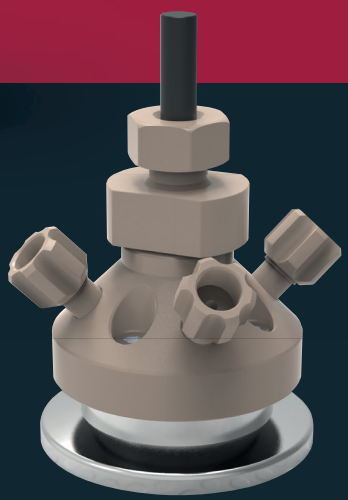
HIDEN ANALYTICAL


# 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.

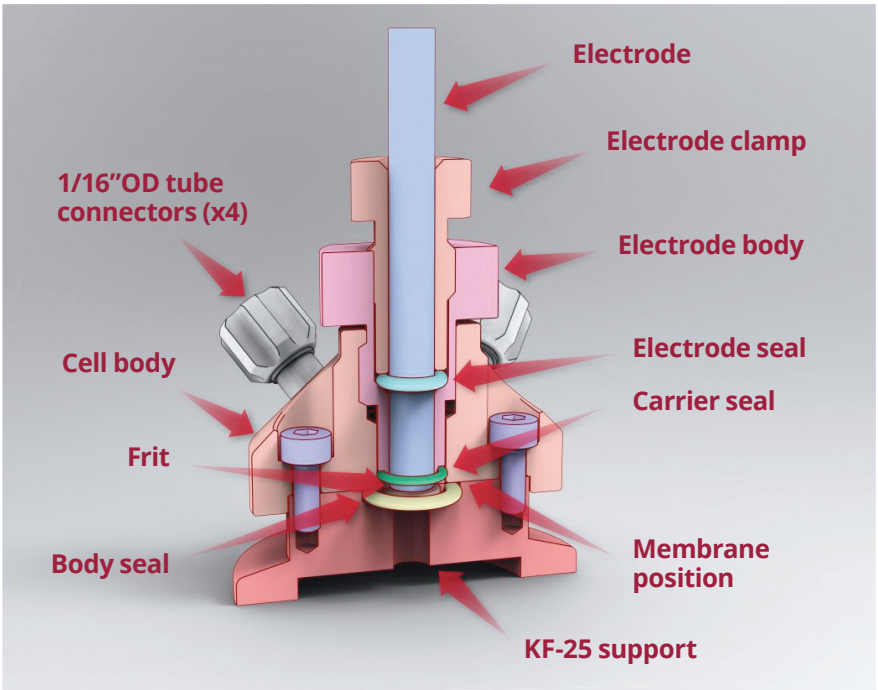

## Key Features

- 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
- DEMS off-gas analysis capillary sampling option with micro flow inlet
- 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 |
| **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 |
| | MIMS inlet. Direct membrane inlet probe - 500 mm | 303416 |
| | MIMS inlet. Flow through probe inlet, integrated MIMS probe and thermocople inlet with signal conditioning module. | 303420 |
| **SPARES KIT** | Recommended spares kit | |
| | ▸ Twin filament, oxide coated iridium | 201200 |
| | ▸ Filament kit | 201600 |
| **SOFTWARE OPTIONS** | QGA - Quantitative Gas Analysis software | 800595 |

# DEMS Cells

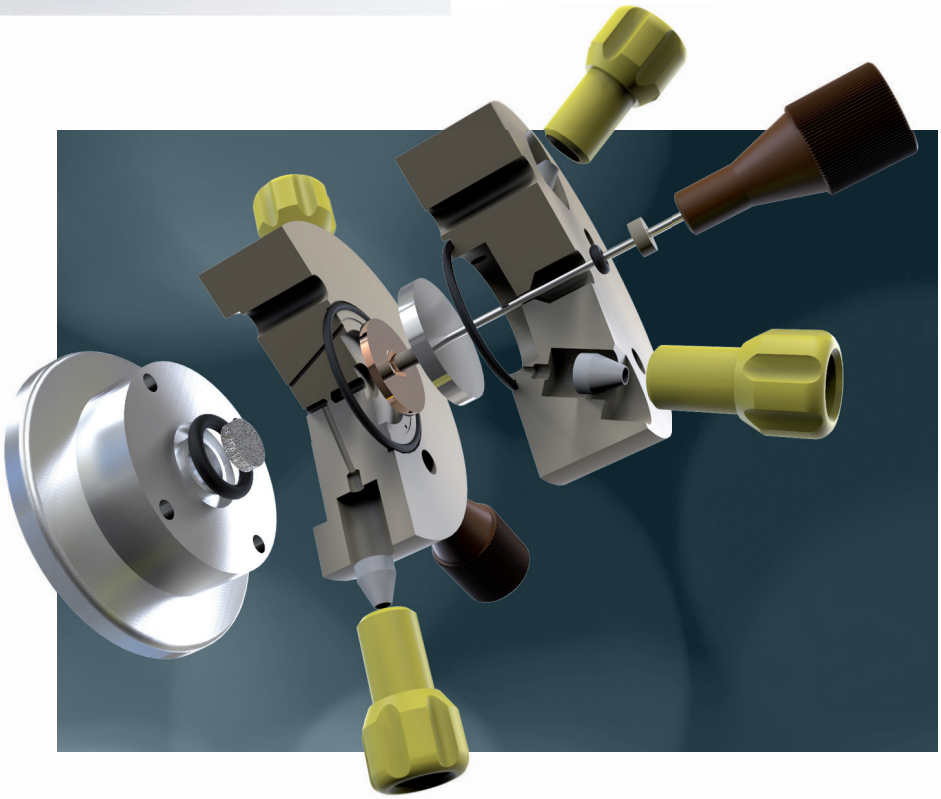



## Type A DEMS cell

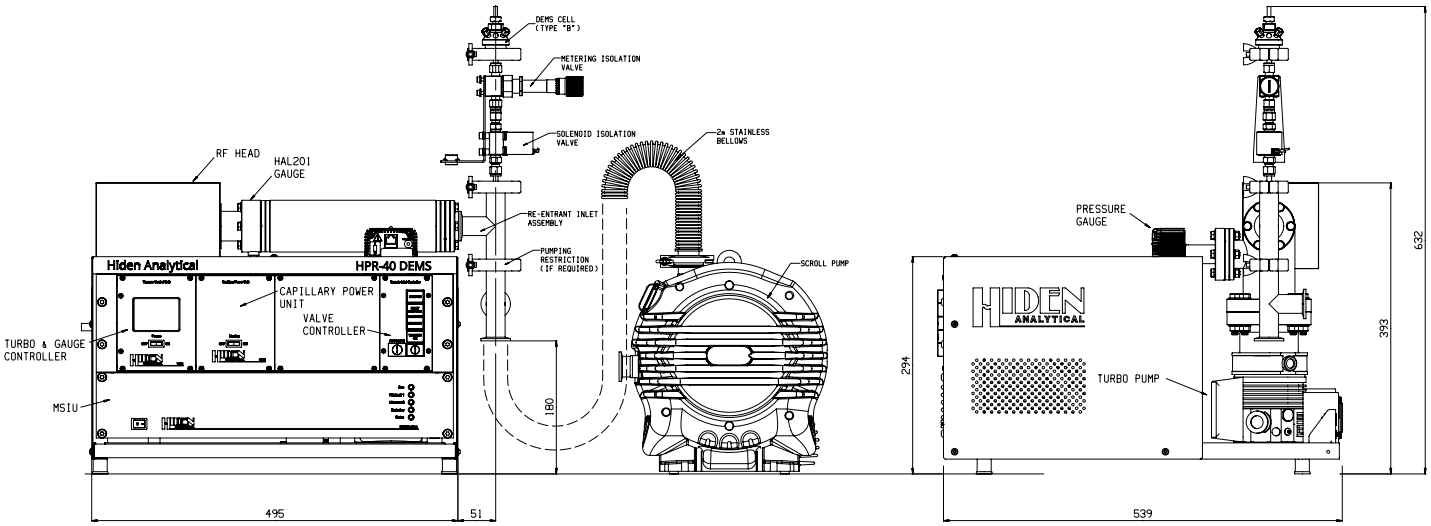
The Type A DEMS cell is optimised for ease of use and flexible experimentation setup. Its four ports allow for electrolyte flow and electrode plus sensor positioning close to the reaction area in between the working electrode and the membrane. Depending on application, the electrocatalyst can be deposited 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. The lower chamber houses the membrane inlet to the MS, while the upper chamber contains the working and counter electrode, separated by an ion-conducting membrane. An additional port within the electrolyte inlet allows firm positioning of a reference electrode.

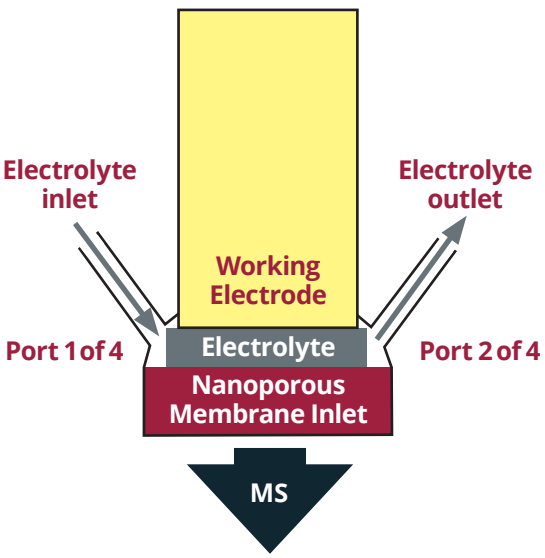


# The DEMS system

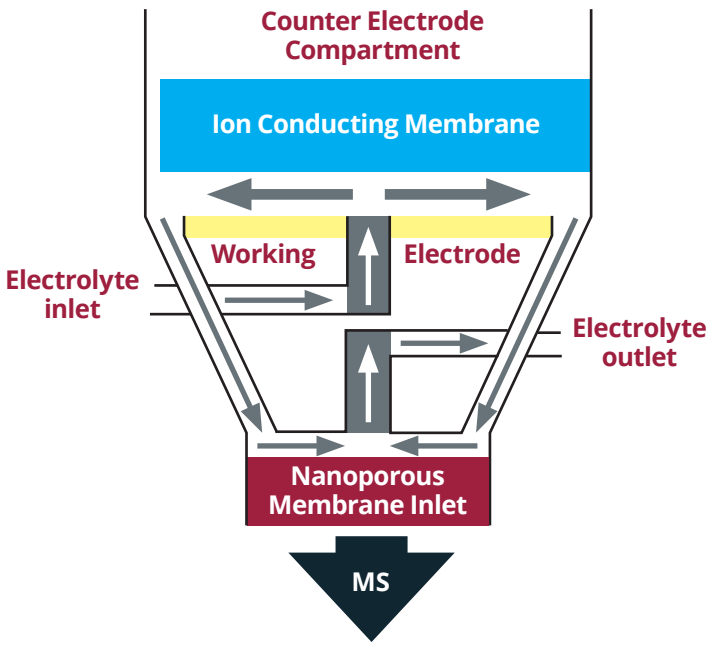



Dimensions in mm

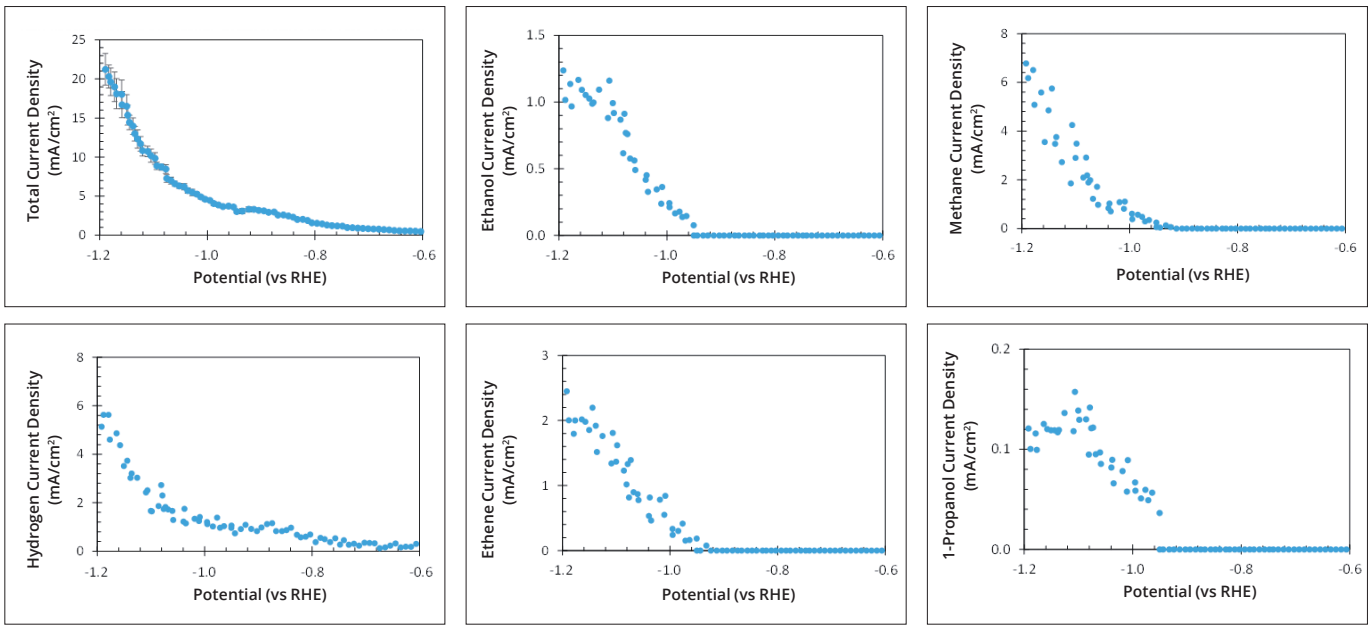
## Type A DEMS cell for materials/catalysis studies




## Type B DEMS cell for electrochemical reaction studies



# Example data




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

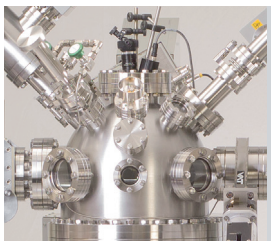
| | |
|---|---|
| **Mass ranges, amu:** | 1-200 / 1-300 amu |
| **Sensitivity:** | 100% to 100 ppb subject to spectral interference |
| **Speed:** | Up to 650 measurements/second |
| **Response time:** | <1 s (dependant on flow rate) |
| **Software:** | MASsoft Professional |
| | Windows 7/8/10 compatible |
| **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:** | 495 x 539 x 632 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

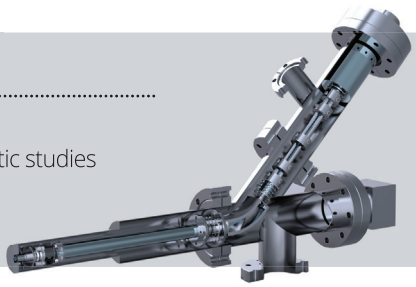



## SURFACE ANALYSIS

- UHV TPD
- SIMS
- 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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