

# Hidden CATLAB Systems

Microreactor for Catalysis Studies & Thermal Analysis



vacuum analysis

surface science

plasma diagnostics

gas analysis



## CATLAB overview

The Hiden **CATLAB** is a catalyst characterisation system designed to make the analysis of catalysts rapid and simple.

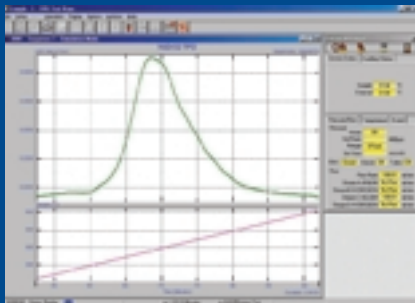
**CATLAB** consists of **two modules**:

- **Module 1:** is the Microreactor including temperature and flow control.
- **Module 2:** is the QIC-20 Quadrupole Mass Spectrometer system, which can also be used as a stand-alone instrument.

The two modules are complimentary and have been designed to optimise system performance for continuous real time analysis of catalysts and evaluation of multiple reaction components simultaneously. Close-coupled connection means the mass spectrometer inlet is as close to the sample as possible. The result is maximum sensitivity and < 500 millisecond response time.

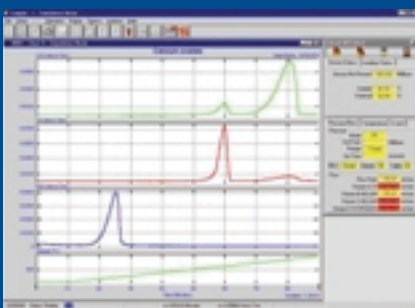
Accurate synchronisation of mass spectrometer signal with sample temperature is achieved via an integrated I/O subsystem.

# CATLAB technology...at a glance



## CATLAB software

Temperature, flow, data acquisition and analysis are controlled by the integrated **CATLAB** Windows™ software. This software package offers automated or manual control of experimental procedures and full control of the microreactor parameters, specifically ramp rate, temperature setpoint and gas flow. Peak integration is available to quantify desorption peaks.

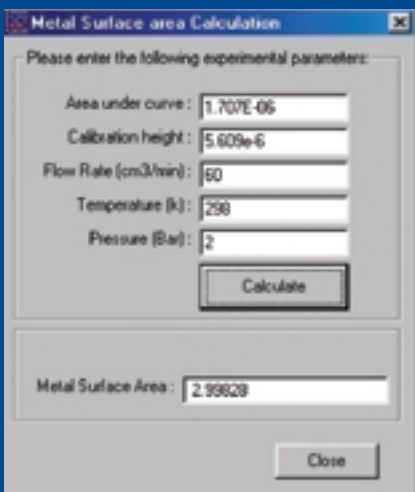


## TPD software

The Hiden **CATLAB** software package was developed in collaboration with Prof. K.C. Waugh of U.M.I.S.T. to allow routine automatic calculations of catalyst parameters.

Catalyst properties can be directly extracted from the generated data for fast, reproducible in-situ catalyst characterisation.

The list of calculated parameters include metal surface area, adsorption isotherms, coverage and heats of desorption.

A screenshot of the 'Metal Surface area Calculation' dialog box. The dialog box contains several input fields for experimental parameters: 'Area under curve' (1.707E-06), 'Calibration height' (5.609e-6), 'Flow Rate (cm3/min)' (60), 'Temperature (K)' (298), and 'Pressure (Bar)' (2). A 'Calculate' button is located below these fields. At the bottom of the dialog box, the 'Metal Surface Area' is displayed as 2.99628. A 'Close' button is also present at the bottom right.

## CATLAB example data

**CATLAB** was used to analyse a standard catalyst using CO TPD and reveals the information that **CATLAB** can provide for catalysts and other materials.

### Experiment Settings:

Catalyst 5% Pt/Al<sub>2</sub>O<sub>3</sub>, particle size of 250-500µm  
Reduction in 80% H<sub>2</sub>/He to 300°C  
CO adsorption at 30°C  
CO TPD, flow rate, 60 ml min<sup>-1</sup>  
Ramp rate 5°C / min to 500°C



# CATLAB

# CATLAB technical specifications

## module 1

sample mass	typically 100 - 250mg up to 2.0g optional
pressure	up to 1 bar
temperature	ambient to 1000°C
accuracy	+/- 1°C
ramp rate	1 to 20°C/min
temperature sensor	type K thermocouple
mass flow controllers	4 streams 3-100ml/min standard upto 8 streams with user defined flow rates optional
minimum flow pressure	3 bar
port connection	3mm (or 1/8") swagelok
power requirement	100-240V AC, 50-60Hz, 1.0kVA

## module 2

mass range	standard 200 amu. options 300 or 510 amu
ion source	direct inlet high pressure source
ion source control	all parameters adjustable in real time
detector	dual faraday cup / channeltron electron multiplier
detection limit	$5 \times 10^{-12}$ torr with faraday cup detector $2 \times 10^{-14}$ torr with channeltron detector
gas sensitivity	krypton( <sup>84</sup> Kr) in air at 0.5 ppm with faraday detector xenon( <sup>129</sup> Xe) in air at 25 ppm with channeltron detector
response speed	from sample to QMS, less than 500ms
analyser bakeout	250°C
quartz inlet capillary	typical inlet flow rate/gas consumption 20 atm ml/min low flow rate versions to 1 atm ml/min available
power requirement	100-240V AC, 50-60Hz, 1.5kVA

### option for corrosive gas handling

An optional upgrade can be requested so that Module 1 can be fitted with corrosive resistant seals and Module 2 fitted with corrosive resistant seals and a fomblinised pumping system.

## CATLAB technology

Advanced features make the Hiden **CATLAB** the instrument of choice. All system elements are designed and integrated to ensure the maximum reproducibility of results.

- Quartz Catalyst Cartridge System for reproducible sample positioning
- Low Thermal Mass Furnace for rapid linear response
- Sample 'In-bed' Thermocouple for optimum temperature accuracy
- Precision Mass Flow Controllers for accurate flow measurement
- Zero Dead volume valves ensuring rapid, reproducible response
- Fully programmable and automated analysis cycle



## CATLAB characterisation

Catalyst Characterisation is performed using both Temperature Programmed (TPD, TPO, TPR, TPRx) and isothermal techniques. These techniques allow a whole range of parameters to be characterised with one system.

Information obtained using these techniques include:

- Metal surface area
- Surface coverage
- Determination of strength / number of active sites
- Adsorption isotherms



# CATLAB

# HIDEN

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