Hiden HPR-40 DSA
Membrane Inlet Mass Spectrometer System
for Dissolved Species Analysis

Introduction

The HPR-40 DSA Membrane Inlet Mass Spectrometer (MIMS) System is configured for real-time quantitative analysis of dissolved or evolved gases and vapours.

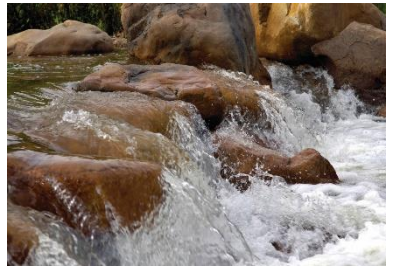
The inlet probe uses a permeable membrane that allows small levels of the dissolved species to pass through and on to the QMS.

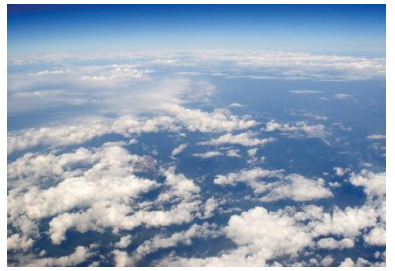
The HPR-40 DSA system has a mass range of 200 amu (300 amu option) and sub ppb detection levels.

Interchangeable membrane inlet probe types address a broad range of applications.

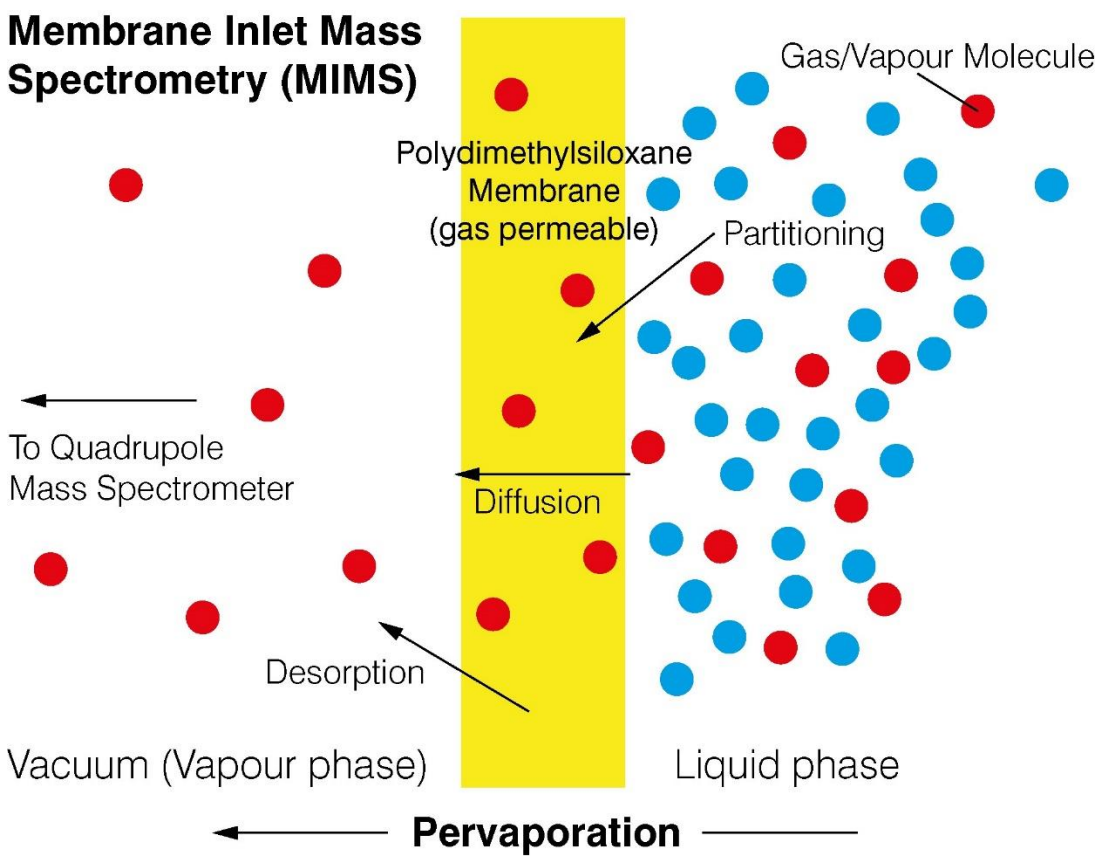
Applications of HPR-40 MIMS

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

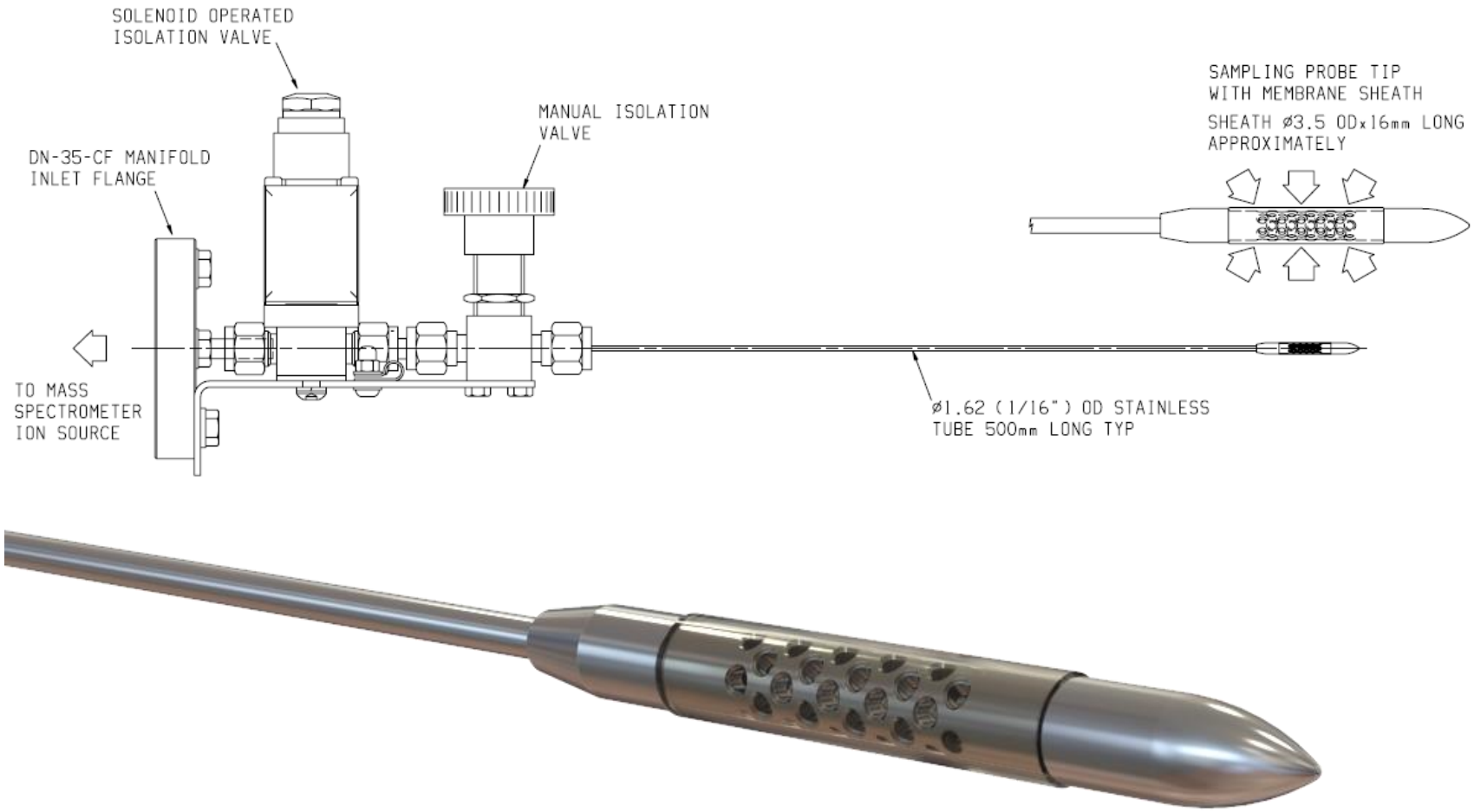


MIMS Overview

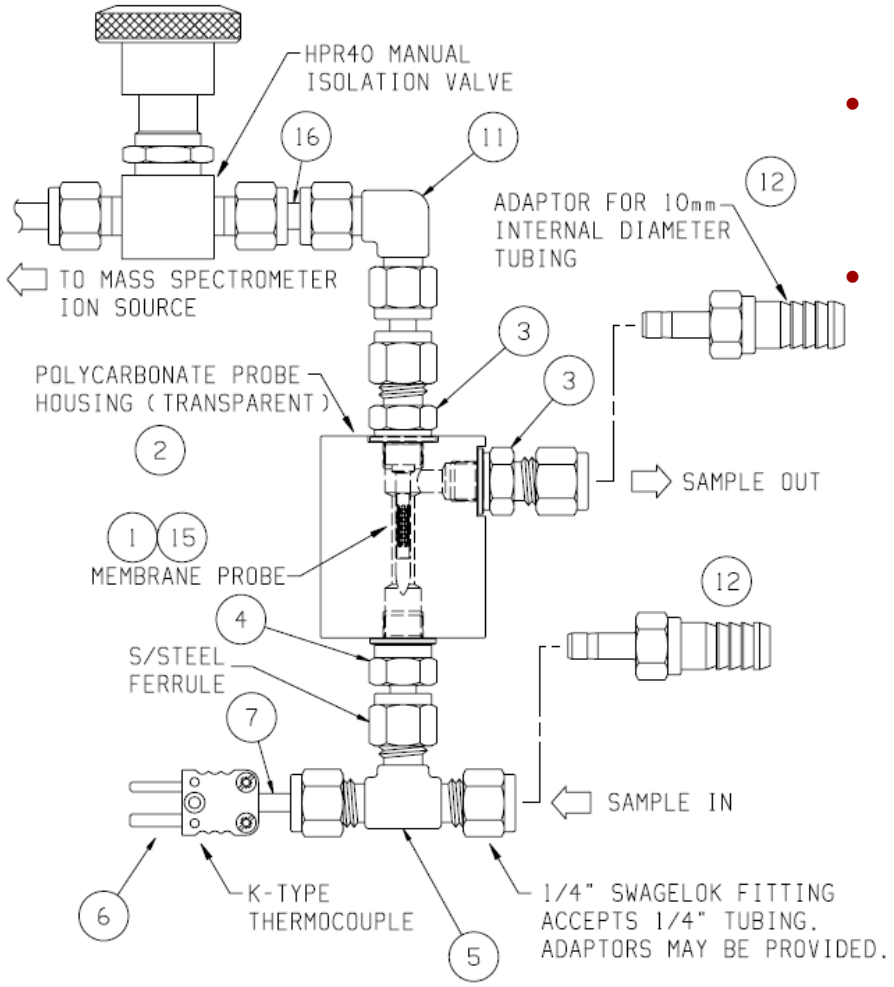


Typical enrichment factors w.r.t. N_2	
CO_2	12.0
CH_4	3.2
C_3H_8	13.6
CH_3OH	46.4
SO_2	50.0
C_3H_6O	19.6
$C_6H_5CH_3$	30.4

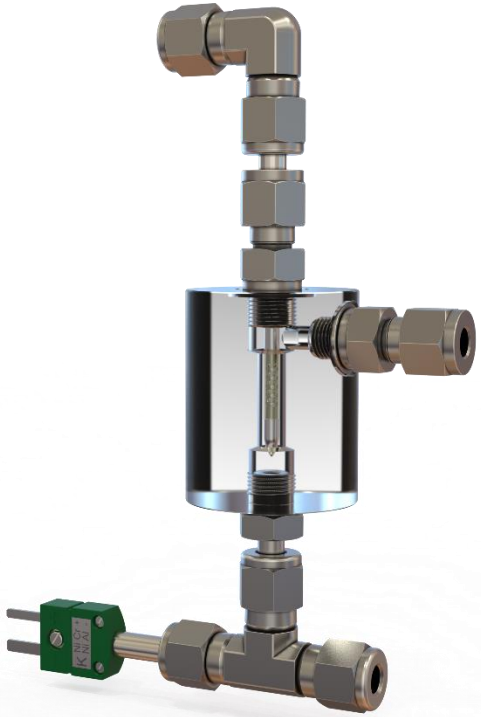
Dissolved Species Membrane Probe



Flow-through Membrane Cell



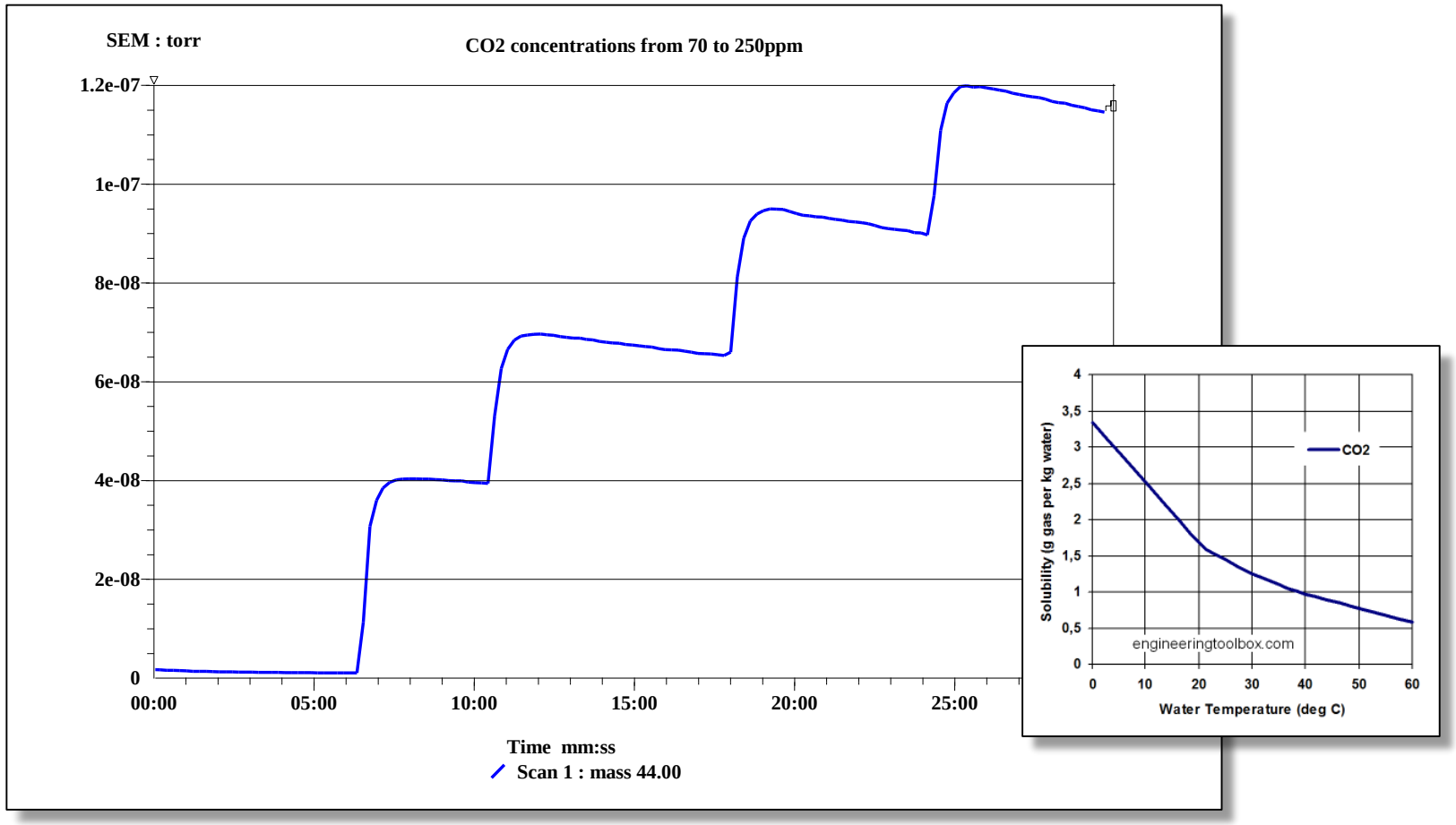
- Dissolved species flow-through membrane cell (with potential for integrated thermocouple).
- Includes liquid flow connections, ideal for circulation applications



Cuvette Style Cell

- Dual volume construction (25 and 50 ml) cuvette including liquid flow connections
- Integrated thermocouple and fluid agitation mechanism
- Ideal for algal biofuel studies and other aquatic or fermentation studies

Calibration Data



The figure shows the addition of 10mL aliquots of a CO_2-satured H_2O solution (1.5g CO_2 per 1 kg H_2O at 23 deg C as per inset graph) to 200 mL pure H_2O. Therefore, the concentrations of CO_2 are approximately 0, 70 ,140, 200, and 250 ppm for the 5 time steps shown.

Oceanic Studies

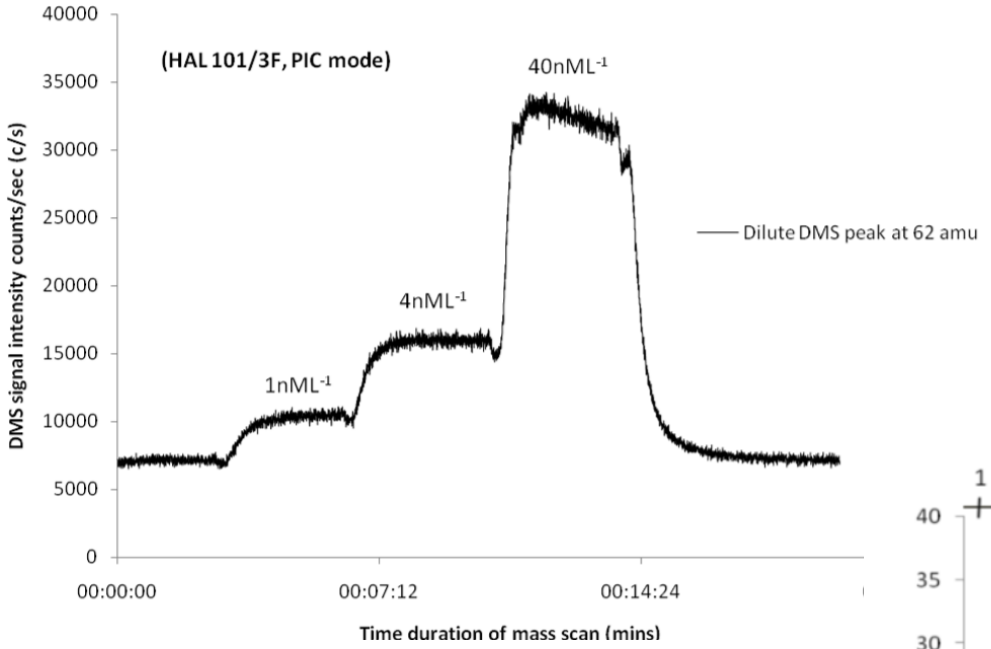
HPR-40 used to detect and analyse low level concentrations of DMS in British Columbian water (Dimethylsulphide, a trace substance implicated in global climate change and regulation).

The HPR-40 configured with a triple filter QMS provides detection levels into the parts per trillion range.

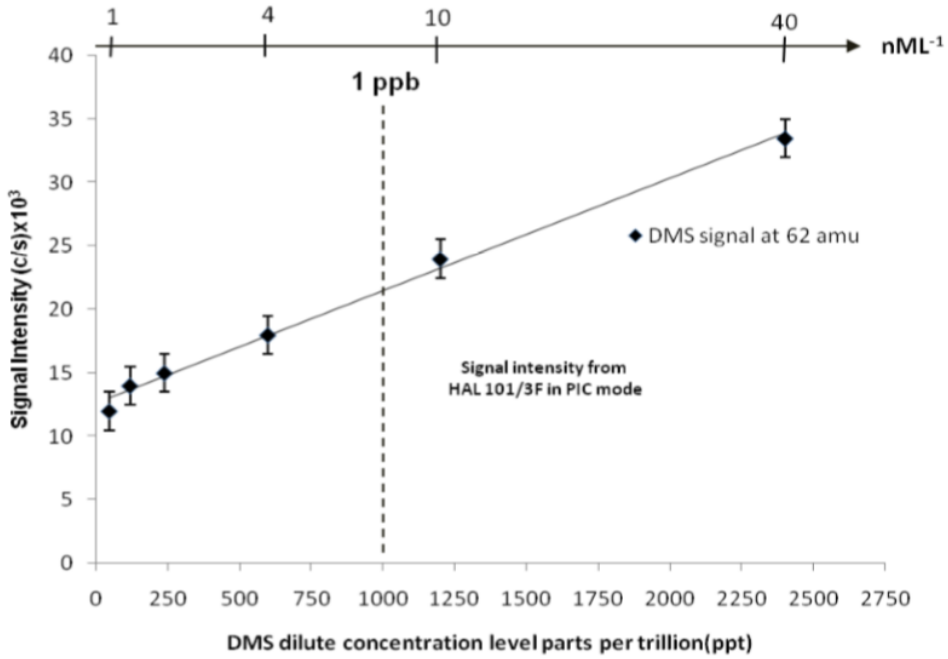
Corresponds to dilute DMS levels of ≤1nmol/L

Influence of regional climate forcing on surface water pCO_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



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

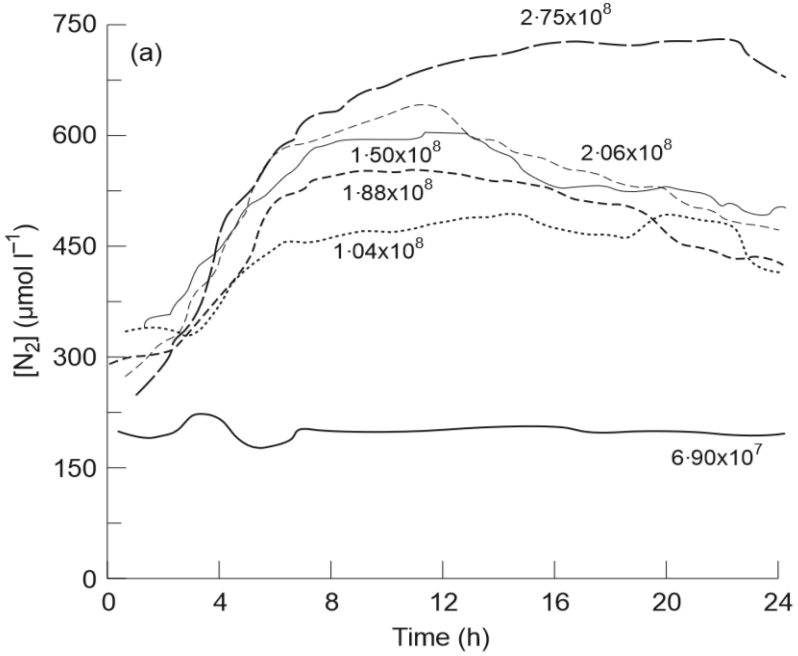
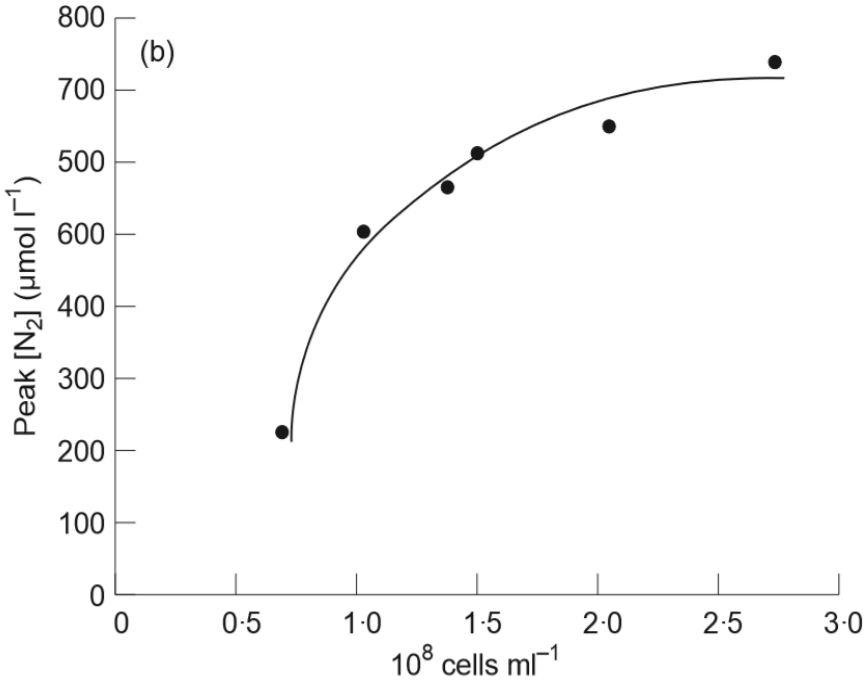


Figure (b) demonstrates that a cell density in excess of 2 x 10^8 cells ml^{-1} did not unduly increase the amount of N_2 produced.

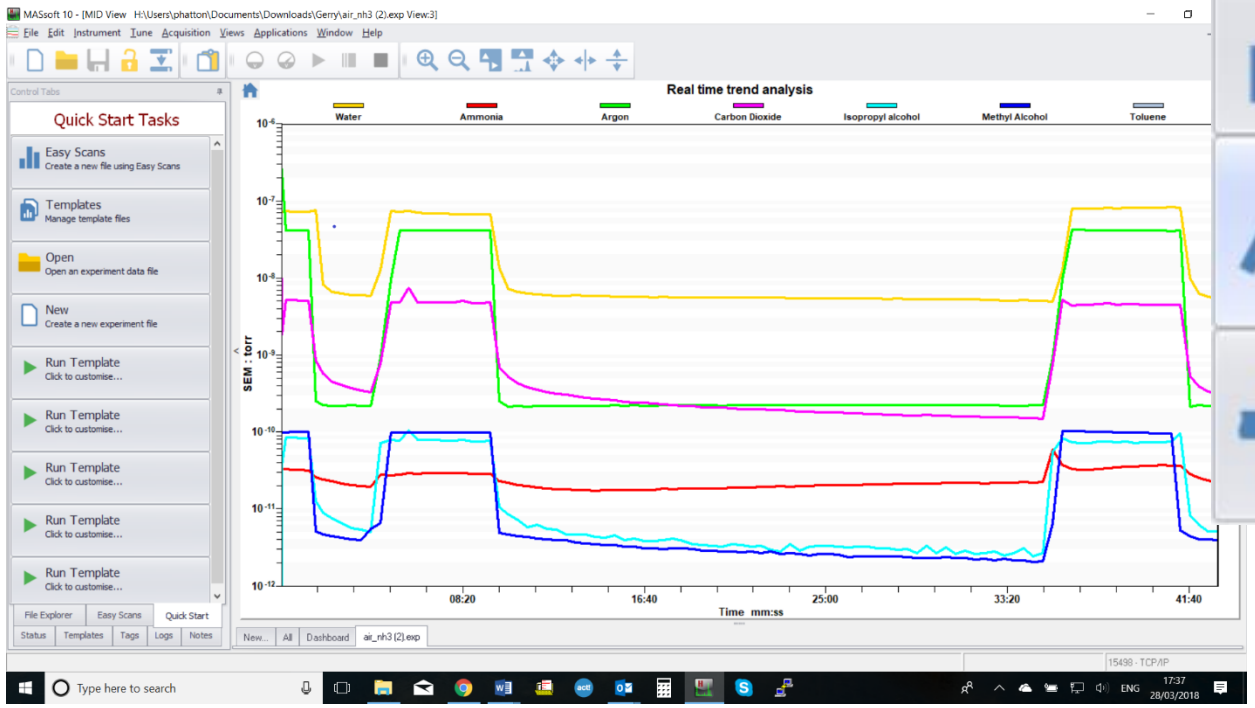
Data obtained by JR Firth and C Edwards, School of Biological Sciences, University of Liverpool, UK

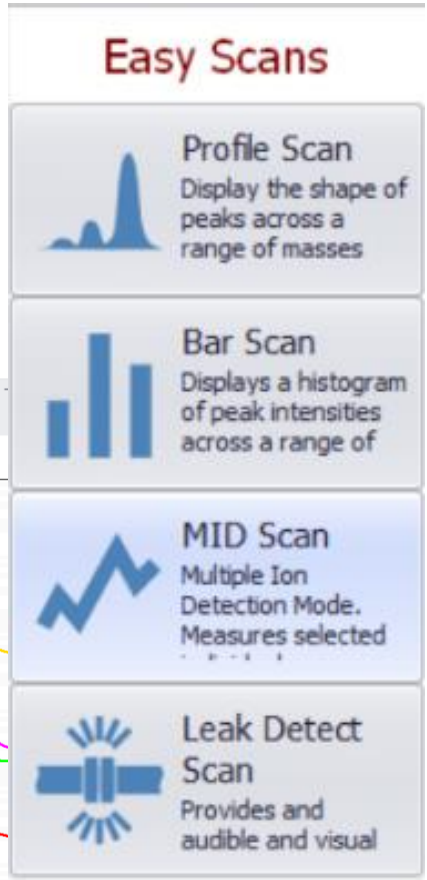
Data shows the effect of cell concentration on denitrification by *Pseudomonas stutzeri*. The lowest change in N_2 level measured was 40 µmol l^{-1} (Figure (a)).



MASsoft Professional control software

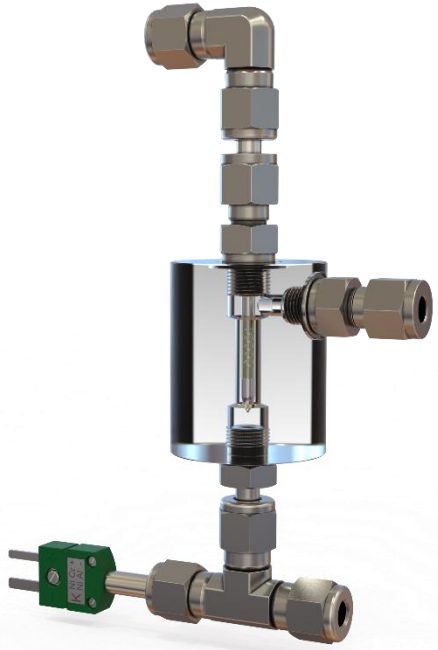
- Template driven quick start operation
- Real time data display
- Mixed mode scanning including trend analysis
- Statistical analysis and peak integration
- Integrated mass spectral library





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 pCO_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 Gu´eguen 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.

Hiden HPR-40 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

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