high performance RGA with 3F series triple-stage mass filter
- high-sensitivity helium leak check mode for vacuum quality verification





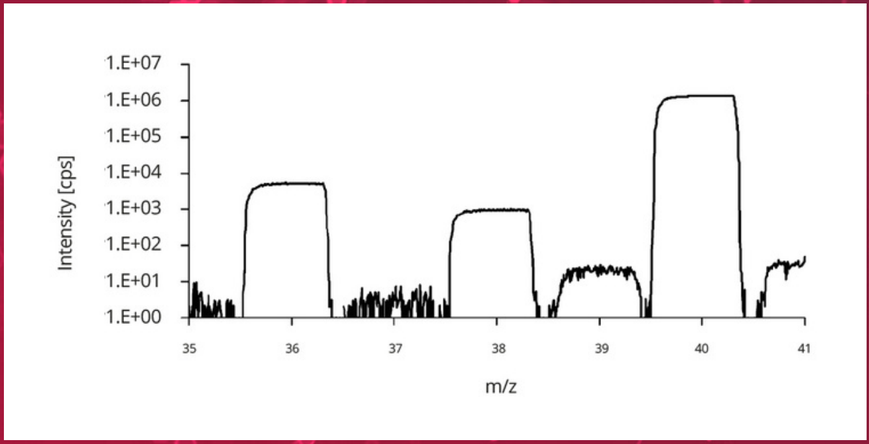
What pole diameter do I need?

- Total RF output power is fixed for a given generator
- Power demand increases dramatically with increasing RF frequency ($\propto \nu 5$)
- For given mass, performance improves with increasing frequency increasing pole diameter
- Overall size and cost increase with increasing pole diameter
- Enlarging pole diameter increases assembly capacitance and limits RF range (increases power losses)



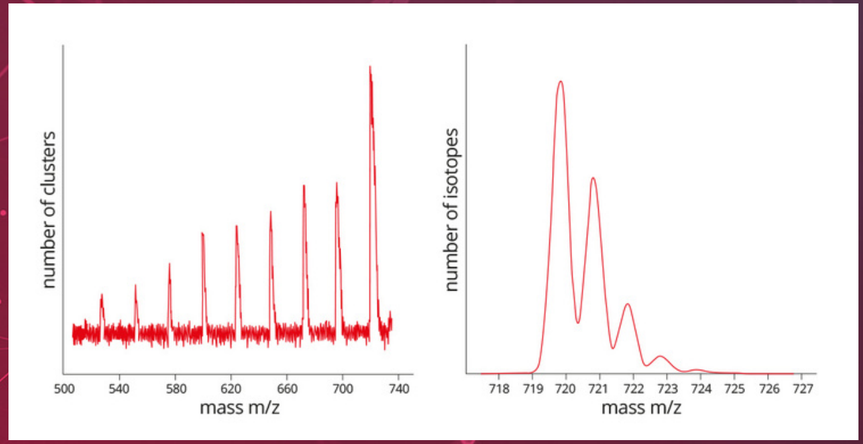
1000 Series RGA

- 9 mm molybdenum rod design
- mass range options: 50, 300, 510, 1000 and 5000 amu
- Increased mass resolution, high mass transmission and ion stability
- Full electron energy control 0-150 eV for complementary Threshold Ionisation Mass Spectrometry TIMS analysis mode
- With high sensitivity PIC detector and optional Faraday detector



High stability for precision isotope ratio measurements: 40Ar/39Ar geochronology research[1].

[1] Björn Schneider et al. 2009 Quaternary Geochronology 4 Pages 508-516



High mass transmission: Fullerene (C60) vapour isotope fragment analysis



Hiden RGA Users

- Los Alamos National Lab
- Samsung
- NASA
- Intel Corporation, USA
- CERN
- Carl Zeiss, Germany
- California Institute of Technology
- Brookhaven National Laboratory
- Corning
- CCFE (JET)
- Durham University
- National Physical Laboratory
- Jozef Stephan Institut
- Max Planck Institut
- Bern University
- Rutherford Appleton Laboratory
- SLAC National Accelerator
- Laboratory University of Sao Paulo
- Aarhus University



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