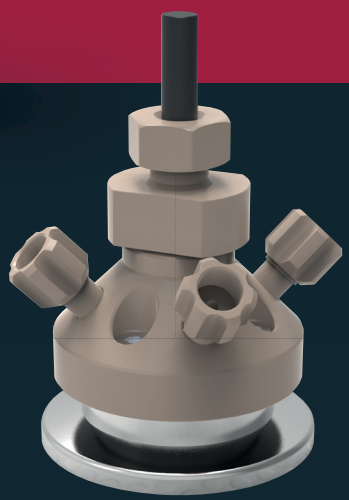
HIDEN ANALYTICAL

DEMS System

Differential Electrochemical Mass Spectrometry



Bench-top Mass Spectrometer for Electrochemistry – DEMS System

Differential Electrochemical Mass Spectrometry is a technique that allows unique online analysis of gaseous and volatile products from electrochemical reactions. The Hiden DEMS system combines advanced electrochemical half cells with excellent performance in mass spectrometry to achieve outstanding analytical capabilities.

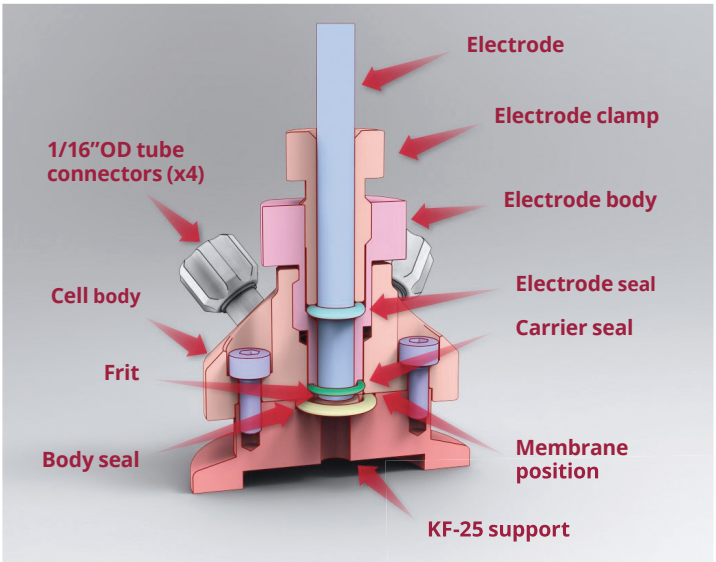
Key Features

- Compact bench-top mass spectrometer system
- Mass scanning, and time/intensity trend monitoring of multiple species
- Modular, user configurable system including DEMS cell
- Fast response (< 1 second), nano-porous electrolyte/MS interface
- Mass range: 200 amu is standard. 300 amu option

System Configuration & Options

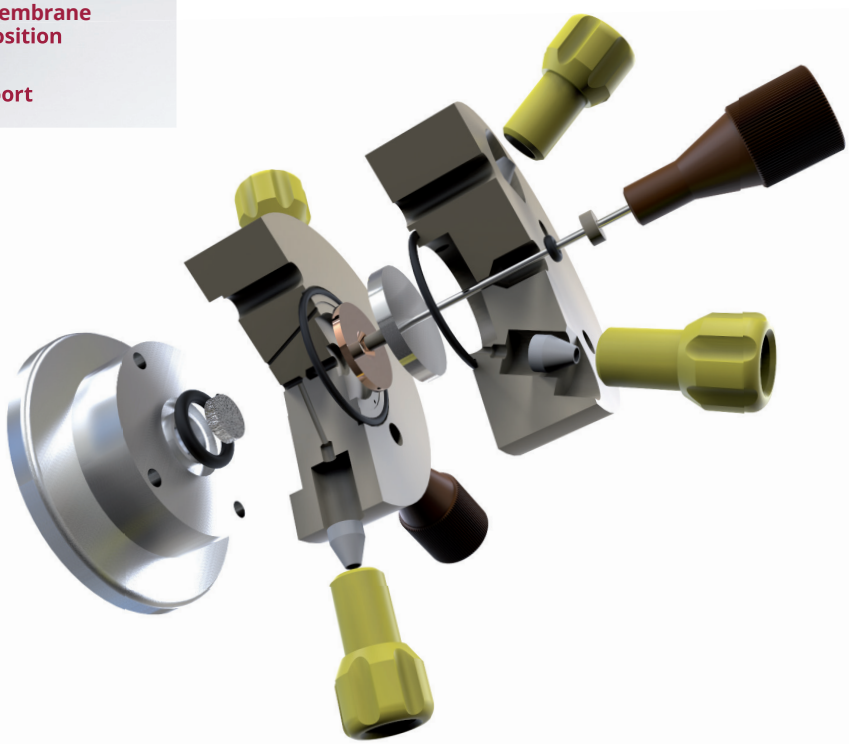
ITEM	DESCRIPTION	PARTCODE
SYSTEM	HPR-40 DEMS bench-top gas analysis system for electrochemistry, including DEMS cells type A and type B and Hiden HAL 201 RC mass spectrometer with Faraday/Electron Multiplier detector. Mass range 200 amu.	**305250**
OPTIONS & ACCESSORIES	Extended mass range. 300 amu mass range (in place of standard 200 amu mass range).	**305021**
	DEMS Probe – Extendable probe, allowing dissolved gas to be measured in custom cells.	
	Multiple WE materials – Options for copper (standard), gold, silver, titanium and vitreous carbon working electrodes.	
	Potentiostat Integration – Cables available for connection to most Potentiostats, allowing trigger start and real time integration of Potential and Current into Hiden software.	
GAS INLET OPTIONS	**QIC inlet -** heated capillary inlet for sampling gases and vapours at atmospheric pressure.	**303560**
	Microflow inlet, flow rate from 12 µl/min, unheated.	**303452**
SPARES KIT	**Recommended spares kit** ▸ Twin filament, oxide coated iridium ▸ Filament kit ▸ DEMS A ▸ DEMS B	 **201200** **201600** **SC3035515** **SC3035515**

DEMS Cells



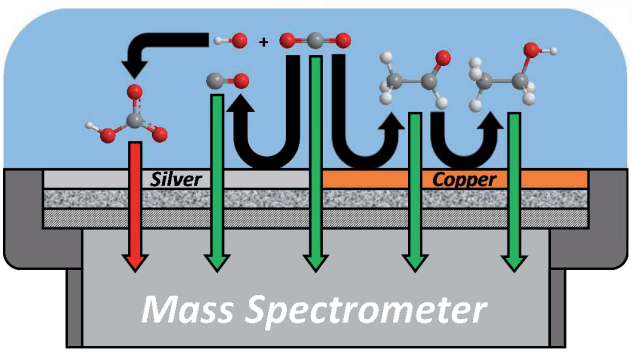
Type A DEMS cell

The Type A DEMS cell is optimised for ease of use and flexible experimentation setup. Its four ports allow for electrolyte flow and electrode plus sensor positioning close to the reaction area in between the working electrode and the membrane. Depending on application, the electrocatalyst can be deposited on the bottom side of the electrode or the vitreous carbon can be used as an inert electrode.



Type B DEMS cell

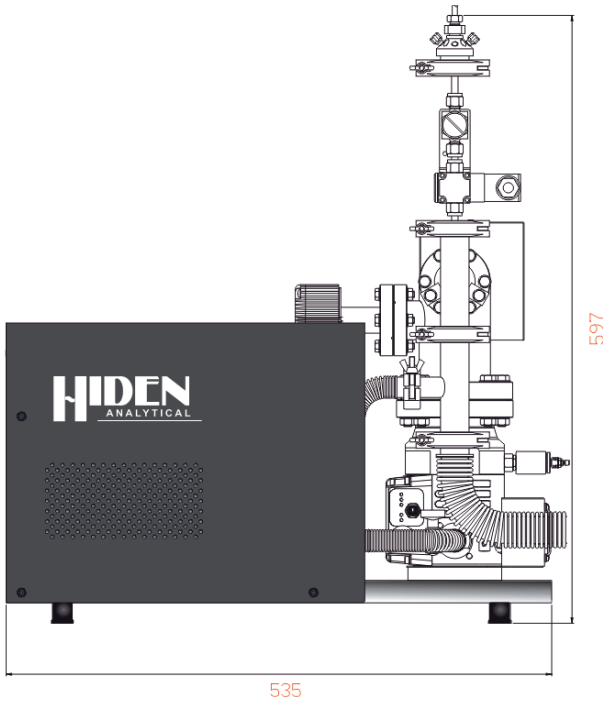
The Type B DEMS cell was designed in collaboration with E. Clark and A. Bell from UC Berkeley. The design optimises electrode configuration, electrolyte flow and membrane position for optimum analyses of electrochemical reactions. A dual thin layer cell, with cathode and anode chambers separated by an ion exchange membrane. Gas products formed at the working electrode and dissolved in the electrolyte, flow over a nano porous PTFE membrane to the MS. An additional port within the electrolyte inlet allows firm positioning of a reference electrode.

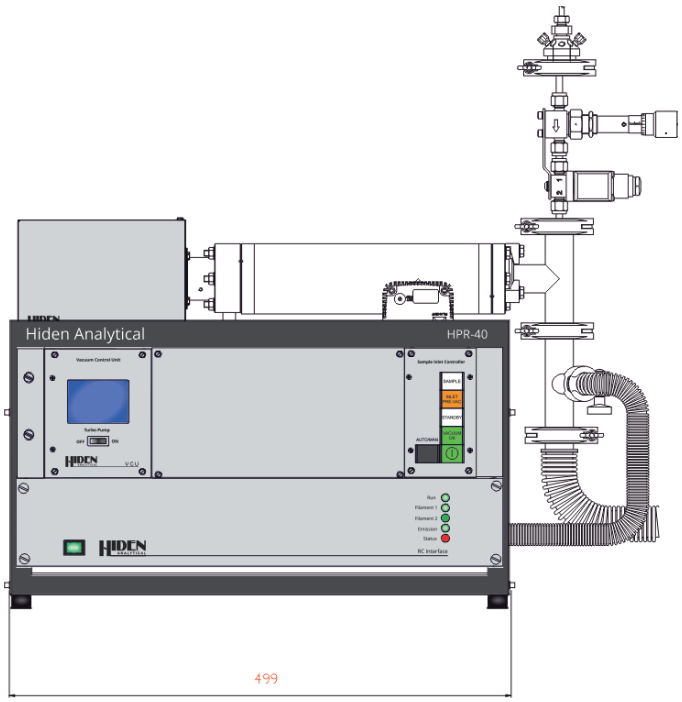


Modified Cathode Chamber

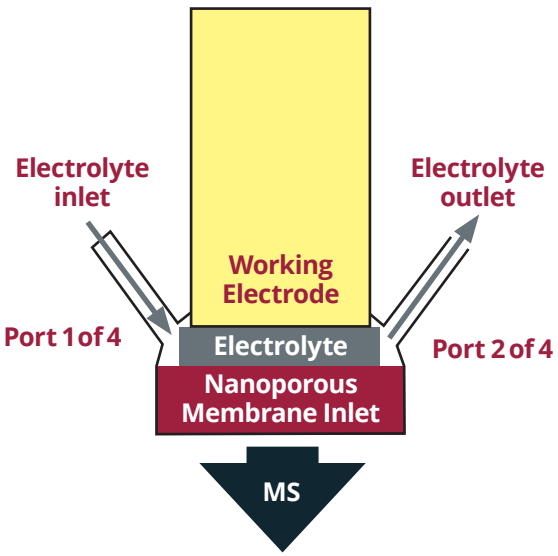
The modified cathode chamber allows for alternative working electrode materials by direct sputtering on to the membrane surface. Coating the membrane surface, allows volatile species at the electrode-electrolyte interface to be sampled. Furthermore, the delay time between product generation and detection is minimized and the liquid-phase product collection efficiency is maximized.

The DEMS system

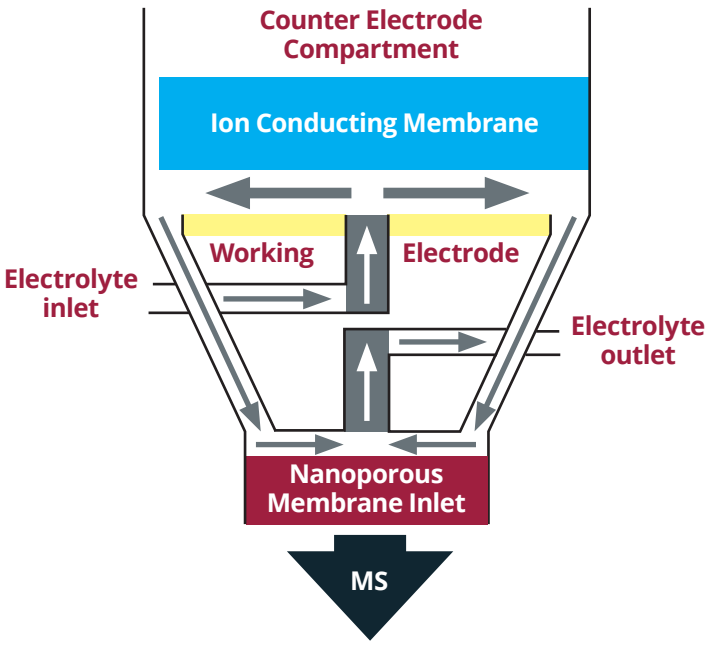




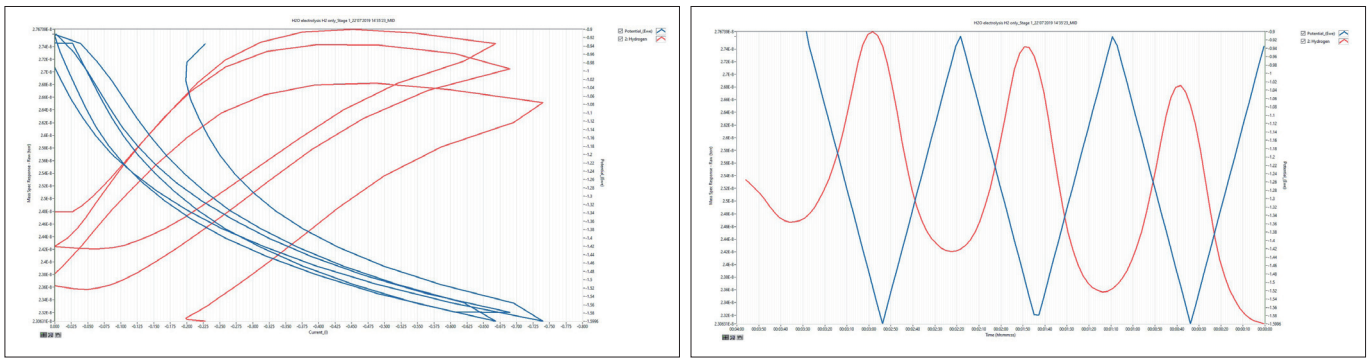
Type A DEMS cell for materials/catalysis studies



Type B DEMS cell for electrochemical reaction studies

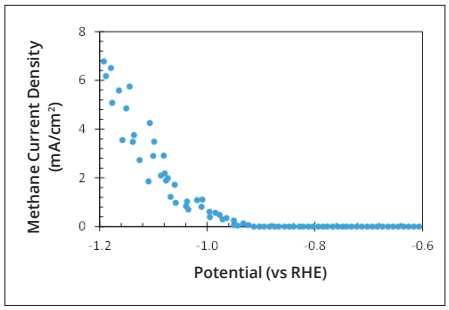


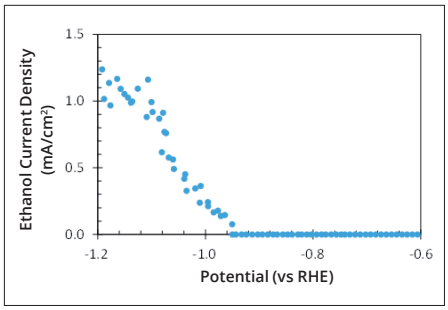
Example data



Example of real time presentation of Hydrogen MS signal - v's Potential and Current and v's Potential and Time during CV of water electrolysis.

DEMS results obtained for CO_2-sparged 0.05 M K_2CO_3 electrolyte (pH = 6.8) with an electrolyte flow rate of 1 mL/min and a scan rate of 0.2 mV/s. Further details are included in the ACS publication. E. L. Clark, M. R. Singh, Y. Kwon, and A. T. Bell (2015) 'Differential Electrochemical Mass Spectrometer Cell Design for Online Quantification of Products Produced during Electrochemical Reduction of CO_2' Anal. Chem., 87 (15), 8013–8020.





Technical Data

Mass ranges, amu:	1-200 / 1-300 amu
Sensitivity:	100% to 100 ppb subject to spectral interference
Speed:	Up to 650 measurements/second
Response time:	<1 s (dependant on flow rate)
Software:	MASsoft Professional
	QGA 2
	Windows 7/8/10 compatible
Interface:	Ethernet/USB/Serial (RS-232) connections
Detector:	Dual Faraday/Channeltron Electron Multiplier
Analogue input:	8x (optional)/16 bit
Analogue output:	8x (optional)/14 bit
Digital input:	8x
Digital output:	8x, 24 V
Dimensions (L x W x H), mm:	499 x 535 x 597 mm
Weight, kg:	Typically 33 kg and external scroll pump 26 kg
Power requirement:	110/220/240 V AC, 50/60 Hz, 1.2 kVA

Hiden**APPLICATIONS**

Hiden's quadrupole mass spectrometer systems address a broad application range in:

GAS ANALYSIS

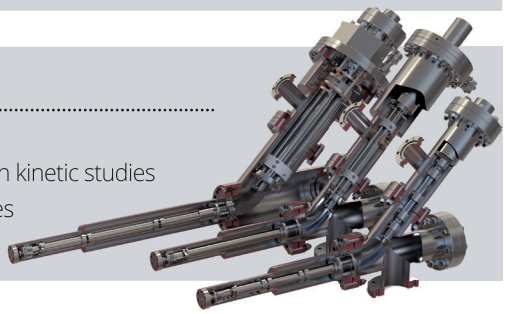
- dynamic measurement of reaction gas streams
- catalysis and thermal analysis
- molecular beam studies
- dissolved species probes
- fermentation, environmental and ecological studies

SURFACE ANALYSIS

- UHV TPD
- ToF qSIMS and SIMS analysers
- end point detection in ion beam etch
- elemental imaging – 3D mapping

PLASMA DIAGNOSTICS

- plasma source characterisation
- etch and deposition process reaction kinetic studies
- analysis of neutral and radical species



VACUUM ANALYSIS

- partial pressure measurement and control of process gases
- reactive sputter process control
- vacuum diagnostics
- vacuum coating process monitoring

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