



# Mound Technical Solutions, Inc.

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## Analytical Module

### Bench Top Gas Analysis System

- Long-Life Closed Ion Source QMS
- 0-100 AMU Mass Range
- FC/EM Ion Detection
- PPM Sensitivity
- Capable of Batch or Continuous 24/7 Operation

### Dry-Pumped Vacuum System

- Control panel for pump information and control
- Self-diagnostics report pump operating parameters
- Auto Protection from Inadequate Vacuum

### Heated Gas Sampling System

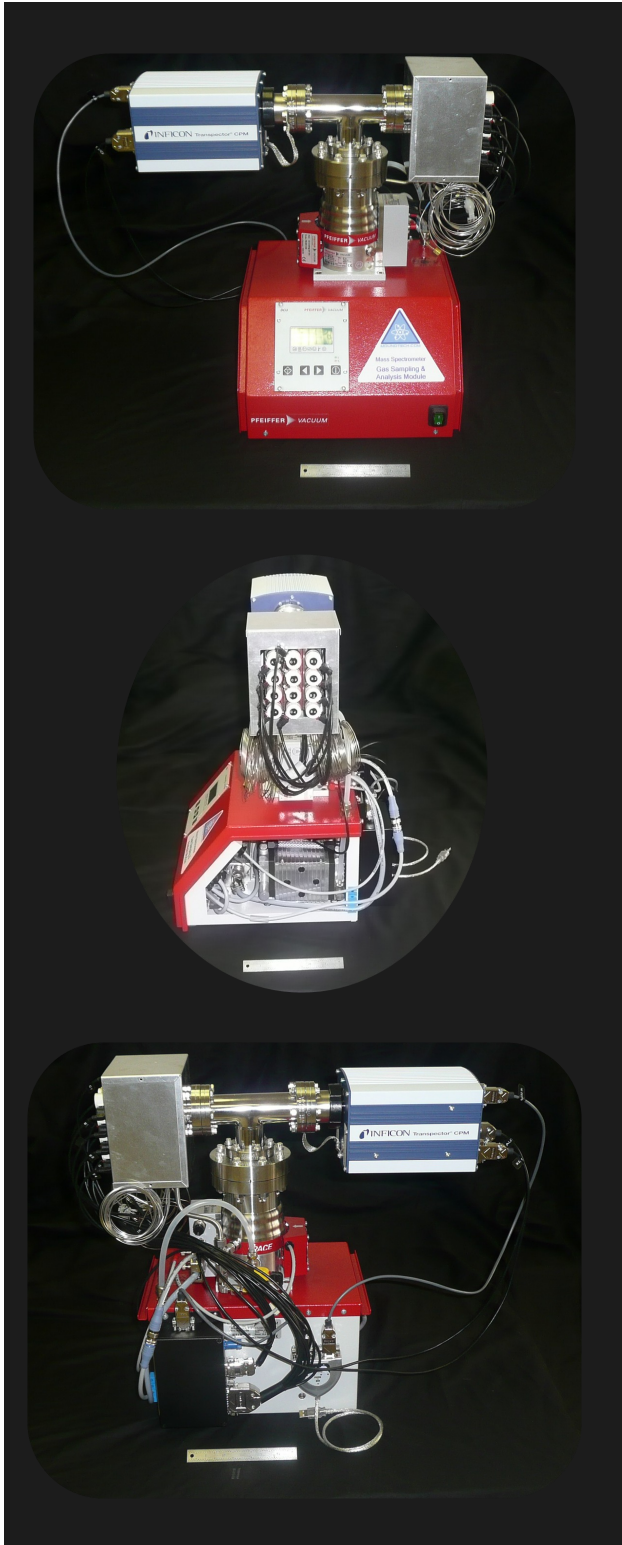
- 4 or 8 Capillary Sampling Lines
- Highly Durable Stainless Steel Construction
- Capillaries Sized for Application Pressure
- Programmable Capillary Selection
- Heated Inlet and Lines ( $\leq 100\text{C}$ )

### MoundTech Sample & Analysis Software

- Mass Spectrometer Control via LabView
- Sample Valve Control & Sequencing
- User Programmable Recipes Automate Sampling
- MS Data Time-Stamped to Correlate Process Data
- Ion Current data (w/ Cap ID) Time Stamped
- Stand-alone or Integration with Test Systems

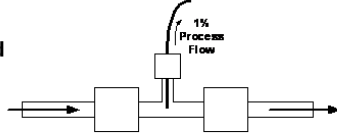
### Real-Time Gas Composition Analysis Software

- Species vs Time Data
- Species Reported:  $\text{H}_2$ , He,  $\text{CH}_4$ ,  $\text{NH}_3$ ,  $\text{H}_2\text{O}$ ,  $\text{N}_2$ , CO,  $\text{O}_2$ ,  $\text{H}_2\text{S}$ , Methanol, Ethanol, Ar,  $\text{CO}_2$ , COS,  $\text{SO}_2$
- No Need to Interpret Data —  
Software Provides Composition Analysis
- Species Update Every 2 Sec



- Mass Spec Sampling of Fuel Cell Gas Streams give real-time display of species flowing passed the sample point

- 1/16" od Capillary inserted into Gas Stream



- Clearing Time Constant Switching Capillaries (Sample Points) is ~1.2 s
  - Measurement time cycle for Typical Selected Peaks is 1.5 s

- Time Monitoring of Selected Peaks gives direct insight into Fuel Cell Chemistry

- Direct Measure of Many Species
    - H<sub>2</sub>, He, CH<sub>4</sub>, H<sub>2</sub>O, Ar, CO<sub>2</sub>, COS, SO<sub>2</sub>...
  - Multi-Species at a Mass usually resolve by MoundTech computations:
    - 28-CO/N<sub>2</sub>, 30-NO/H<sub>2</sub>CO, 32-O<sub>2</sub>/CH<sub>3</sub>OH/S, etc

- Flow\* Mole-Fractions of Gas Species vs Time can give Partial Flow Rates for Chemical Engineering

- $q_i = Q(t) * X_i(t)$  [Display Option for MT571]
  - Where Q(t) is Process Gas Flow Rate and X<sub>i</sub> are Mole Fractions from Gas Analysis

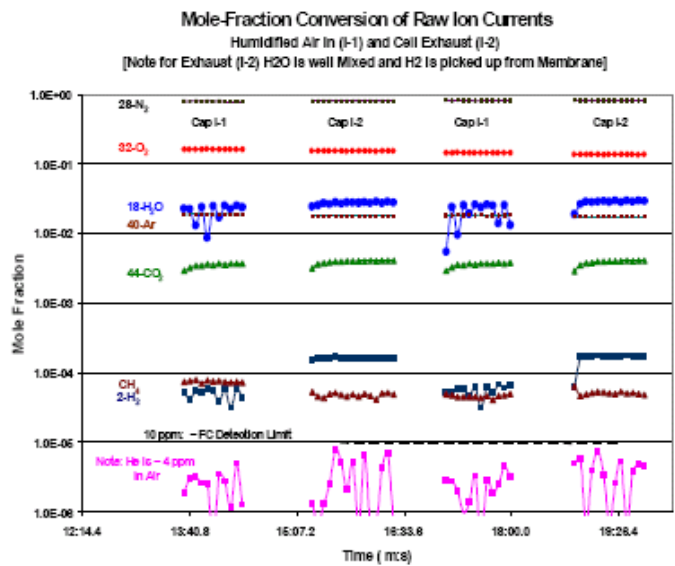
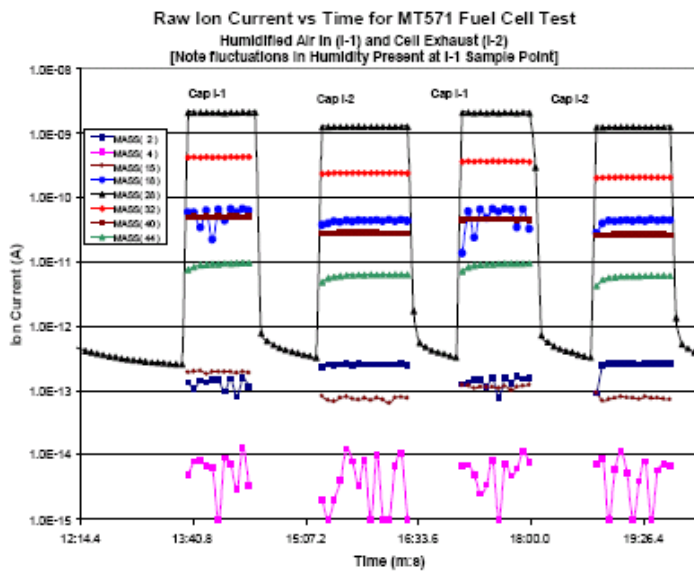
## Mass/Species of Interest for Fuel Cells

- 2-H<sub>2</sub> [Major Fuel Component]
- 4-He [Inert Tracer/ Leak Detection]
- 15-CH<sub>4</sub> [Byproduct of some Reformers]
- 18-H<sub>2</sub>O [RH & Reaction Product]
- 28-N<sub>2</sub> [Diluent when Air is Oxidizer]
- 28-CO [Undesired Reaction Product]
- 30-H<sub>2</sub>CO [Undesired Reaction Product]
- 31/32-CH<sub>3</sub>OH [Methanol – Fuel (Un-Reformed)]
- 32-O<sub>2</sub> [Oxidizer; Consumption Measure]
- 32-S [Fragment ion present if S is present]
- 34-H<sub>2</sub>S [Sulfur Impurity]
- 39-C<sub>3</sub>H<sub>3</sub> [Aromatic Hydrocarbon Fragment]
- 40-Ar [Inert (Air); Diagnostic for Flows]
- 43-C<sub>3</sub>H<sub>7</sub> [Alkane Hydrocarbon Fragment]
- 44-CO<sub>2</sub> [Relation Product of Reforming]
- 60-COS [Sulfur Impurity]
- 64-SO<sub>2</sub> [Sulfur Impurity]

## Raw Ion current vs Time and Derived Composition vs Time

[Note Transients from switching Capillaries are suppressed for clarity]

[All data shown are measured using the CPM Faraday Cup Detector]



- This Experiment shows the equivalence of basic Air composition through 2 capillaries.
  - The pickup of ~50 ppm of hydrogen flowing through the cell after a previous H<sub>2</sub> test is clearly evident
  - The use of the Faraday Detector is encouraged for stability of output giving accuracy of analysis.
- MoundTech' Stated Detection Limit of 10 ppm for FC Measurement is conservative: 5ppm of He is seen

## Lightweight and easily transportable

**Dimensions:** Width: 13" (330 mm)  
Depth: 15" (381 mm)  
Height: 20" (508 mm)

**Weight:** ~60 lbs (27 kg)

**Power Requirement:** 90-132/185-265 VAC 50/60 Hz, 140 Watt

**No Compressed Air or Water Required for Operation**

**Computer Controlled [USB]**

