

Hidden QGA

Quantitative Gas Analysis System

Hidden QGA System



A compact bench-top gas analyser configured for real time analysis.

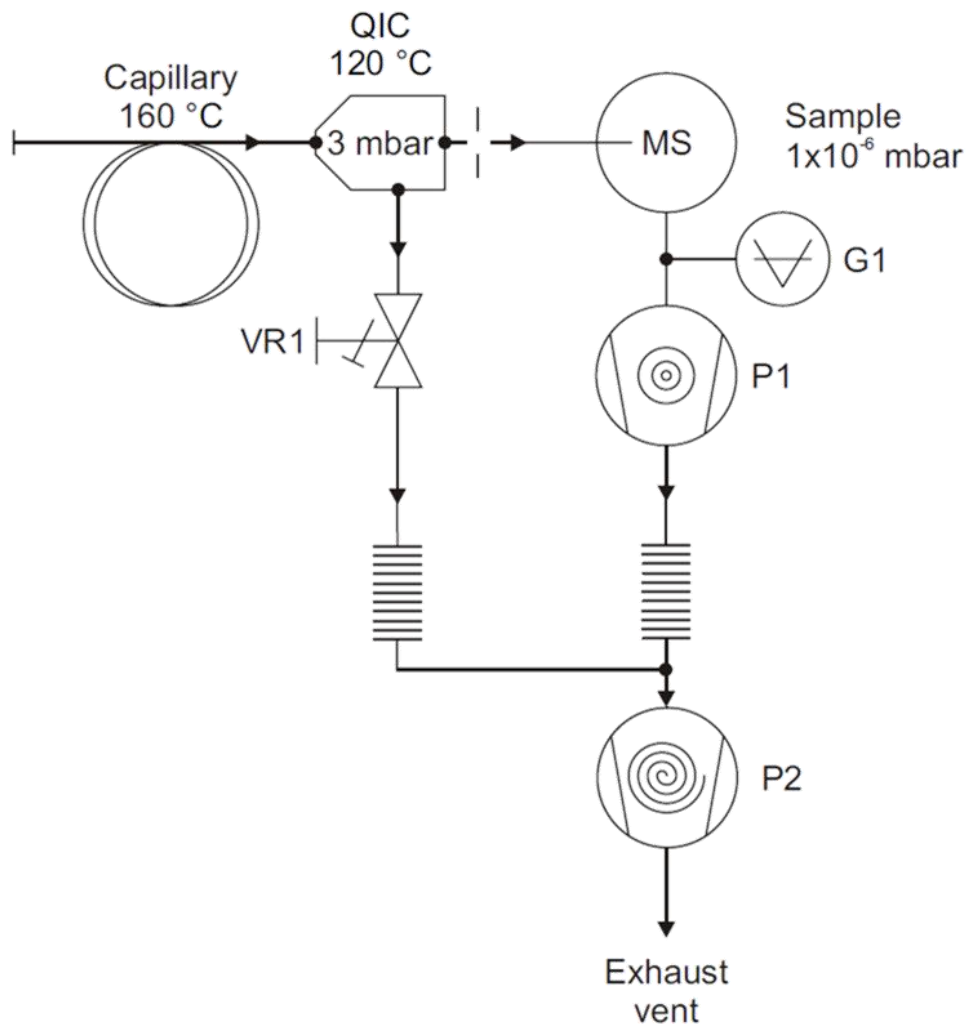
Introduction

The Hiden QGA quantitative gas analysis system is configured for continuous analysis of **gases and vapours** at pressures near **atmosphere**.

Operating to 200°C, the QIC (quartz inert capillary) flexible 2m capillary inlet provides fast response times of less than 300ms.

The QGA system has a mass range of 200 amu (300 amu option) and a detection capability from **100% to less than 100ppb**.

QGA Vacuum Schematic

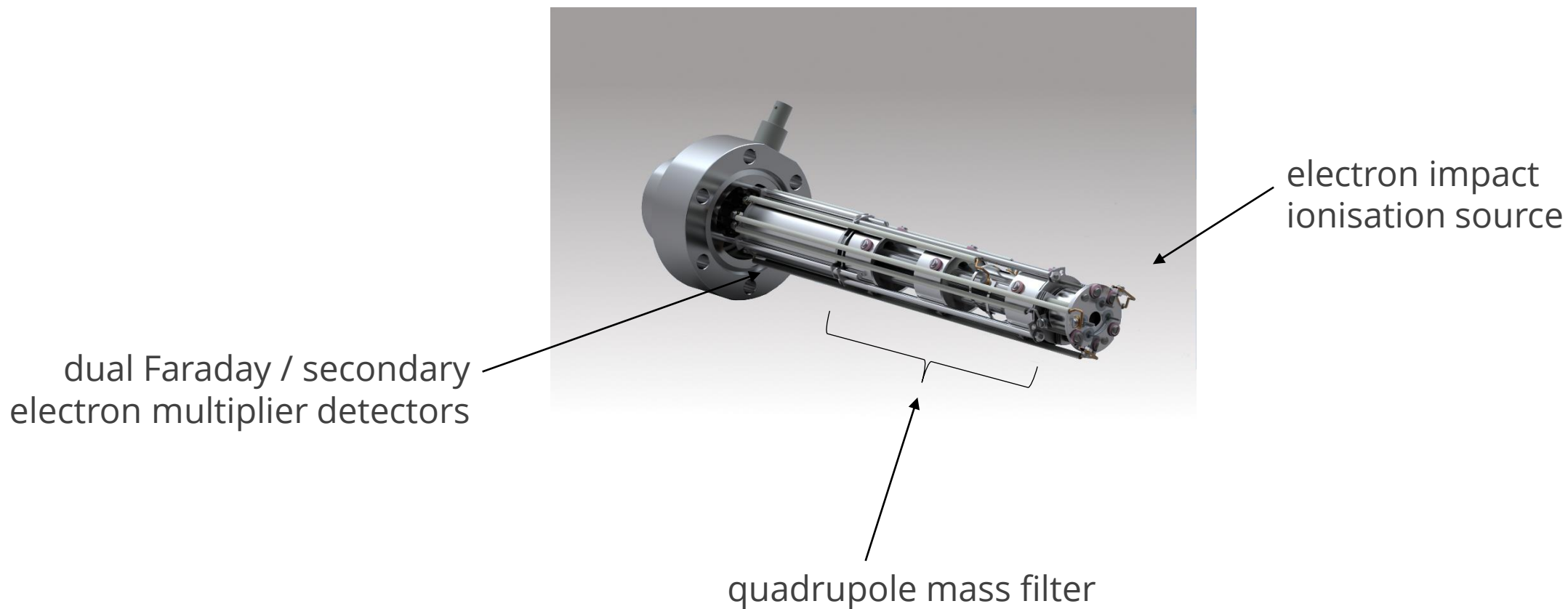
**Key**

- G1 Penning gauge
- VR1 QIC Inlet bypass control valve
- P1 60 l/s turbo drag pump
- P2 Backing and bypass Scroll pump
- MS UHV Housing (Mass spectrometer chamber)

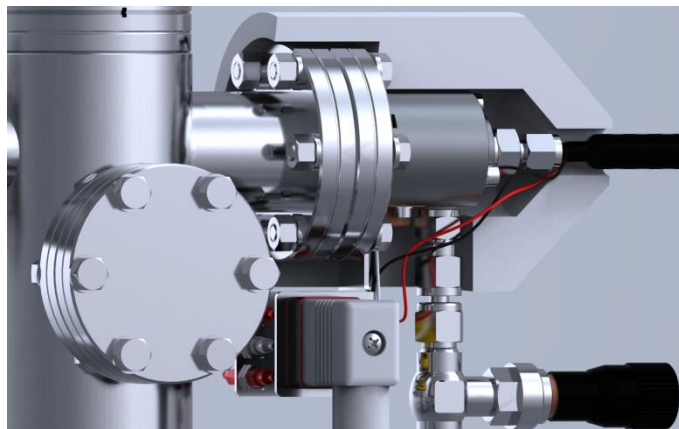


*Backing and bypass
Scroll Pump*

QGA Mass Spectrometer

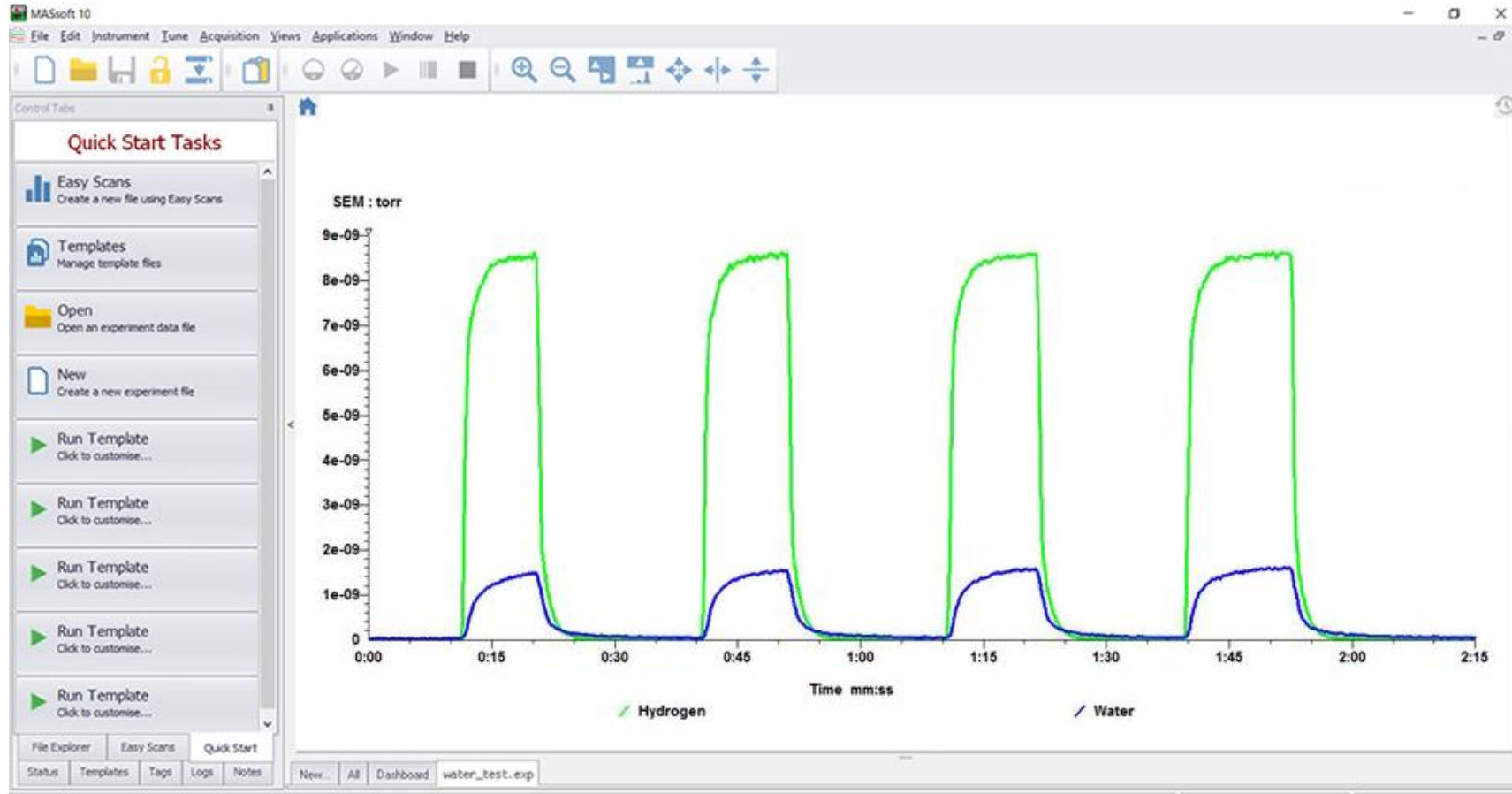


QIC Inlet Technology



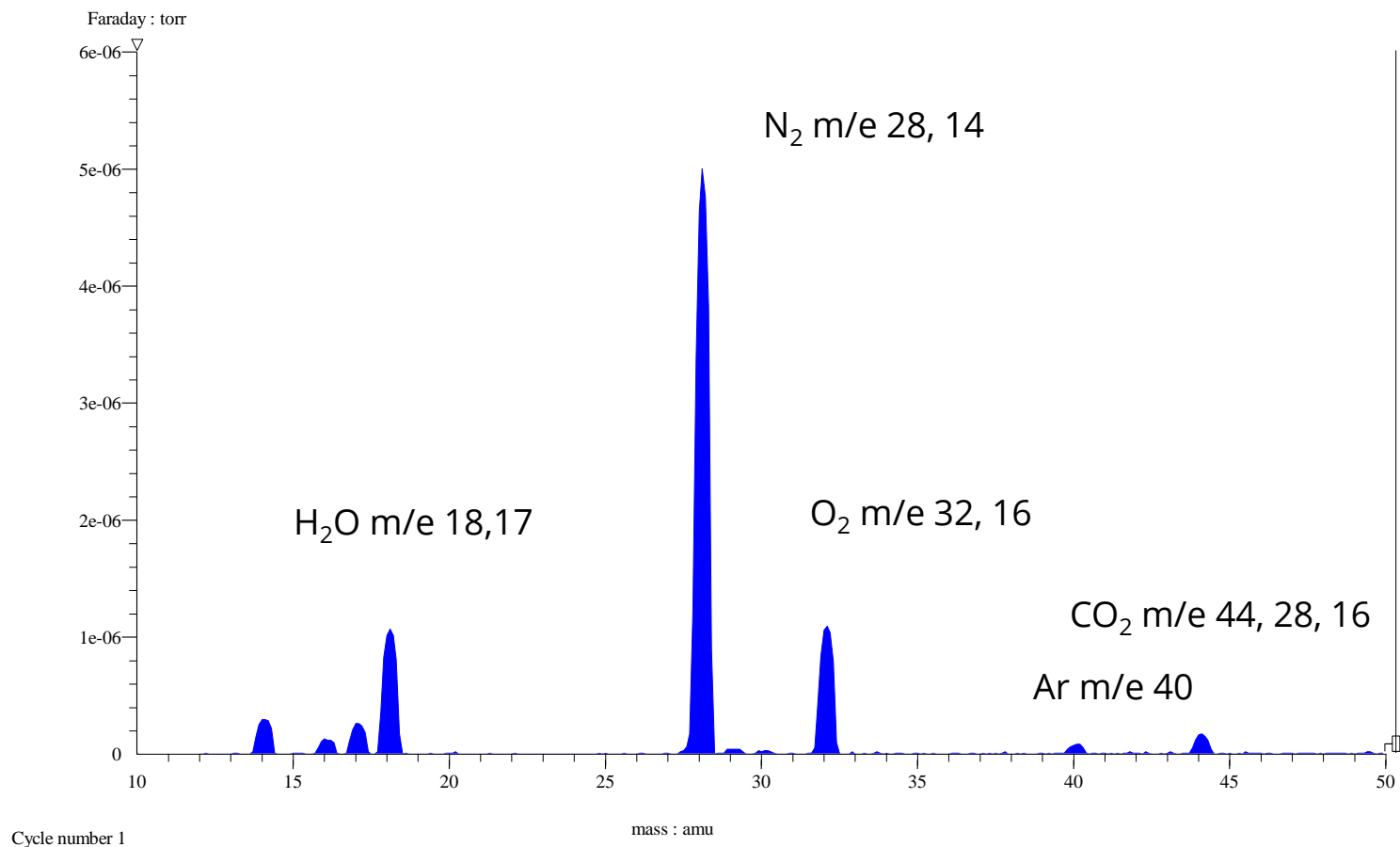
- | | | |
|--------------------------------------|---|--------------------------------|
| Quartz and Platinum Wetted Surfaces | → | No memory effects |
| Heated Capillary | → | No condensation effects |
| Flow Matched | → | Optimum response / recovery |
| Minimal Internal Volume | → | PPB detection |
| Interchangeable Sampling Capillaries | → | Analysis from 10 Torr to 2 Bar |

Fast Response to Permanent Gases / Vapours



Data shows the response of a QGA system to gas and vapour during switching between a dry He stream and a wet H₂ and Ar flow. For clarity, only the H₂ and H₂O data is shown in the graph.

Typical Mass Spectrum of Air



Note: Different species can have the same mass e.g. CO, N_2 m/e 28

Soft Ionisation

Unique to Hiden gas analysis systems, soft ionisation allows users to selectively ionise different gases by setting the ionisation energy for a particular mass.

This powerful technique can simplify the analysis of otherwise complex cracking patterns from multi-component gas/vapour mixtures.

The ionisation energy can be altered from 4 to 150 eV, in 0.1 eV increments. Standard operation is at 70 eV.

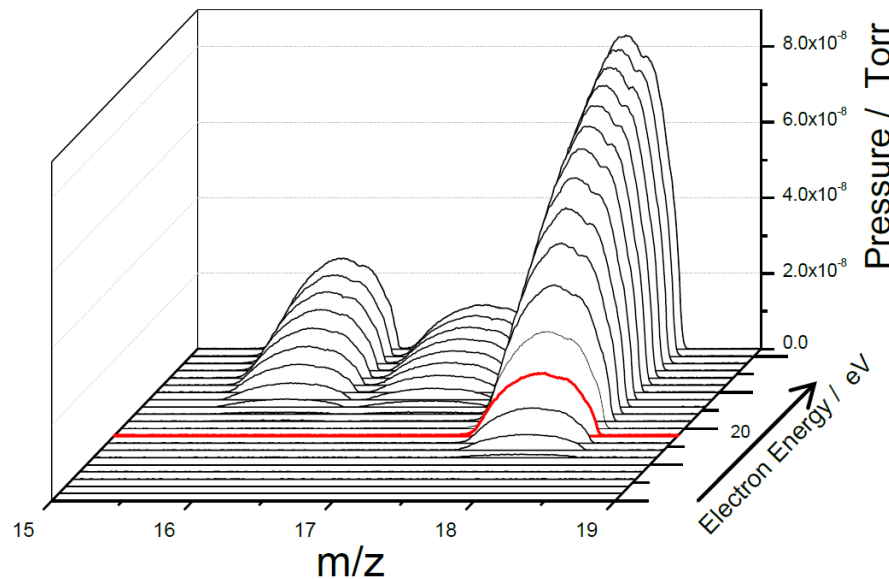


Figure 1 A: m/z vs Electron energy-H₂O/Air

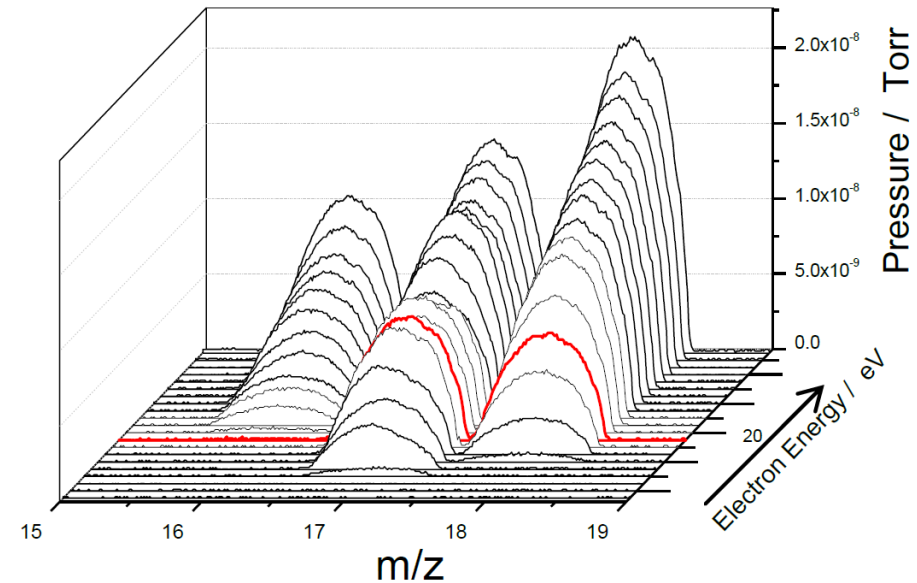
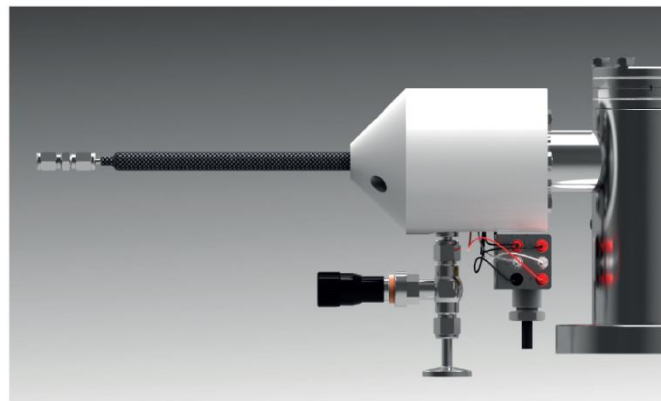


Figure 1 B: m/z vs Electron energy-NH₃/ H₂O/Air mix

Gas Sampling Options

Pressure:

Inlet options are available for sampling both above and below atmospheric pressure. High pressure inlets for sampling at up to **30 bar** and special capillaries for sampling down to **1 mbar**.



Multi-stream selectors:

2, 8, 16, 20, 40 and 80 way options

Temperature:

- Heated capillary extensions
- High temperature capillary inlets
- Hot-zone adaptors
- Heated multi-stream inlets

MASsoft Professional Control software

The screenshot displays the MASsoft Professional Control software interface. The main window shows a 'Real time trend analysis' plot with SEM (10⁻¹² to 10⁻⁴) on the y-axis and Time (mm:ss) on the x-axis. The plot shows several peaks corresponding to different components: Water, Ammonia, Argon, Carbon Dioxide, Isopropyl alcohol, and Methyl Alcohol. The x-axis has markers at 08:20, 16:40, 25:00, 33:20, and 41:40. The y-axis has markers at 10⁻¹², 10⁻¹¹, 10⁻¹⁰, 10⁻⁹, 10⁻⁸, 10⁻⁷, and 10⁻⁶.

On the right side, there is a 'Scan Editor' window showing a sequence of scans:

- Scan 1 : mass 2.00
- Scan 2 : mass 18.00
- Scan 3 : mass 32.00
- Scan 4 : mass 40.00
- Scan 5 : Pressure 0.40

Below the scan editor, there is a 'MID Mode' dialog box with a table of scan parameters:

| Component | Name | Mass | Mode | Detector | Range | Au. | Rel Sene | Rel SEM | Colour | Line | Style |
|-----------|------|-------|--------|----------|-------|-----|----------|---------|---------|------|---------|
| Hydrogen | | 2.00 | Unknov | Faraday | -5 | ✓ | 0.440 | 1.000 | Aqua | --- | Thin sc |
| Water | | 18.00 | Unknov | Faraday | -5 | ✓ | 0.900 | 1.000 | Lime | --- | Thin sc |
| Oxygen | | 32.00 | Unknov | Faraday | -5 | ✓ | 0.860 | 1.000 | Red | --- | Thin sc |
| Argon | | 40.00 | Unknov | Faraday | -5 | ✓ | 1.200 | 1.000 | Blue | --- | Thin sc |
| Pressure | | 0.40 | Unknov | Faraday | -5 | ✓ | 1.200 | 1.000 | Fuchsia | --- | Thin sc |

The interface also includes a 'Quick Start Tasks' panel on the left, a 'Control Tabs' panel at the top, and a 'Real time trend analysis' window at the top right. The bottom of the screen shows the Windows taskbar with the date 29/03/2018 and time 10:42.

A multilevel software package allowing both simple control of mass spectrometer parameters and complex manipulation of data plus control of external devices.

QGA Professional Software for Quantitative Gas Analysis



An application specific software package for quantitative gas and vapour analysis providing real time continuous analysis of up to 32 species with concentrations measured in the range 0.1PPM to 100%.

- Automatic subtraction of spectral overlaps
- Automated calibration routines
- Mass spectral library with intelligent scan feature
- Multi-stream support

QGA Professional Software for Quantitative gas Analysis

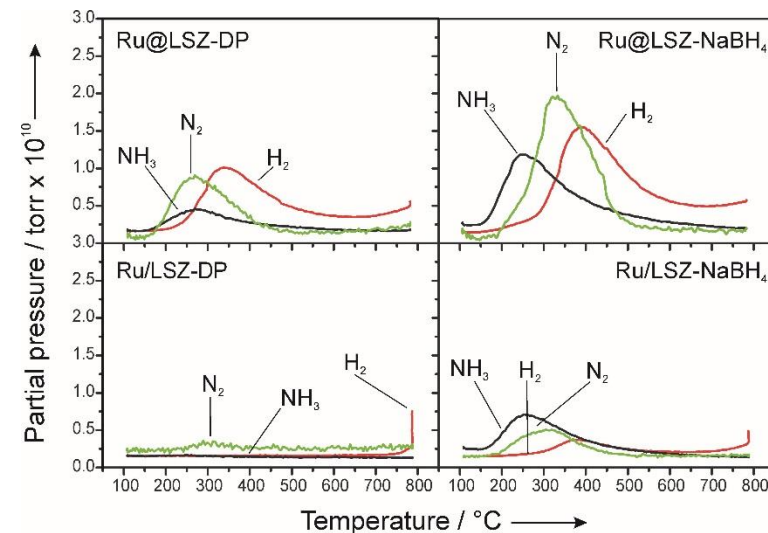
Applications

- Catalysis
- Reaction Kinetics
- TPD/TPR/TPO
- Thermal Analysis Mass Spectrometry
- Gas Purity Analysis
- Process Characterisation
- Fermentation Off Gas Analysis
- Environmental Gas Analysis
- Combustion Studies
- CVD/MOCVD



Applications: Catalysis Research

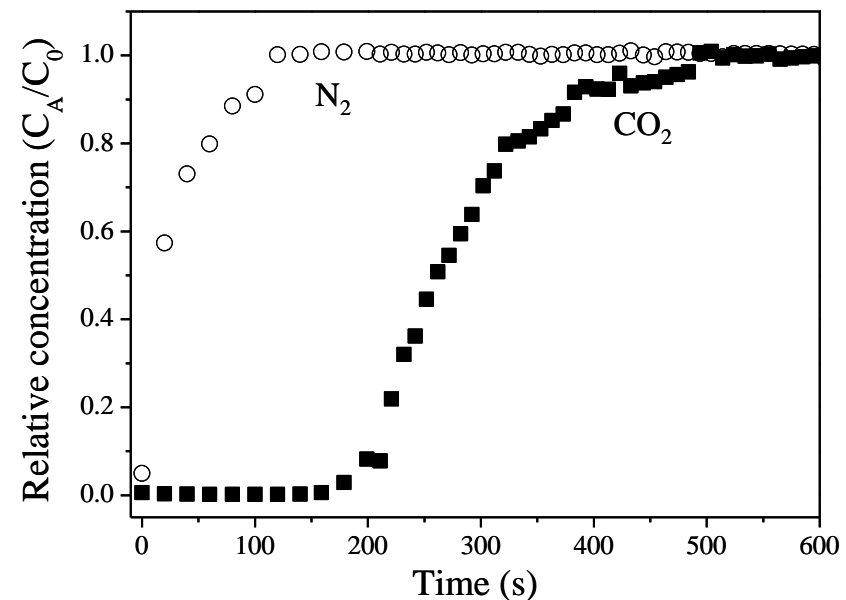
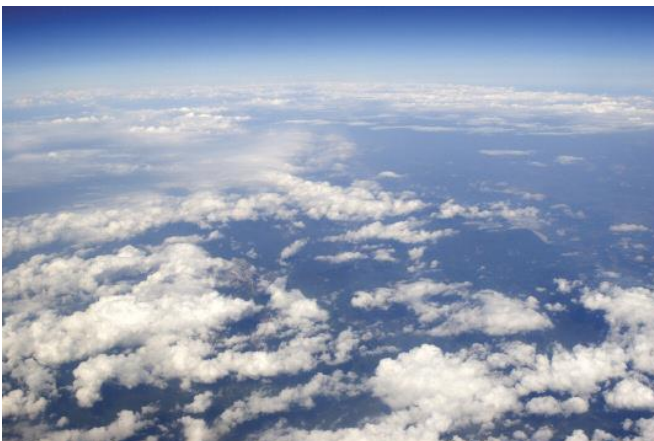
- Catalyst characterisation
- Kinetic and thermodynamic measurements
- TPD, TPO, TPR, TP-Reaction
- On-line continuous product analysis
- Total Surface Area / Metal Surface Area
- Mechanisms of Surface Reactions
- Heats of Adsorption and Co-adsorption
- Operando Studies



NH₃-TPD on embedded Ru@LSZ and impregnated Ru/LSZ catalysts.

Ref: Lorenzut et al. (2011) *Hydrogen production through alcohol steam reforming on Cu/ZnO-based catalysts*, Applied Catalysis B, **101** (3&4), 397-408.

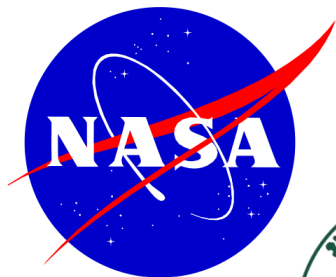
Applications: Environmental Gas Analysis



Breakthrough curve of CO₂ (15% CO₂, 85% balance N₂) on mesoporous alumina.

Ref: Yang et al. (2010) CO₂ adsorption over ion-exchanged zeolite beta with alkali and alkaline earth metal ions, *Mesoporous Materials* **135** (1-3), 90-94.

Hidden QGA Users



Janssen



MANCHESTER
1824

The University of Manchester



Imperial College
London

TU Delft

Delft University of Technology

- Johnson Matthey
- Imperial College London
 - NASA
- Poitiers University
 - Nissan
- KTH Stockholm
- Karlsruhe Institute of Technology
- University of Florida
- The University of Hong Kong
- Paul Scherrer Institut
- ULB Brussels University
- Texas A&M University
- University of Sao Paulo
 - University College London
- Technical University Denmark
- Beijing Forestry University
- CSIR – Indian Institute of Petroleum
- Diamond Light Source
- Shanghai Institute of Technology
- Janssen Pharmaceutica
 - PDVSA
 - Air Liquide
 - BASF
 - TU Delft
- Seoul National University
- University of Manchester
 - University of British Columbia
 - USTB
- University of Nottingham



Karlsruher Institut für Technologie



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Johnson Matthey

Summary

- Compact bench-top gas analysis system
- Real-time, multi-species analysis – 100 ppb to 100%
- Fast response to permanent gases and vapours – less than 300 ms response time
- Automated calibration routines for accurate quantitative analysis
- Soft ionisation for reduced spectral fragmentation and simplified data interpretation