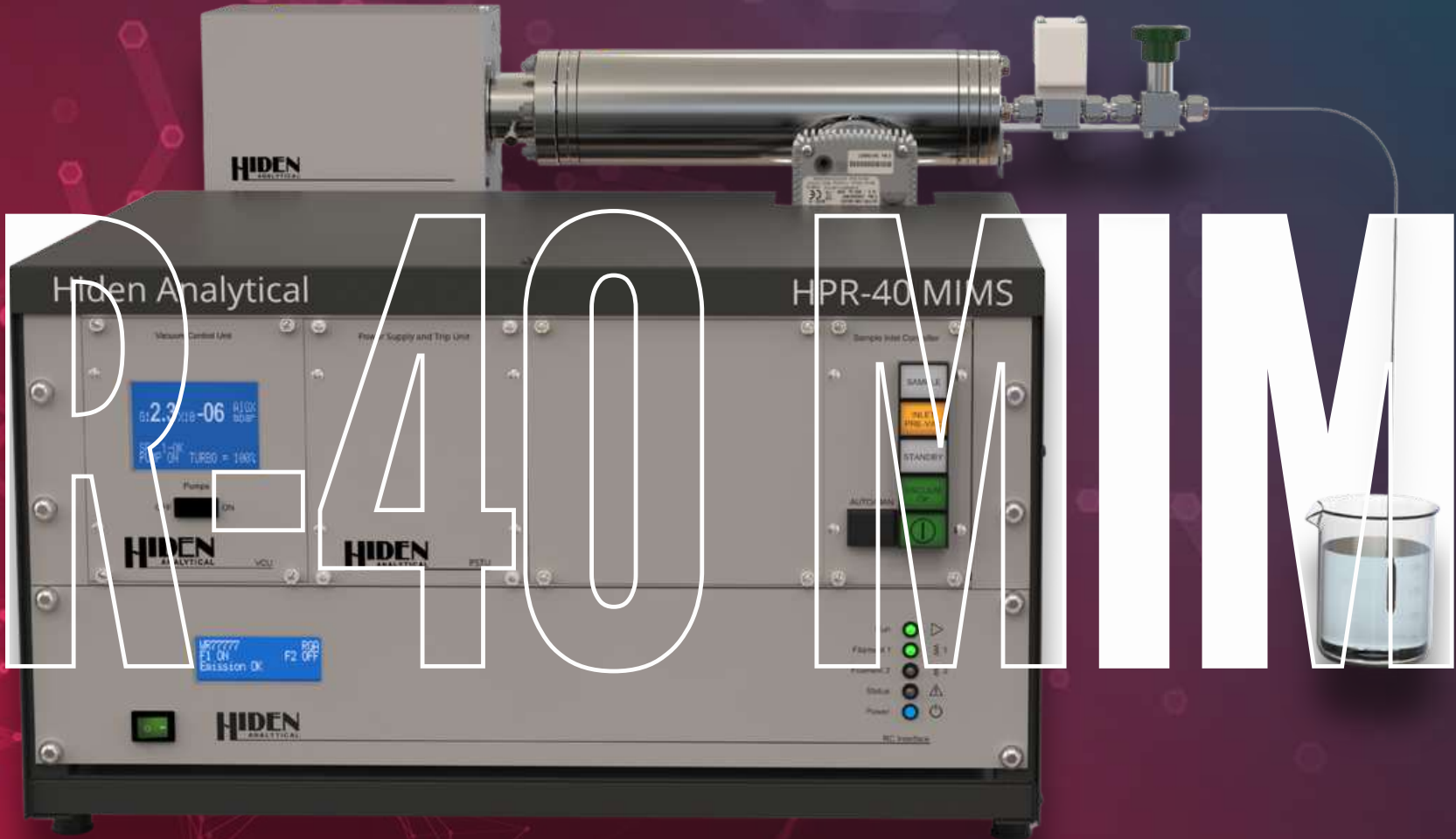


HPR-40 MIMS



For Groundwater Research

Introduction



- The HPR-40 MIMS System is configured for real-time quantitative analysis of **dissolved or evolved gases and vapours**.
- The inlet probe uses a permeable membrane that allows small levels of the dissolved species to pass through and on to the QMS.
- The HPR-40 MIMS system has a mass range of 200 amu (300 amu option) and **sub ppb detection levels**.
- Interchangeable membrane inlet probe types address a broad range of applications.

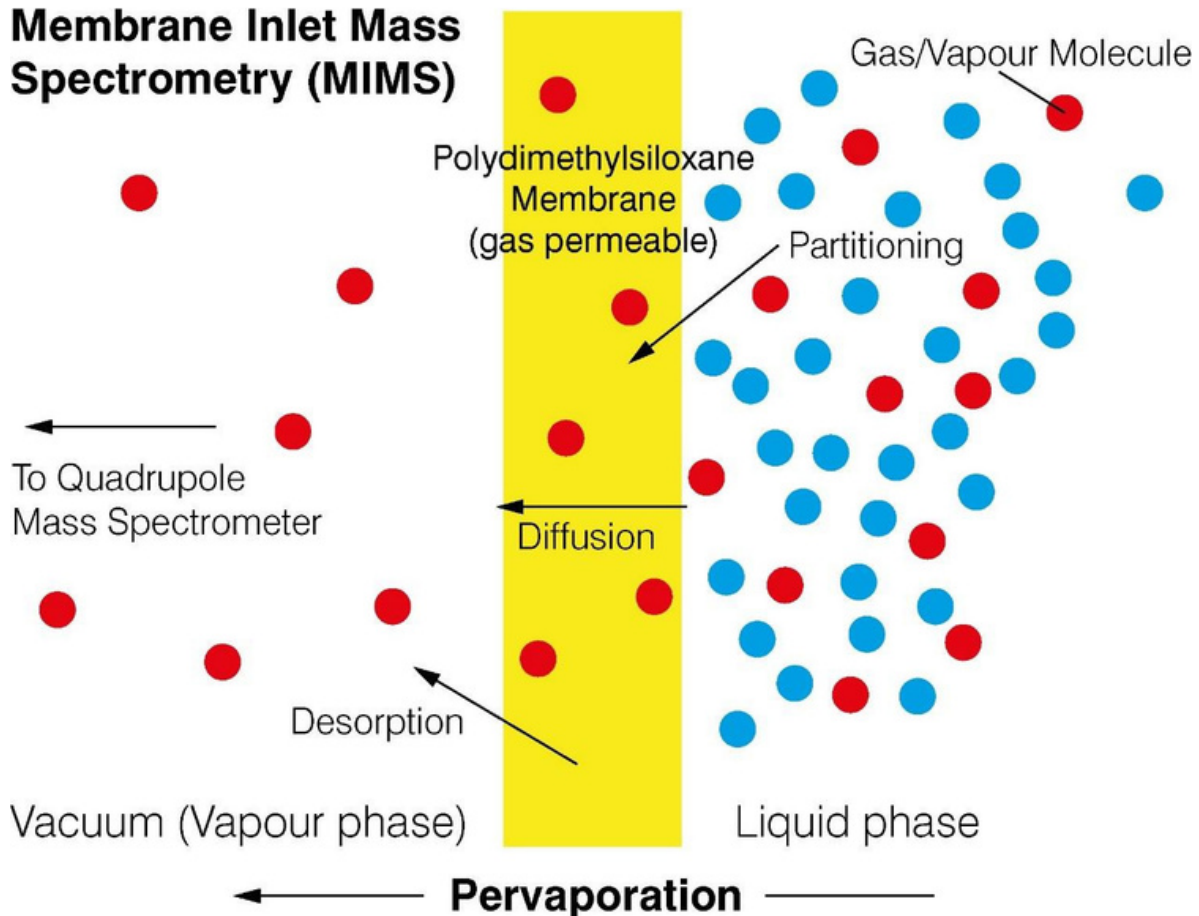
Applications of HPR-40 MIMS

- Soil core analysis
- Fermentation process analysis
- Water analysis in Estuary, River or Reservoir
- Groundwater studies
- Methane production control
- Microbiological / Enzyme activity studies
- Environmental monitoring



MIMS Overview

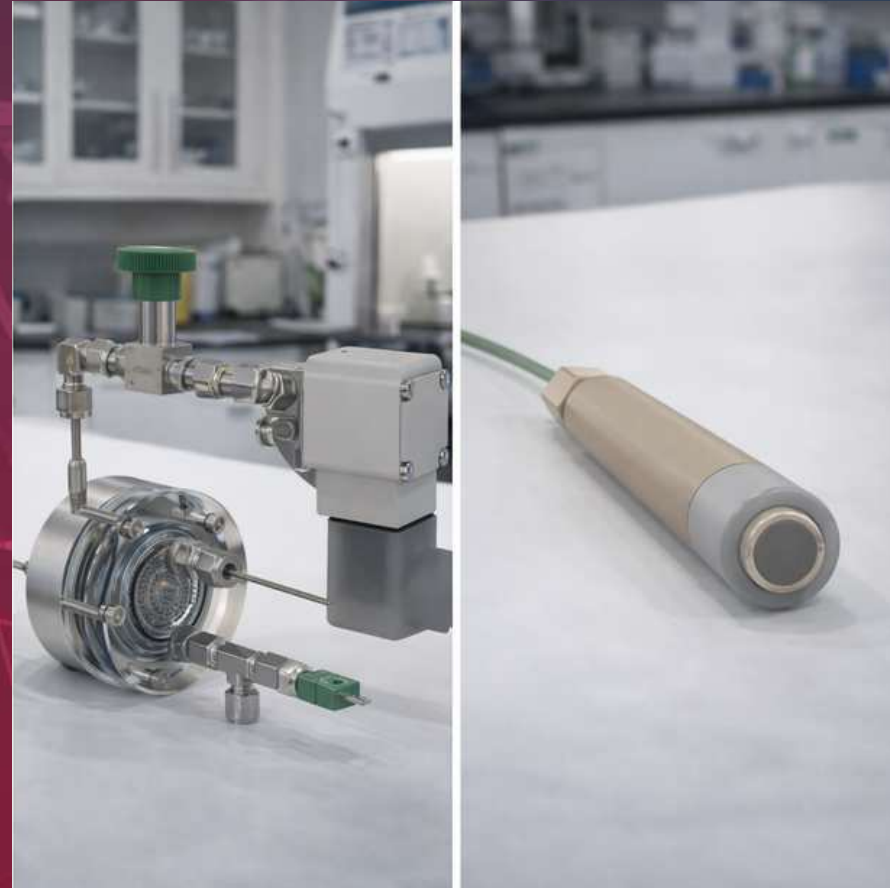
Membrane Inlet Mass Spectrometry (MIMS)

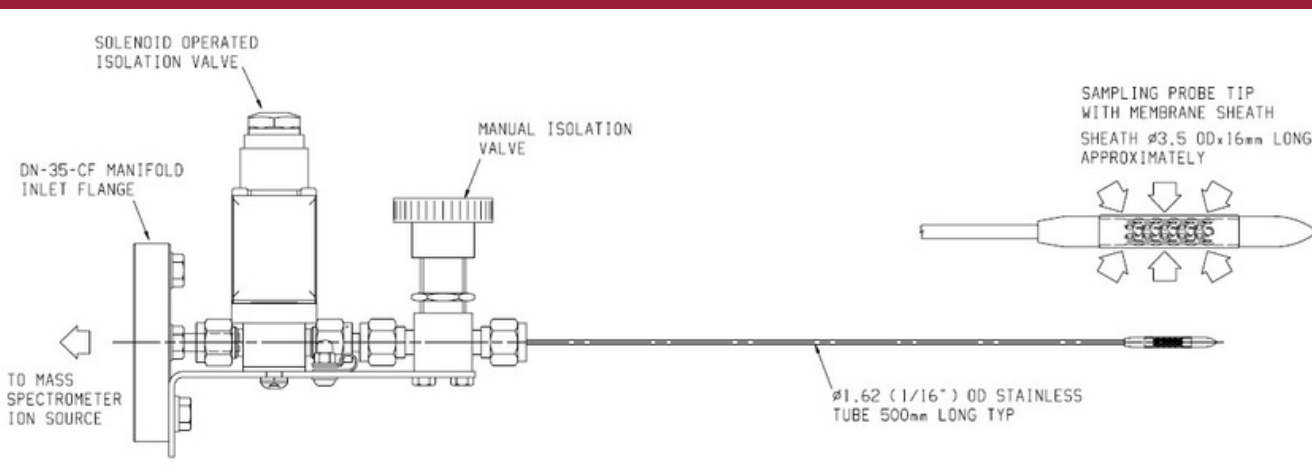


Typical Enrichment factors w.r.t. N₂

CO ₂	12.0
CH ₄	3.2
C ₃ H ₈	13.6
CH ₃ OH	46.4
SO ₂	50.0
C ₃ H ₆ O	19.6
C ₆ H ₅ CH ₃	30.4

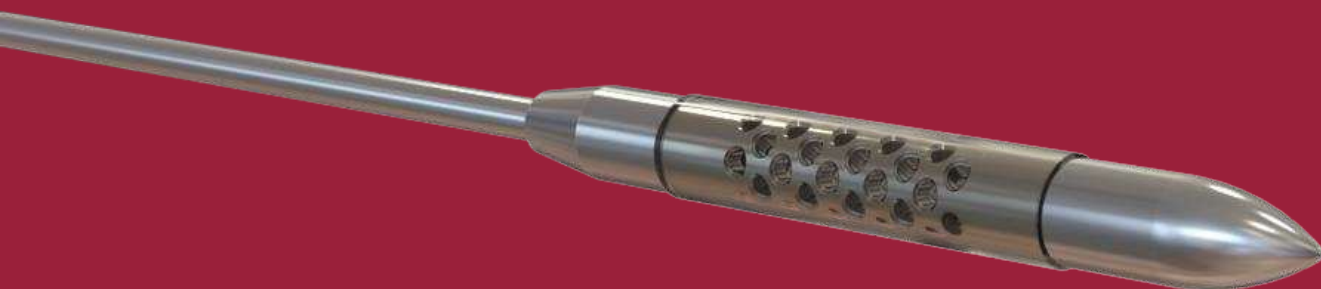
Gas Sampling Inlets - Dissolved Gases in Liquids





MIMS Probe

- Designed for direct, in-situ analysis of static samples
- Suitable for liquids & slurries, including fermenter liquors & heterogeneous matrices
- Ideal for robust, flexible sampling across single or multiple static sample environments

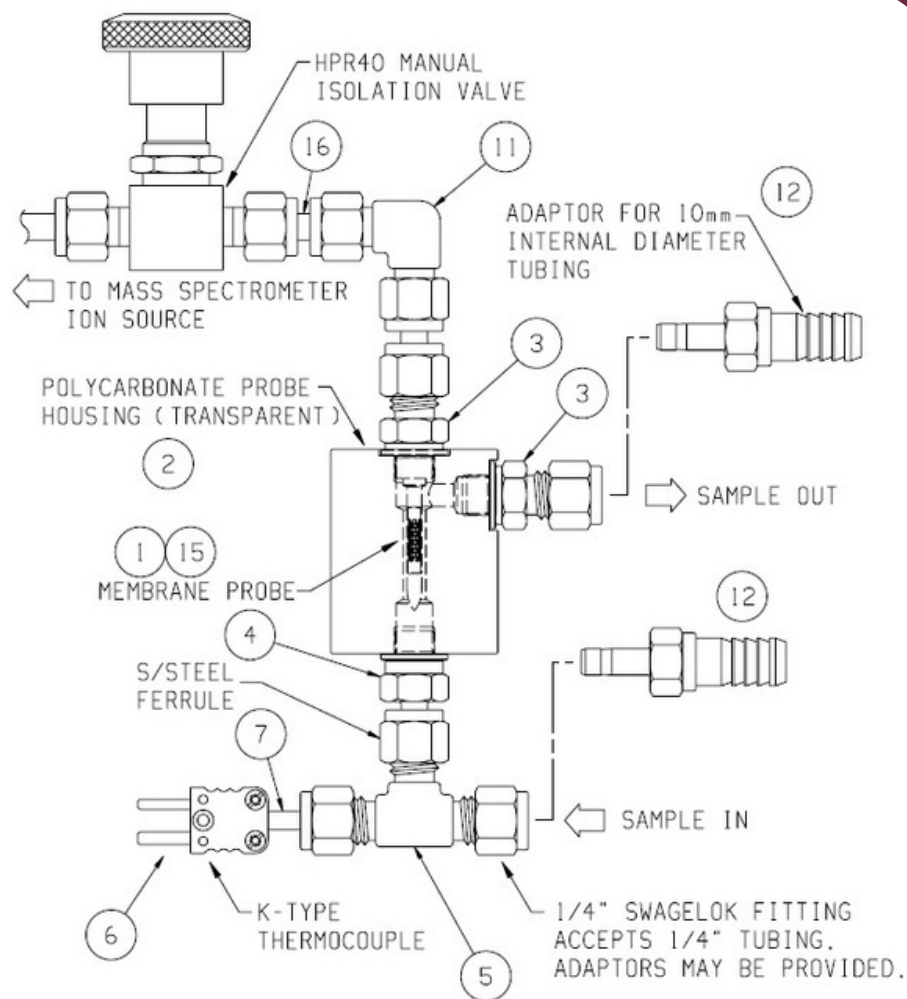




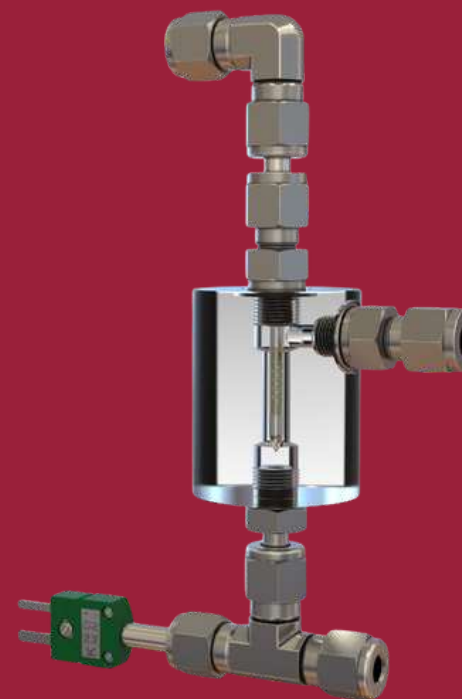
MIMS Proximity Probe

- Enables ultra-low volume and thin-layer sampling in confined or space-limited setups
- Delivers fast response and high sensitivity for surface-adjacent and interfacial measurements
- Well suited to inline monitoring, reaction kinetics, droplet, biofilm, and DEMS applications

FT-Standard



- Dissolved species flow-through membrane cell (with potential for integrated thermocouple).
- Includes liquid flow connections, ideal for circulation applications

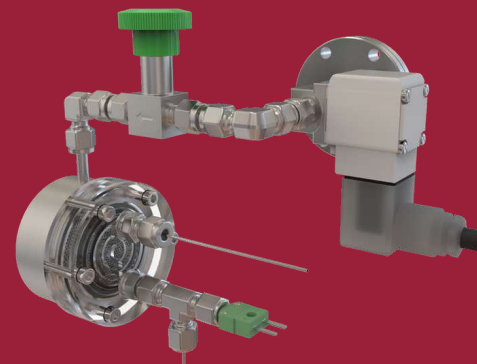


FT-Low Volume



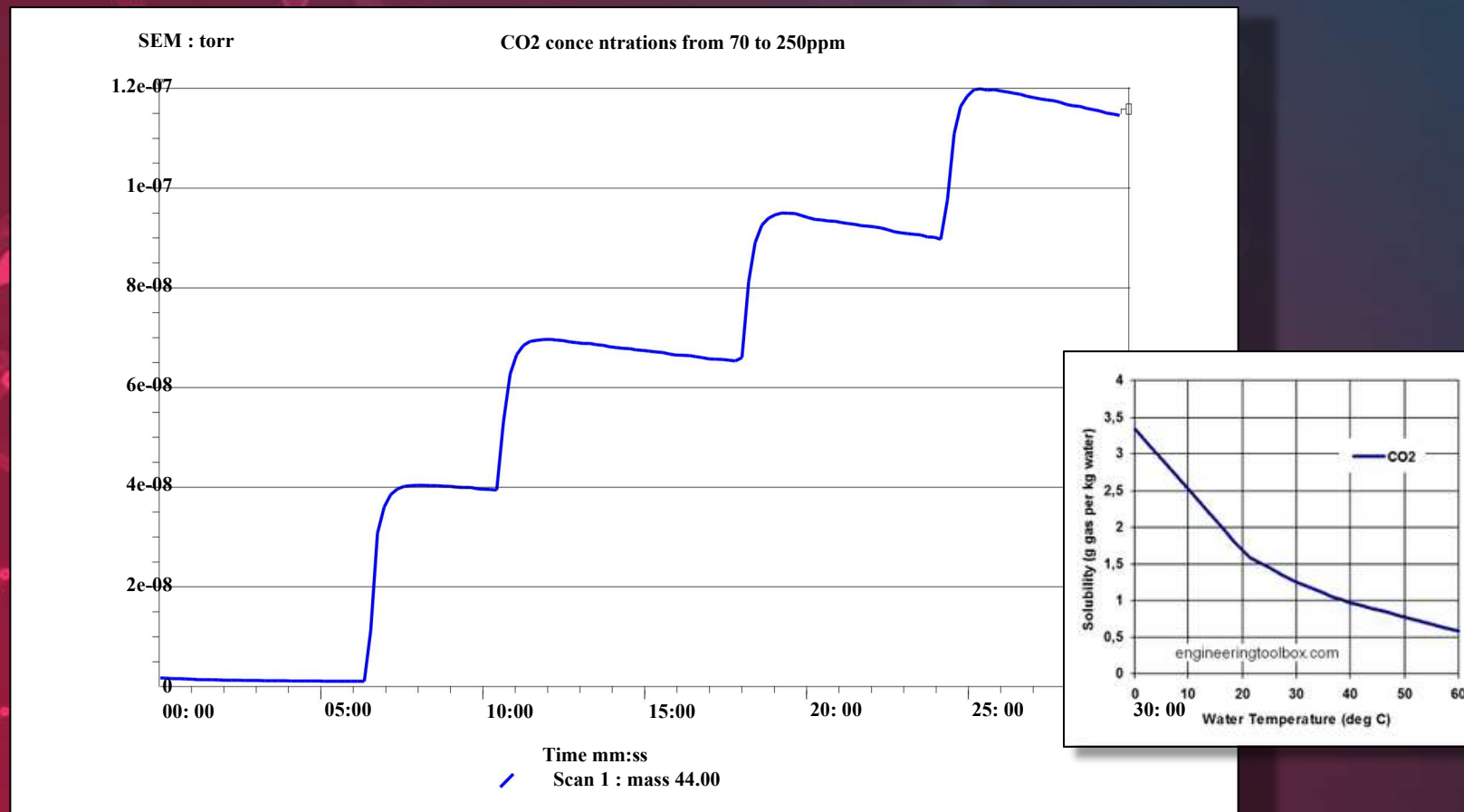
- Designed for low sample volumes requiring high sensitivity analysis
- Minimises dead volume to improve temporal resolution
- Well suited to vial analysis, denitrification studies, and dynamic environmental measurements

FT-High Sensitivity



- Flow-through inlet optimised for enhanced analyte transfer and challenging matrices
- Compatible with alternative membrane types, enabling targeted species analysis
- Suitable for wastewater, slurry, solvent, and oil analysis, including silicone-incompatible media

Calibration Data



The figure shows the addition of 10 mL aliquots of a CO₂-saturated H₂O solution (1.5 g CO₂ per 1 kg H₂O at 23 °C as per inset graph) to 200 mL pure H₂O. Therefore, the concentrations of CO₂ are approximately 0, 70, 140, 200, and 250 ppm for the 5 time steps shown.

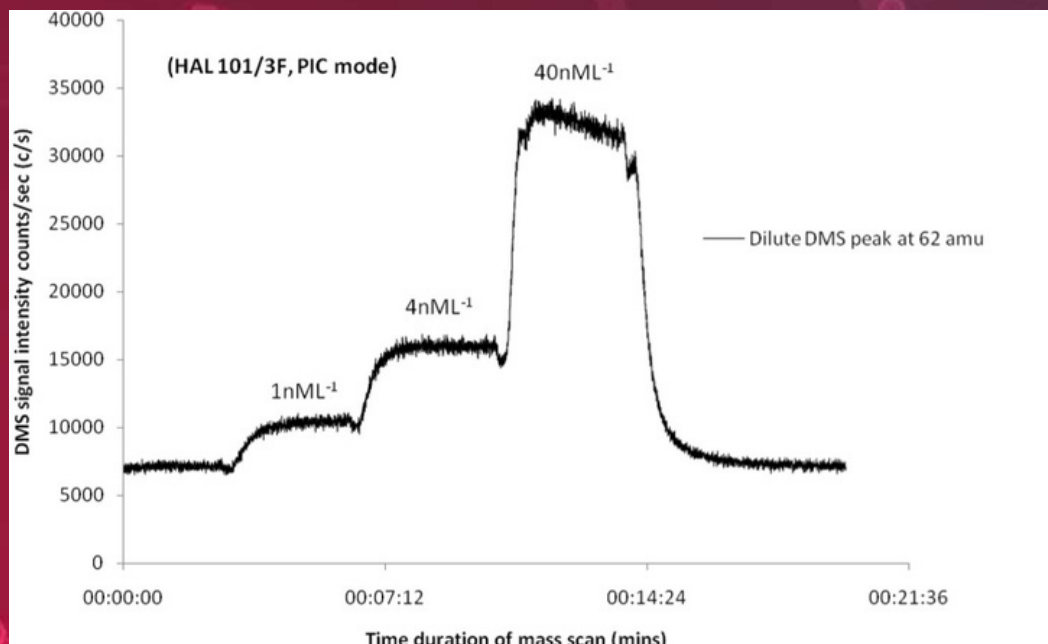
Oceanic Studies



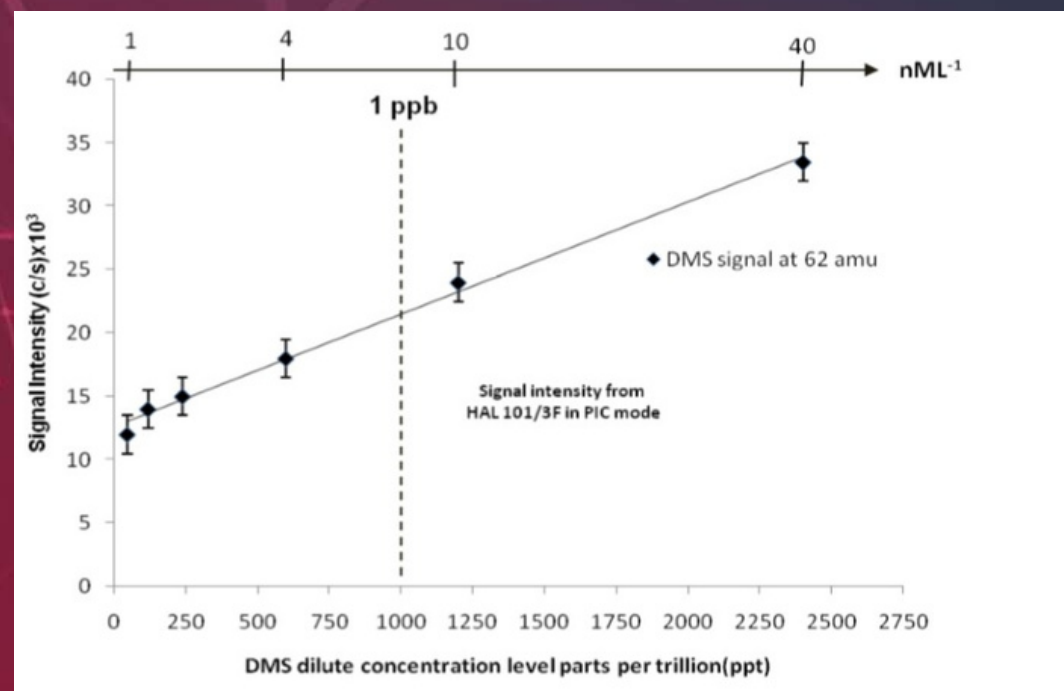
- HPR-40 used to detect and analyse low level concentrations of DMS in British Columbian water (Dimethylsulphide, a trace substance implicated in global climate change and regulation).
- The HPR-40 configured with a triple filter QMS provides detection levels into the parts per trillion range.
- Corresponds to dilute DMS levels of $\leq 1 \text{ nmol/L}$

Influence of regional climate forcing on surface water $p\text{CO}_2$, DO_2/Ar and dimethylsulphide (DMS) along the southern British Columbia coast.

PD Tortell, A Merzouk, D Ianson, R Pawlowicz and D Yelland Continental Shelf Research 2012 47 119–132



*Data obtained shows sub
ppb detection levels
(≤60ppt)*



*Data obtained with assistance
from P.D. Tortell, Department of
Botany, University of British
Columbia*

Denitrification study

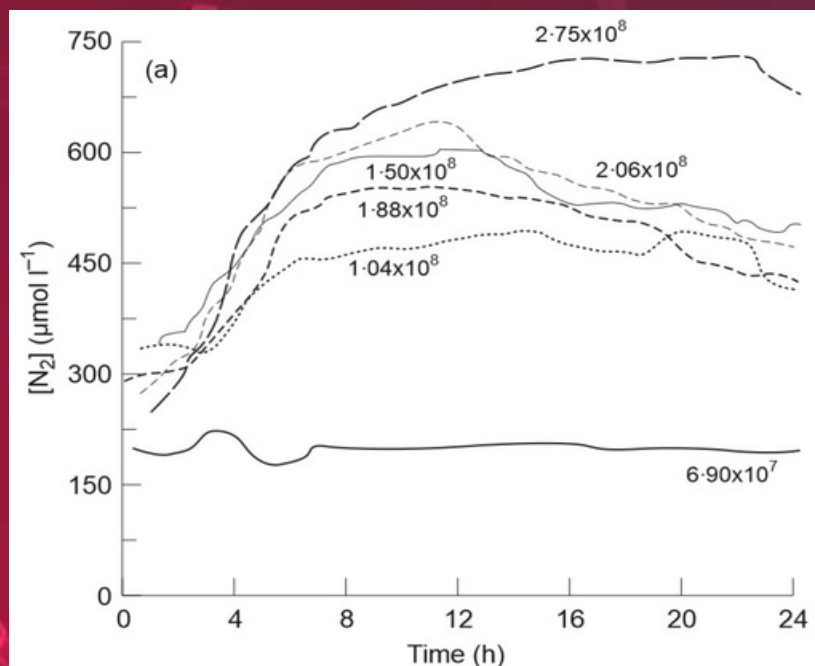


- Continuous real-time measurement of gases enabled the dynamics of the process to be investigated.
- Concentrations of between 10 and 17 mmol/L were optimal.
- Rate of denitrification dependant on cell concentration and required MIMS to model environmental conditions with low numbers of bacteria.



Denitrification by Pseudomonas stutzeri in a sterile lake water microcosm supplemented with succinate and nitrate. JR Firth and C Edwards Journal of Applied Microbiology 2000 88 853-859

Data Obtained in Denitrification Studies



Data shows the effect of cell concentration on denitrification by *Pseudomonas stutzeri*. The lowest change in N₂ level measured was 40 µmol l⁻¹ (Figure (a)).

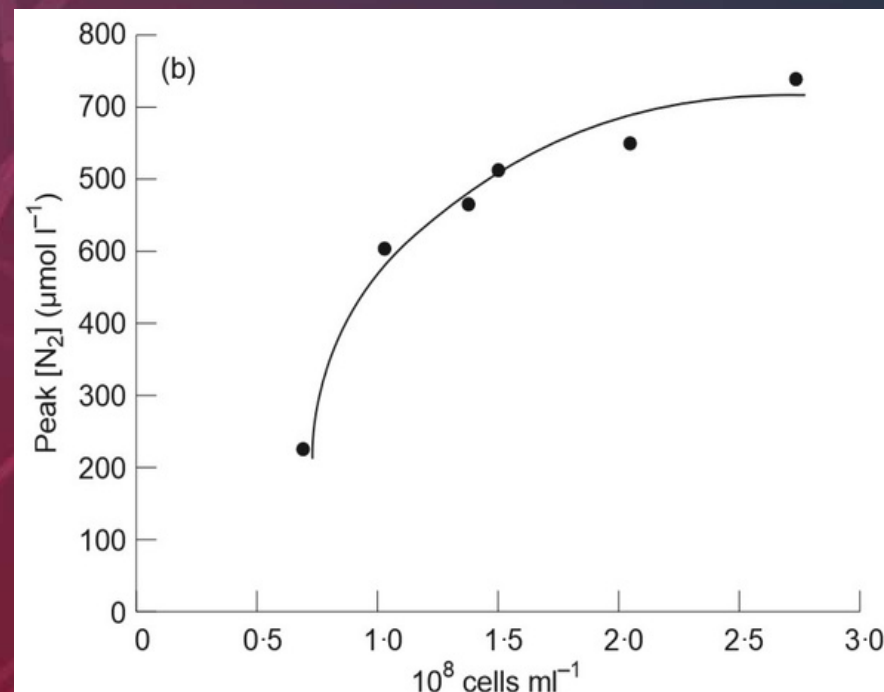
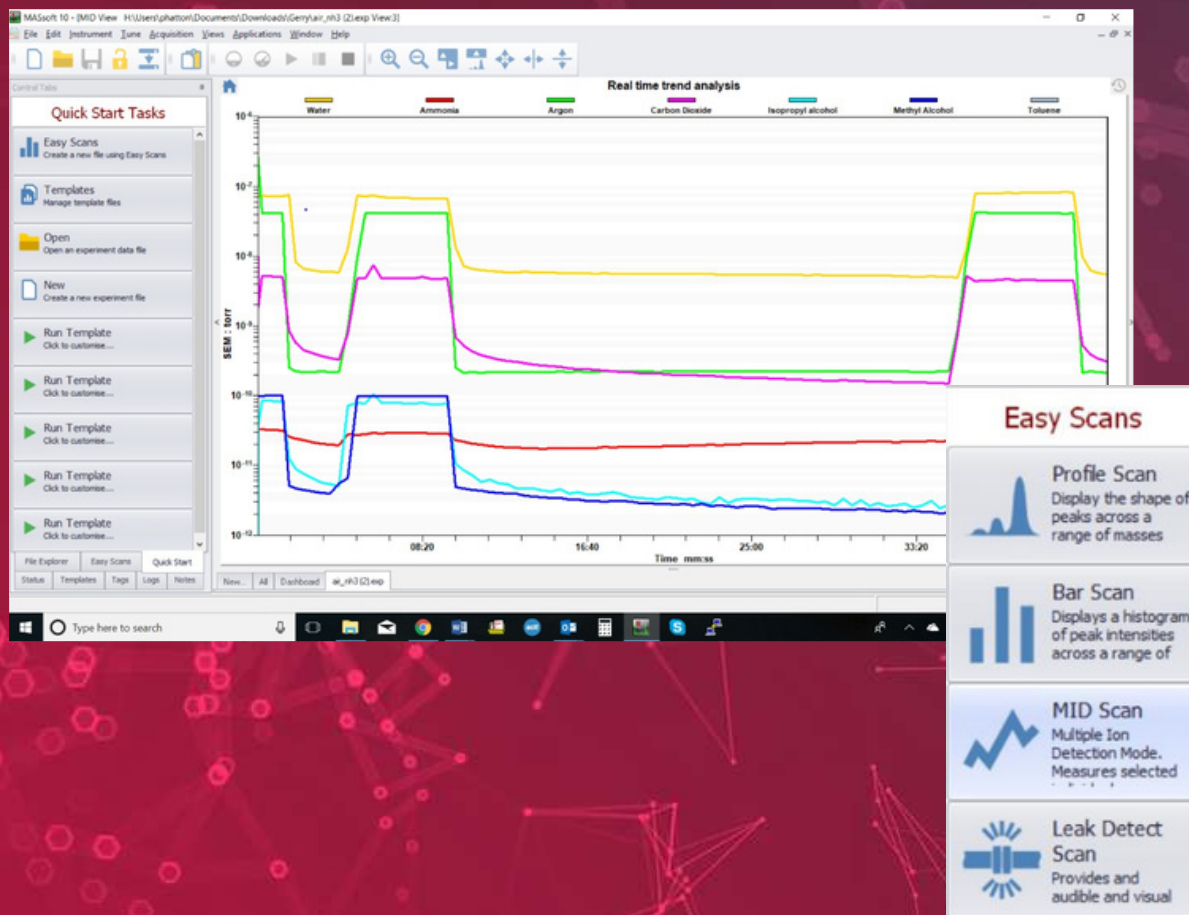


Figure (b) demonstrates that a cell density in excess of 2×10^8 cells ml⁻¹ did not unduly increase the amount of N₂ produced.

Data obtained by JR Firth and C Edwards, School of Biological Sciences, University of Liverpool, UK



MASsoft Professional Control Software

- Template driven quick start operation
- Real time data display
- Mixed mode scanning including trend analysis
- Statistical analysis and peak integration
- Integrated mass spectral library

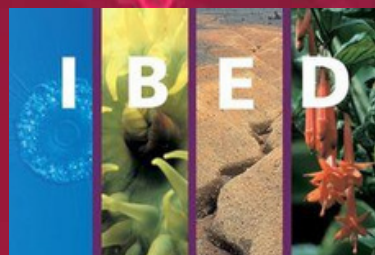
Summary

- Membrane Inlet Mass Spectrometer for Dissolved Species Analysis
- Designed and manufactured by Hiden in the UK
- Configurable species probe inlets can be used for a wide variety of scientific applications



Academic References

- Denitrification by *Pseudomonas stutzeri* in a sterile lake water microcosm supplemented with succinate and nitrate. JR Firth and C Edwards *Journal of Applied Microbiology* 2000 88 853-859.
- Development of membrane inlet mass spectrometry for examination of fermentation processes. J-R Bastidas-Oyanedel, Z Mohd-Zaki, S Pratt, J-P Steyer and DJ Batstone *Talanta, The International Journal of Pure and Applied Analytical Chemistry* 2010 83 482-492.
- Influence of regional climate forcing on surface water $p\text{CO}_2$, DO_2/Ar and dimethylsulfide (DMS) along the southern British Columbia coast. PD Tortell, A Merzouk, D Ianson, R Pawlowicz and D Yelland *Continental Shelf Research* 2012 47 119-132.
- High resolution measurement of Southern Ocean CO_2 and O_2/Ar by membrane inlet mass spectrometry. C Guéguen and PD Tortell *Marine Chemistry* 2007 108 184-194.
- Field Continuous Measurement of Dissolved Gases with a CF-MIMS: Applications to the Physics and Biogeochemistry of Groundwater Flow. E. Chatton, T. Labasque, J. de La Bernardie, N. Guihéneuf, O. Bour, L. Aquilina *Environ. Sci. Technol.* 2017, 51 (2) 846-854.



HPR-40 MIMS Users

- Trent University
- Forest Research Institution (SCION)
- Xiamen University
- University of Kuopio
- Cardiff University
- University of Wales
- Ricoh
- University of Queensland
- University of Newcastle
- University of California, Berkeley
- Liverpool University
- Institute for Biodiversity and Ecosystem Dynamics
- National Institute of Oceanography, Goa
- GBA Laborgruppe
- University of Rennes



- 
- The Hiden website is an excellent resource with product pages, brochures, catalogues, product pages with some application notes, presentation and other information.
 - Contact +44 1925 445225 for direct support.
 - www.HidenAnalytical.com
 - Info@hiden.co.uk