

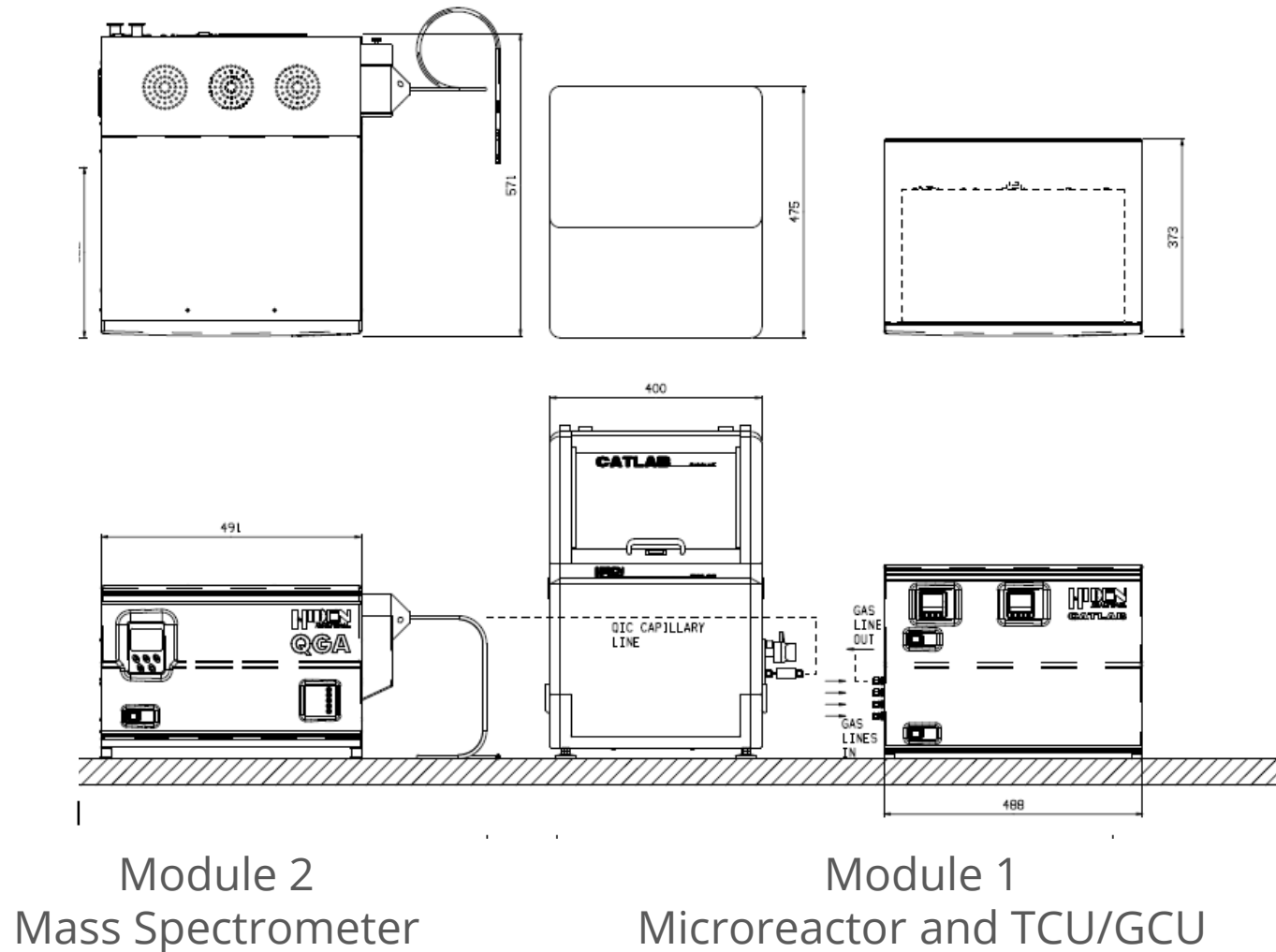
Hidden CATLAB

Integrated Microreactor-Mass Spectrometer
for Reaction Testing, TPD/R/O and
Pulse Chemisorption

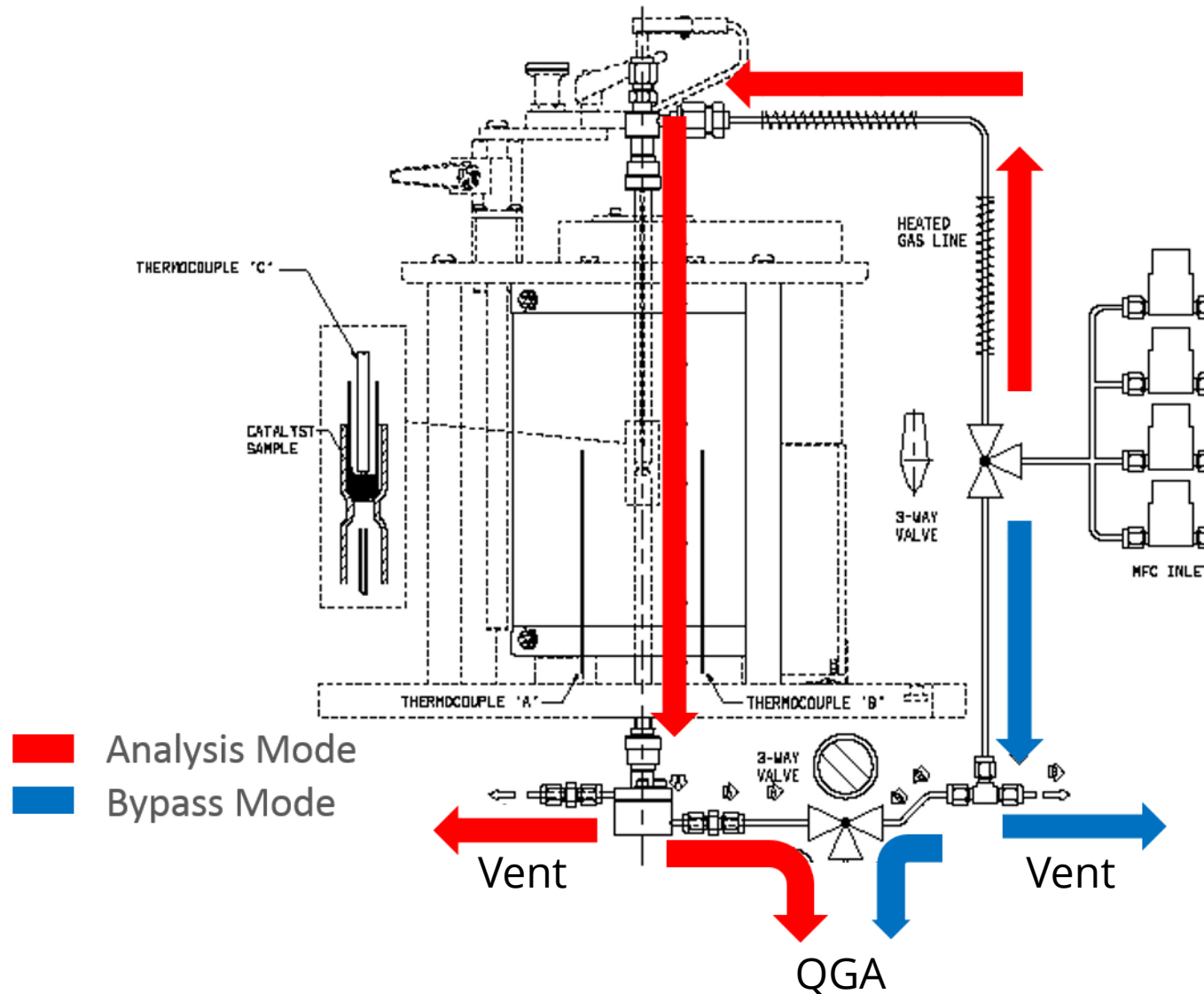
CATLAB Modules



Standard CATLAB Layout



CATLAB Schematic



CATLAB Options

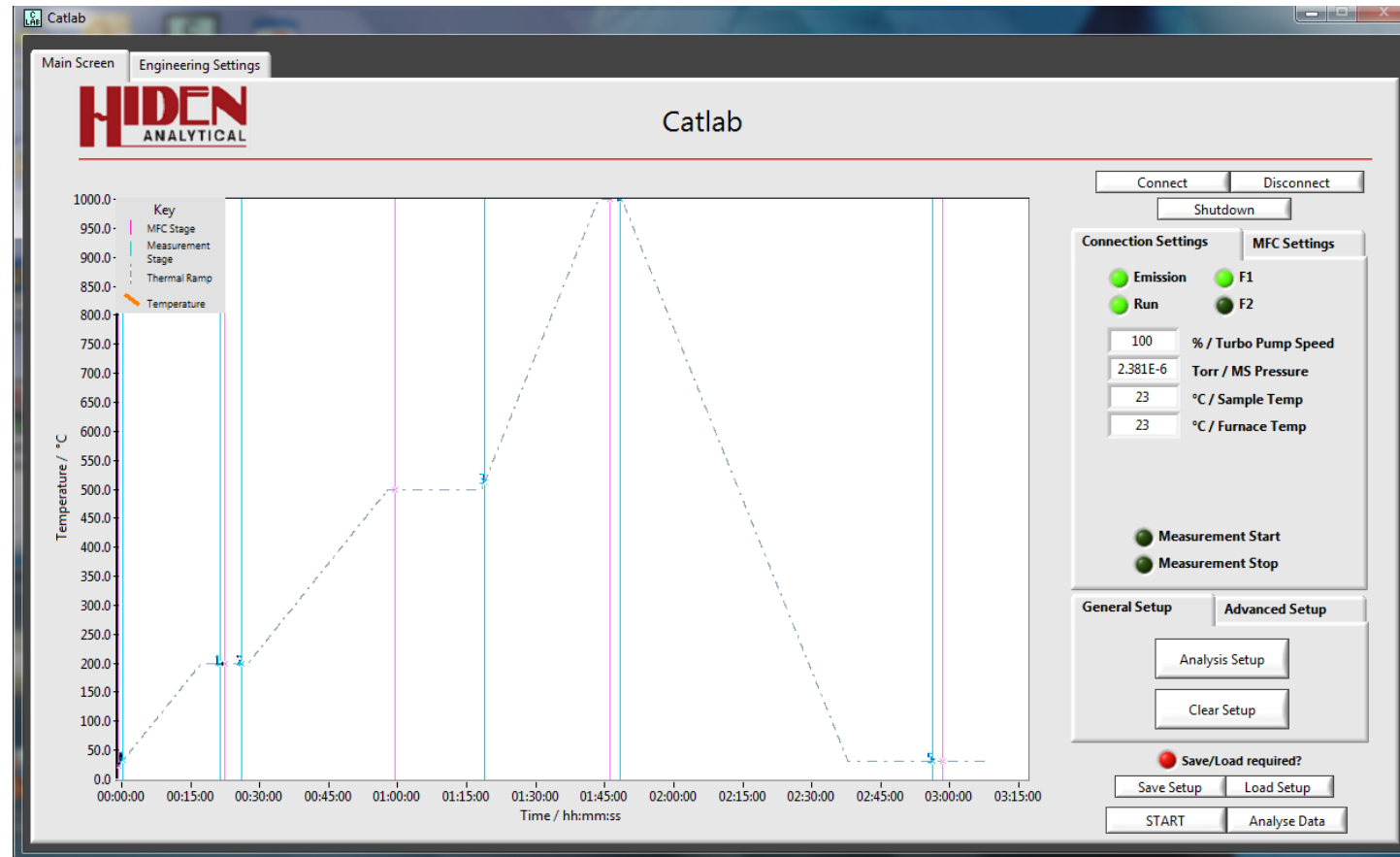
- Corrosion resistant upgrade - includes upgrade of one gas flow line and corrosive gas resistant sample line seals, and a gas dilution/purge valve mass spectrometer pumping system.
- Additional corrosion resistant feed lines if required.
- Additional 4 channel gas control unit integrated to provide 8 stream gas selection in total.
- Option to choose the maximum flow of each MFCs.
- Vapour Generation (gives vapour pressure equivalent to max liquid temperature $\sim 30^{\circ}\text{C}$). Other options available for higher flow rates.
- 300 amu mass range option. Mass range to 1000 amu available for specialised applications

QIC Series Gas Analysers



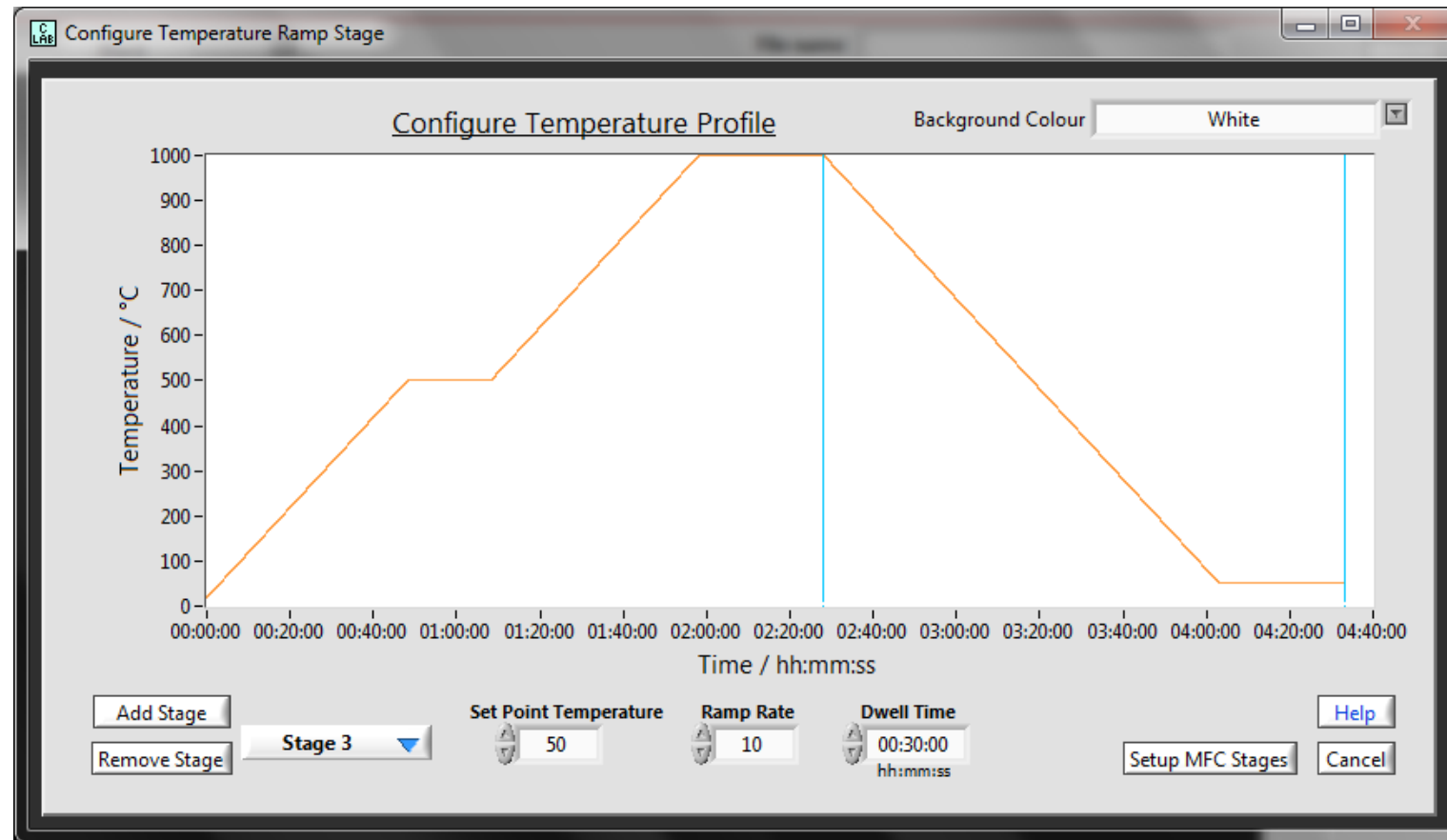
- 200 amu mass range, dual Faraday/ Electron Multiplier detector.
- Detection capability from 100 % to 0.1 ppm.
- Fast scan speeds of 100 amu/s.
- < 500 ms response time to changes in gas concentrations.
- Low dead volume, flexible heated inlet capillary for fast response to gases and vapours.
- Soft ionisation for analysis of complex mixtures and organics.
- Can be used as a stand-alone gas analysis system or in combination with other equipment i.e. Thermal Analysis.

CATLAB Control Software



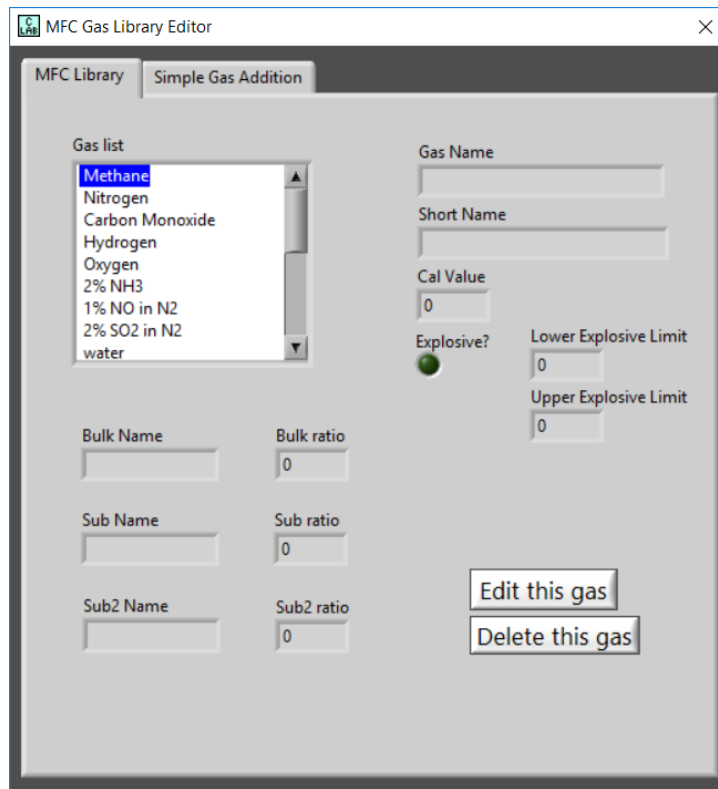
- Control of Mass Spectrometer, Temperature and Gas Flows in one software package

Temperature Control

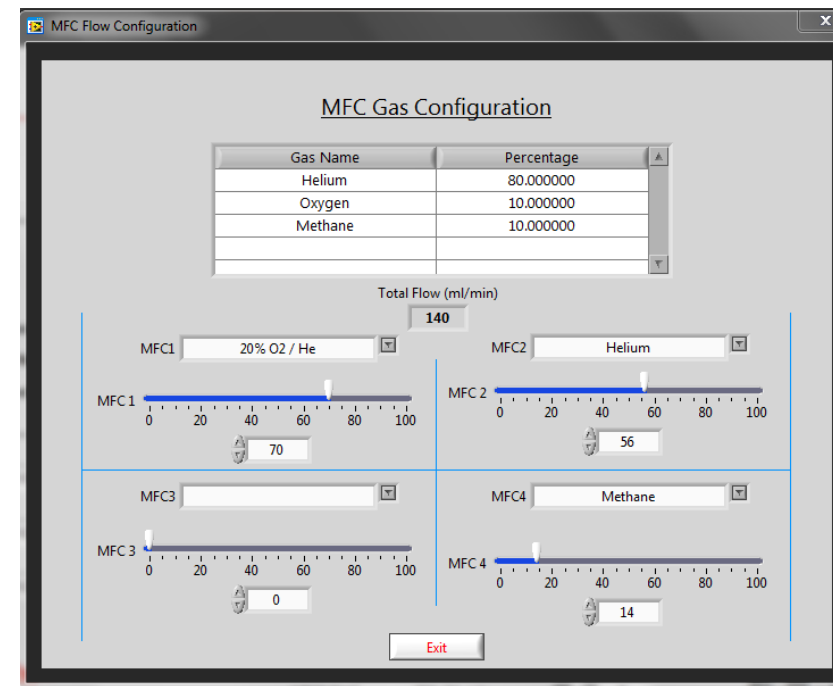


- Multi-stage temperature ramps

Gas Mixing Control

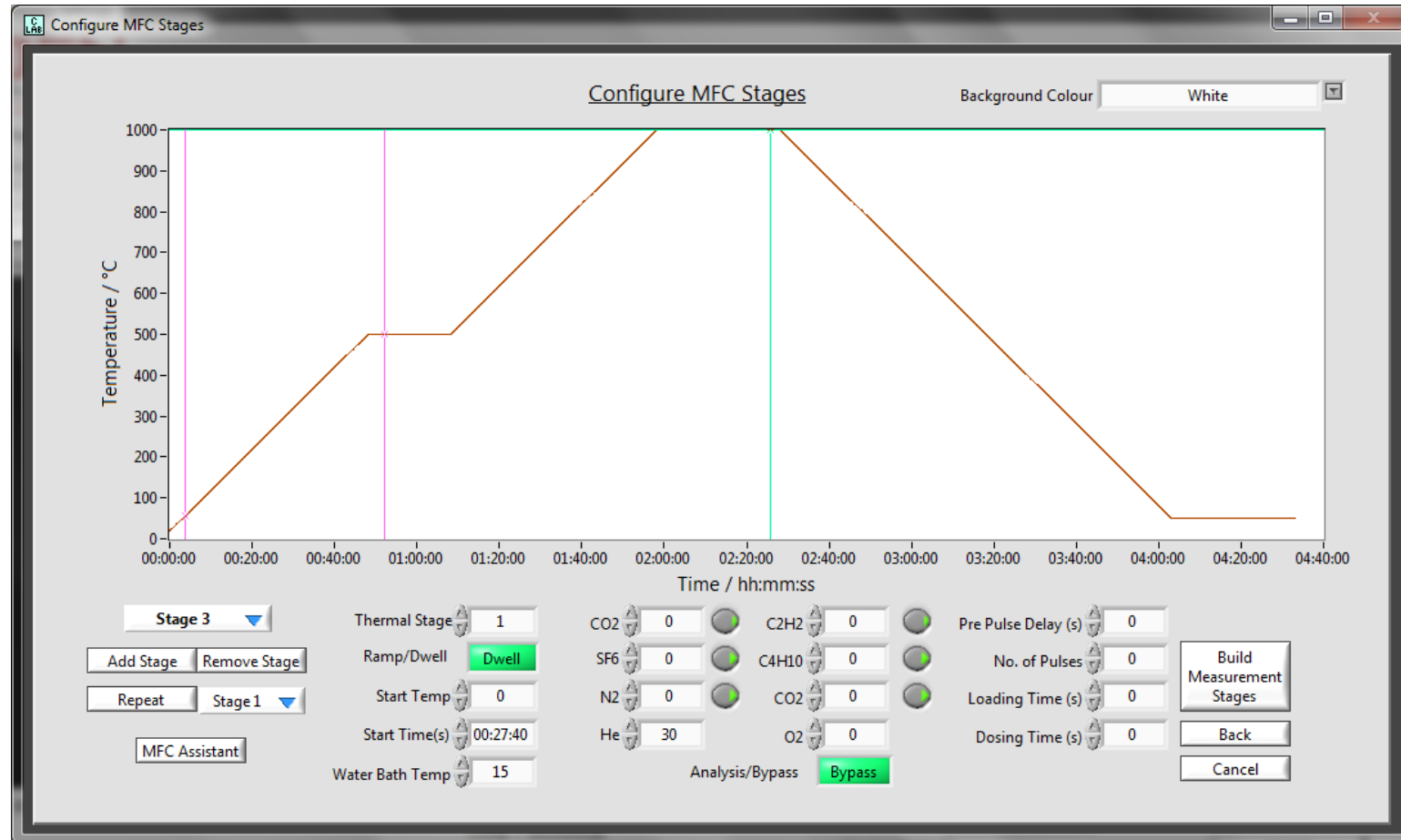


- MFC Gas Mix Library Editor



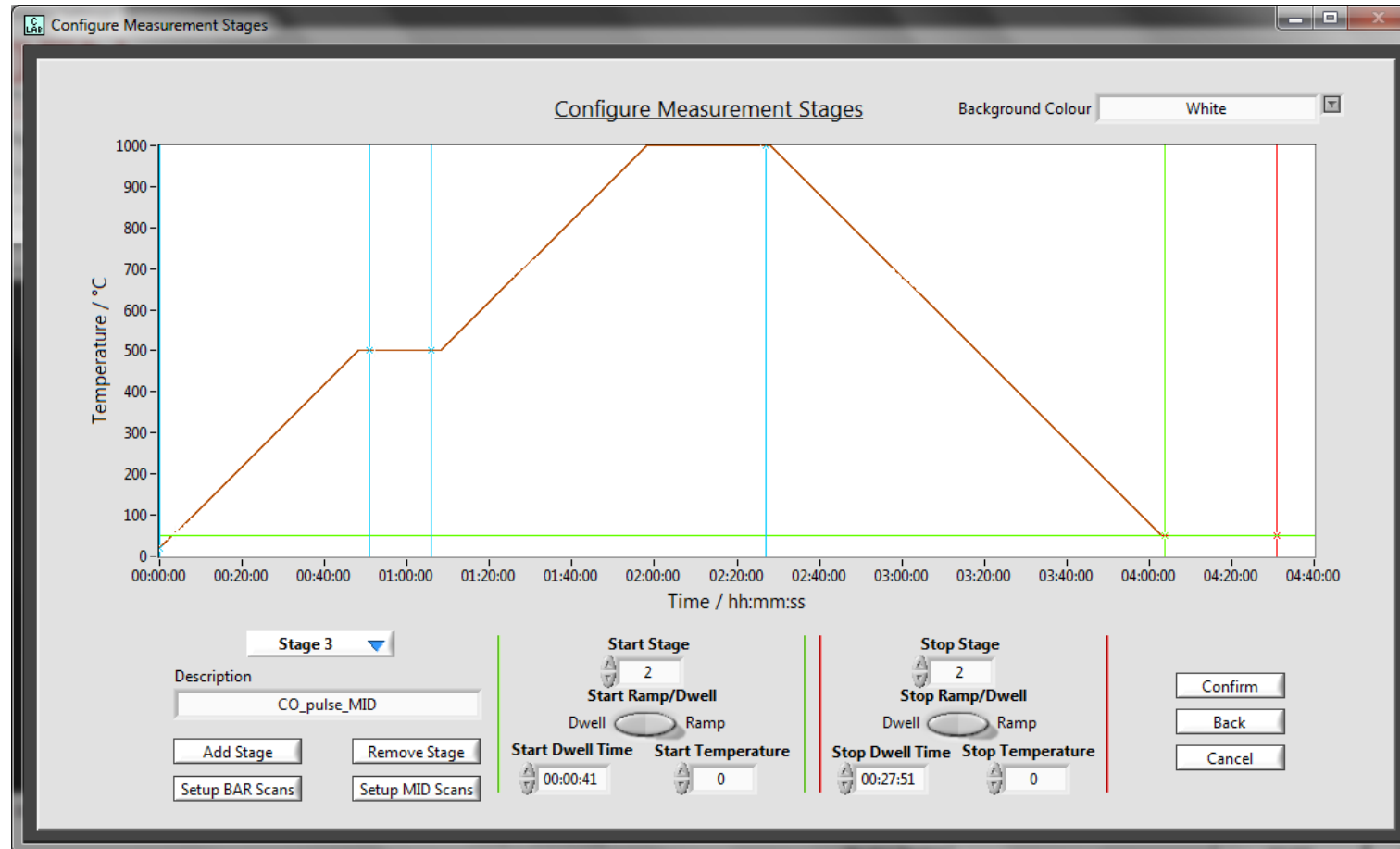
- Gas Mix Calculator

Gas Mixing Control



- Gas switching controlled by either temperature or time

MS Analysis Control



- Optimised multistage analysis - configure different analysis for different parts of the experiment

Mass Spectrometer Control

MID Setup

Gas	40	20	36	38	0	0	0	0	0	0
Gas 1 Argon	999	107	3	1	0	0	0	0	0	0
Gas 2 Hydrogen	999	100	0	0	0	0	0	0	0	0
Gas 3 Water	999	230	11	7	3	1	0	0	0	0
Gas 4 Oxygen	999	114	4	1	0	0	0	0	0	0
Gas 5	0	0	0	0	0	0	0	0	0	0
Gas 6	0	0	0	0	0	0	0	0	0	0
Gas 7	0	0	0	0	0	0	0	0	0	0
Gas 8	0	0	0	0	0	0	0	0	0	0

Page 2

Save Load

Exit

Show Advanced Settings

Show Limits

- MID Scan setup for known species
- Automatic overlap removal

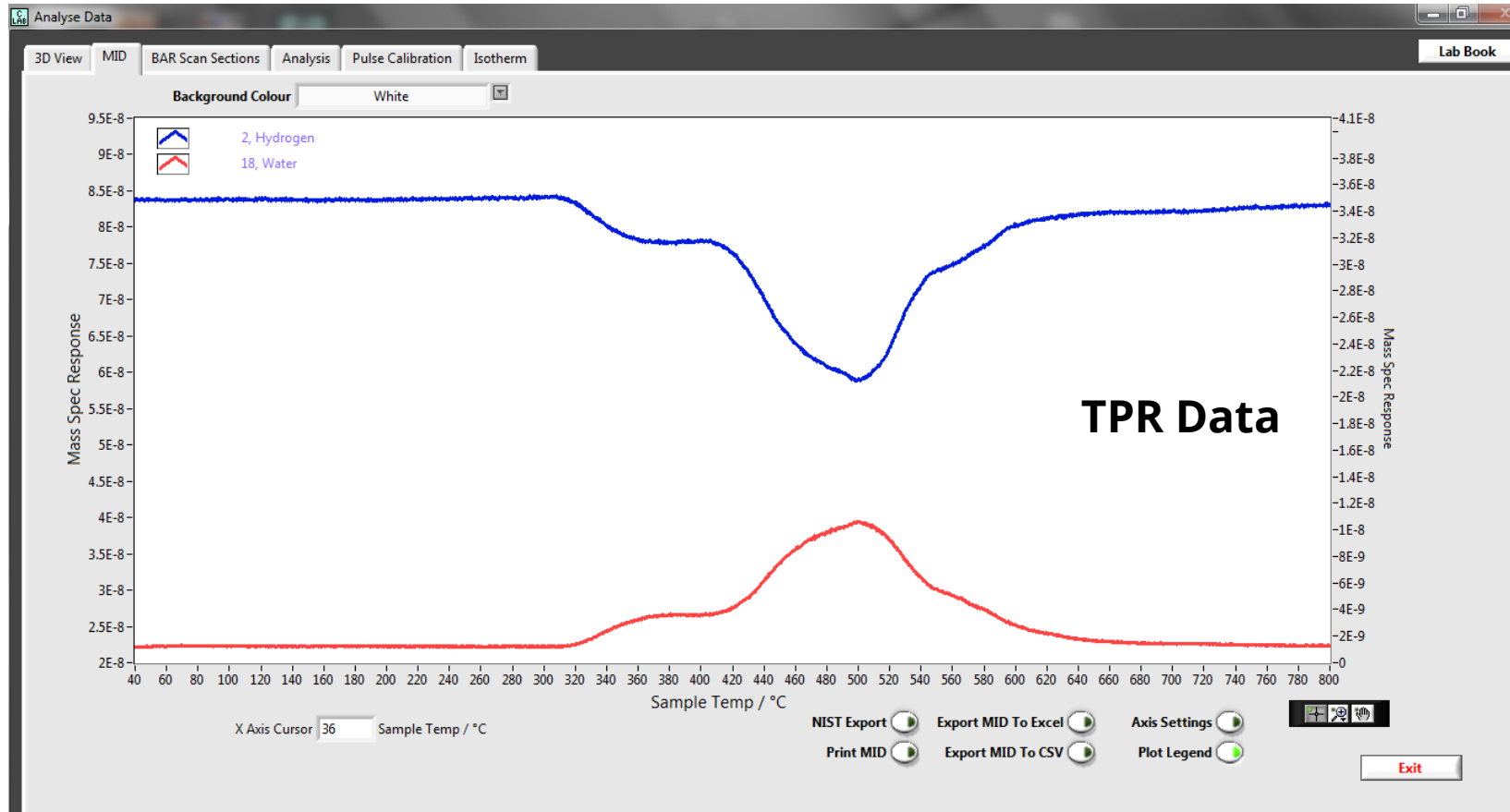
Mass Spectrometer Control

The screenshot displays the 'BAR Scan Setup' window, which is used for configuring mass spectrometer scans. The window features a title bar with standard Windows controls and a main area titled 'Bar Scan Settings'. Below this title, there are three distinct sections for configuring different scans: the main 'Bar Scan' and two subscans, 'Bar Subscan 2' and 'Bar Subscan 3'. Each section contains a series of controls: an 'Enabled' checkbox (all are checked), 'Start Mass' and 'Stop Mass' numeric inputs with associated up/down arrows, an 'Increment' numeric input with up/down arrows, a 'Detector' dropdown menu (all set to 'SEM'), 'Autorange High' and 'Autorange Low' numeric inputs with up/down arrows, a 'Start Range' numeric input with up/down arrows, an 'AutoZero' checkbox (all are checked), 'Electron Energy' and 'Emission Current' numeric inputs with up/down arrows, a 'Settle Speeds' dropdown menu (all set to 'Normal'), and a 'Dwell Time' dropdown menu (all set to 'Normal'). At the bottom of the window, there are three buttons: 'Save', 'Load', and 'Exit'.

Bar Scan Settings												
	Start Mass	Stop Mass	Increment	Detector	Autorange High	Autorange Low	Start Range	AutoZero	Electron Energy	Emission Current	Settle Speeds	Dwell Time
Bar Scan	1	30	1	SEM	-7	-11	-8	ON	70	500	Normal	Normal
Bar Subscan 2												
Bar Subscan 2	35	50	1	SEM	-7	-11	-8	ON	70	500	Normal	Normal
Bar Subscan 3												
Bar Subscan 3	100	200	1	SEM	-7	-11	-8	ON	70	500	Normal	Normal

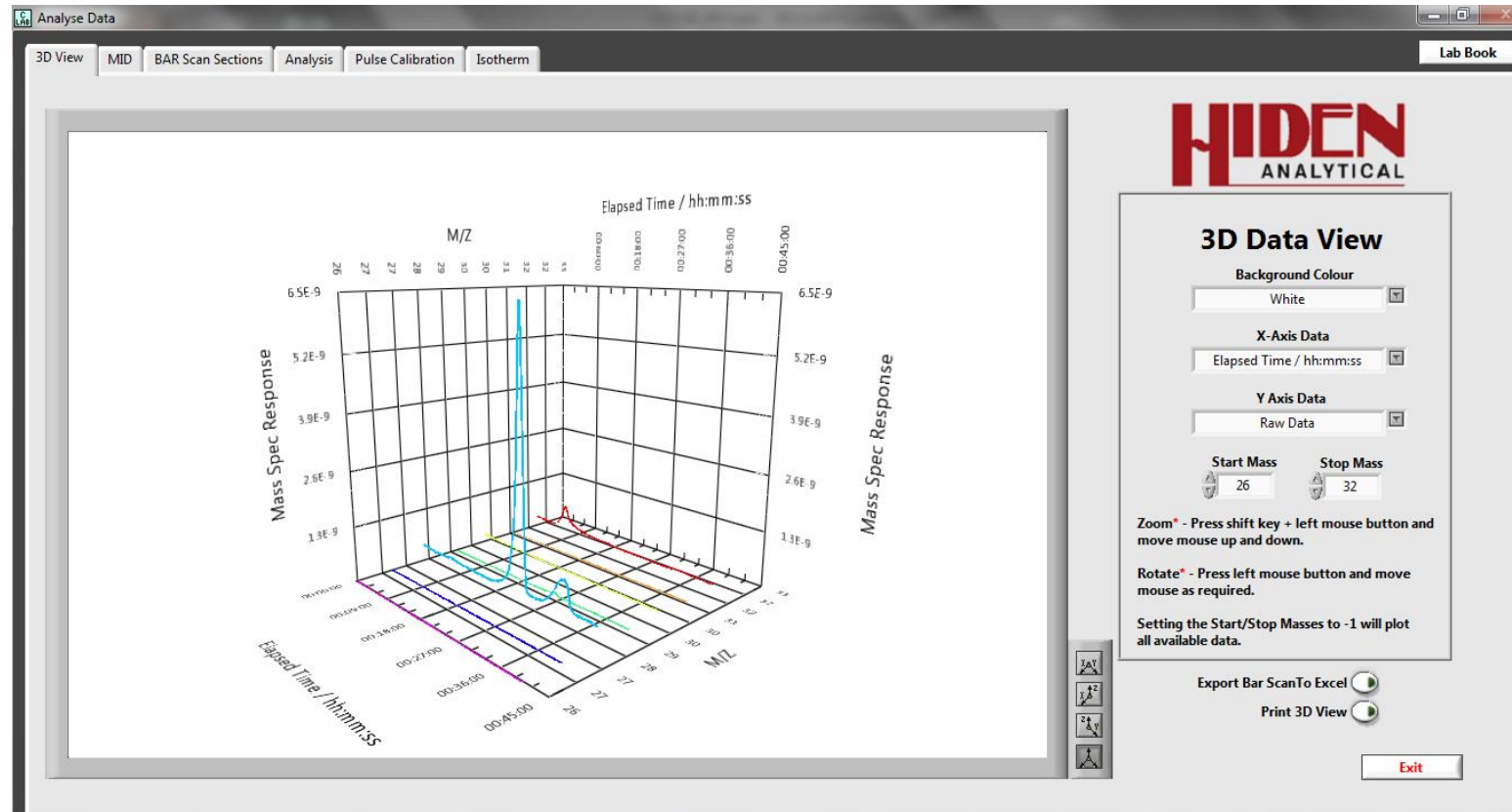
- Multiple Bar scans can be configured for optimised sampling of unknowns

MS Data Display



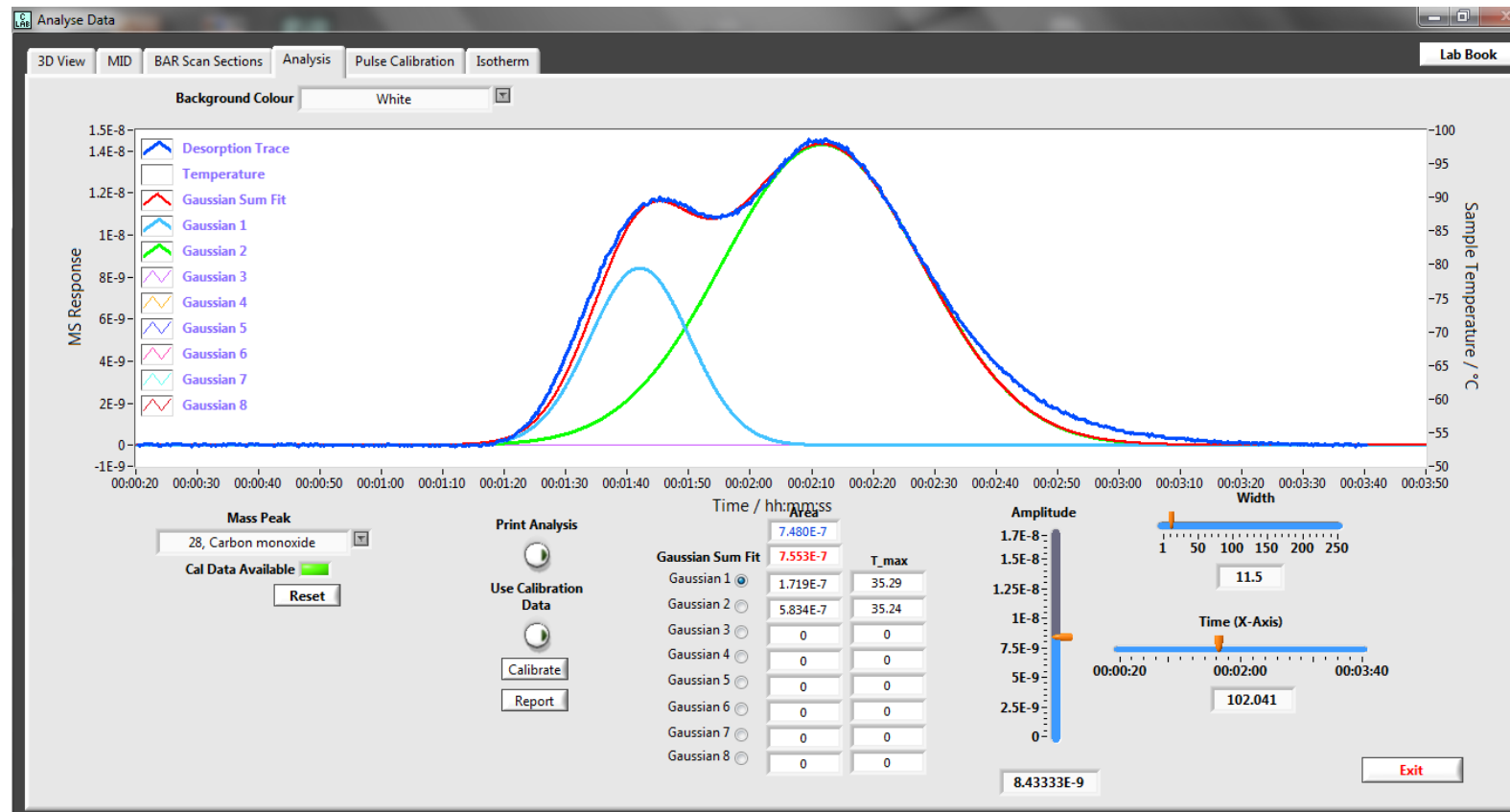
- Data plotted with x-axis as time or temperature

MS Data Display



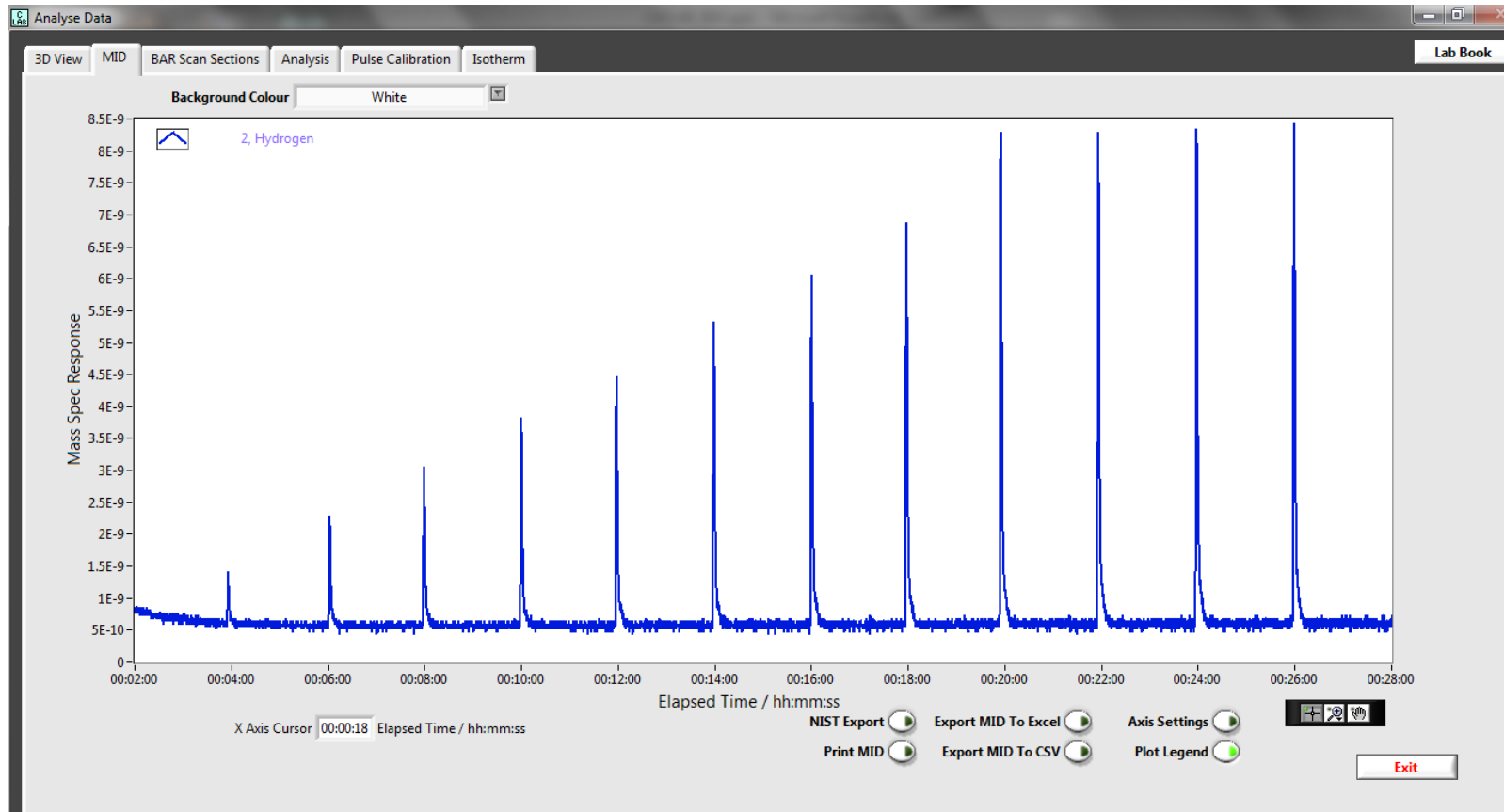
- 3D Bar Graph mode for easy identification of bar mode trends

Data Analysis



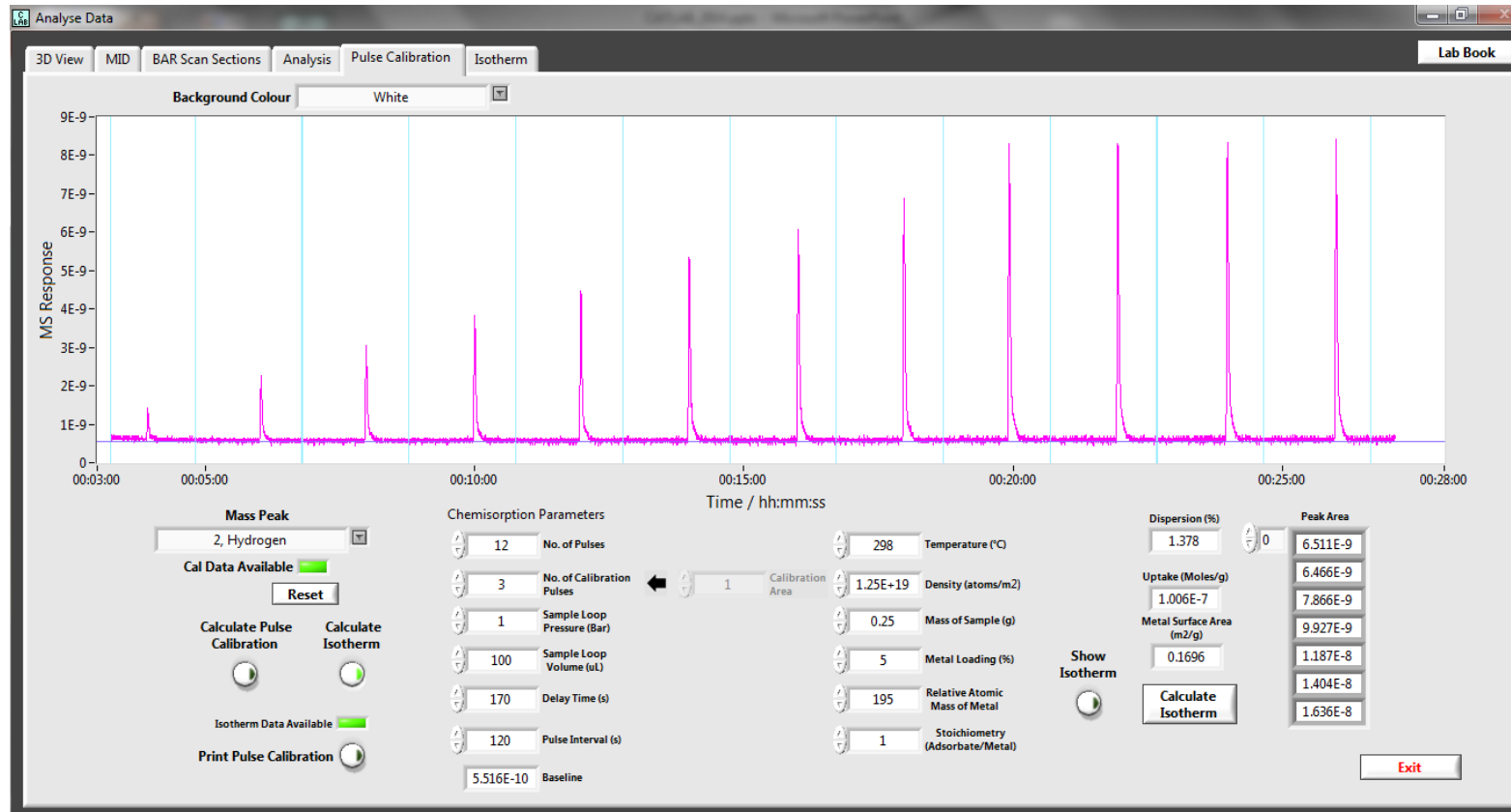
- Peak fitting analysis routines
- Integrated area
- Baseline subtraction

Pulse Chemisorption



- Injection of single gases or multiple reactants

Pulse Chemisorption Quantification



- Uptake measurements
- Dispersion calculation
- Metal surface area
- Pulse Adsorption Isotherm

Summary

- Integrated microreactor and mass spectrometer
- Both microreactor and mass spectrometer manufactured by Hiden Analytical
- Single integrated software package to control MS and microreactor
- Ideal for catalyst characterisation and reaction testing
- Designed for optimum mass spectrometer performance



Selected Academic References

- **Electronic and Geometric Structure of Ce³⁺ Forming Under Reducing Conditions in Shaped Ceria Nanoparticles Promoted by Platinum** .*J. Phys. Chem. C*, 2014, 118 (4), pp 1974–1982. O. V. Safonova, A. Guda, C. Paun, N. Smolentsev, P. M. Abdala, G. Smolentsev, M. Nachtegaal, J. Szlachetko, M. A. Soldatov, A. V. Soldatov, and J. A. van Bokhoven
- **The effect of coke deposition on the activity and selectivity of HZSM-5 zeolite during ethylbenzene alkylation reaction in the presence of ethanol.** *Catal. Sci. Technol.*, 2014, **4**, 1017-1027. S. S. Khattaf, C. D'Agostino, M. N. Akhtar, N. O. Al-Yassir, N. Tan and L. F. Gladden.
- **Reaction Kinetics of C₃H₆ Oxidation for Various Reaction Pathways Over Diesel Oxidation Catalysts** .*Topics in Catalysis*, December 2013, Volume 56, Issue 18-20, pp 1916-1921. H. Oh, I. S. Pieta, J. Luo, W. S. Epling
- **An investigation of the role of surface nitrate species in the oxidation of propene on a Pt-based diesel oxidation catalyst..** *Catal. Sci. Technol.*, 2013, **3**, 2349-2356 , S. Chansai, R. Burch, C. Hardacre, H. Oh, and W. S. Epling.
- **Molybdenum oxide on Fe₂O₃ core-shell catalysts; probing the nature of the structural motifs responsible for methanol oxidation catalysts** .*ACS Catal.*, **2014**, 4 (1), pp 243–250, C. Brookes , P. P Wells , G. Cibir , N. Dimitratos , W. Jones , D. J. Morgan , and M. Bowker.
- **Chiral Co(II) metal-organic framework in the heterogeneous catalytic oxidation of alkenes under aerobic and anaerobic conditions.** *ACS Catal.*, 2014, 4, pp 1032–1039 Giulia Tuci, Giuliano Giambastiani, Stephanie Kwon, Peter Curran Stair, Randall Q. Snurr and Andrea Rossin

Selected CATLAB Users



PDVSA



UCL
Université
catholique
de Louvain



ETH zürich

- Johnson Matthey
- Texas A&M University
- Hong Kong University
- Cambridge University
- Bayreuth University
- Research Complex at Harwell
- Sao Paolo University
- Bulgarian Academy of Sciences
- Université Catholique de Louvain
- Kunming University
- ETH Zurich
- PDVSA



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- www.HidenAnalytical.com
 - The Hiden website is an excellent resource with product pages, brochures, catalogues, product pages with some application notes, presentation and other information.
 - Contact +44 1925 445225 for direct support.