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HIDEN ISOCHEMA

IGA

GRAVIMETRIC GAS & VAPOR SORPTION ANALYZERS

Hiden Isochema is a world leader in the design and manufacture of high accuracy sorption instruments for research, development and production applications in materials science and related fields.

IGA ECOSORP
Gravimetric Analyzer for Carbon Capture Applications

XEMIS
Next Generation Gravimetric Sorption Analyzer

IGASORP
Dynamic Vapor Sorption Analyzer

IMI
High Accuracy Hydrogen Storage Analyzer

XCS
Climate Control Systems

MBR
Membrane Permeation Analyzer

ABR
Automated Breakthrough Analyzer

IGA
Gravimetric Gas & Vapor Sorption Analyzers

Full details on our complete range of products and services are available on our website.

www.hidenisochema.com

High accuracy gravimetric gas and vapor sorption analyzers for the precise characterization of sorption equilibria and kinetics.

UNRIVALLED MEASUREMENT PRECISION, ACCURACY AND REPEATABILITY

An ultrasensitive thermostatted microbalance provides high resolution and excellent long-term stability with precise pressure and temperature control.

FAST AND ACCURATE ANALYSIS OF EQUILIBRIA AND KINETICS USING THE UNIQUE IGA METHOD

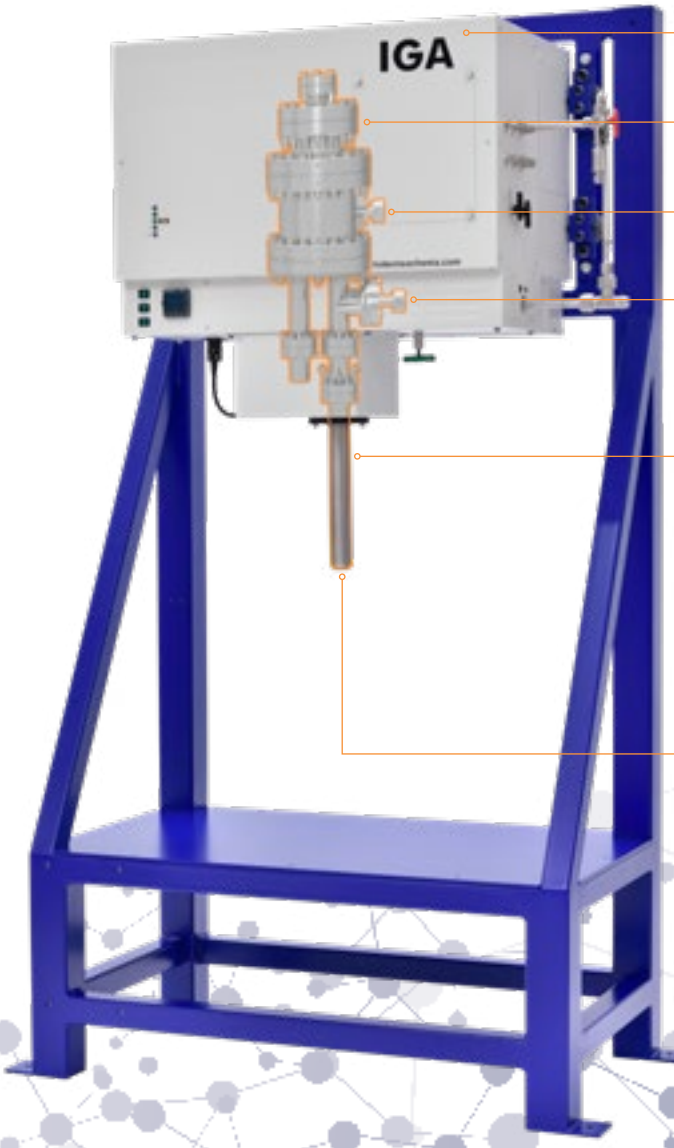
Provides consistent analysis with optimum measurement accuracy and faster overall process times.

COMPLETE ISOTHERMAL, ISOBARIC AND KINETIC ANALYSIS FROM VACUUM TO 20 BAR

Precise pressure control from sub-millibar to 20 bar allows determination of isotherms, isobars and isobaric kinetics with a wide range of gases.

A VERSATILE AUTOMATED ANALYZER SUITABLE FOR USE WITH A RANGE OF GASES, MATERIALS AND METHODS

IGA OVERVIEW



THERMOSTATTED CABINET
For optimal long term stability

IGA MICROBALANCE
With sub-microgram resolution

PRESSURE VESSEL
With all metal fittings

VACUUM CONNECTION
For in-situ degassing

SAMPLE REACTOR
Selected to suit application

INTERCHANGEABLE THERMOSTATS

Liquid N_2 dewar

Furnace

Refrigerant recirculation

OPTIONS

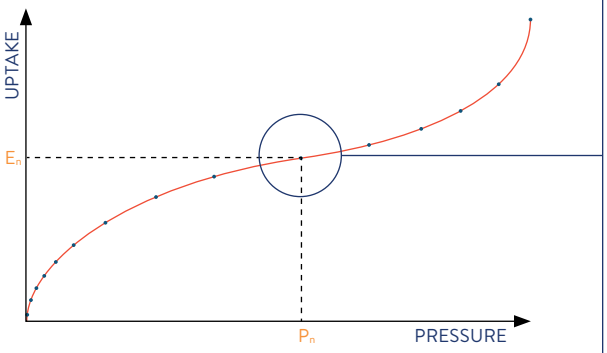
- Vapor sorption with active pressure regulation from 10^{-3} mbar
- Dynamic mode with control of pressure, flow and gas composition
- Advanced functions with integrated mass spectrometer

KEY FEATURES

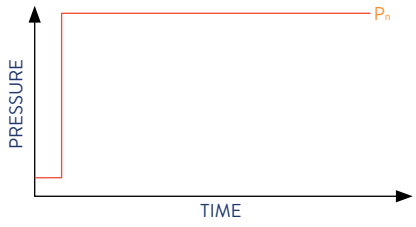
- Unrivalled long term microbalance stability
- Fast and accurate analysis of equilibria and kinetics
- Fully programmable for advanced method development
- Active pressure regulation from sub-millibar to 20 bar
- Modular design provides flexible upgradeability

THE **IGA** METHOD

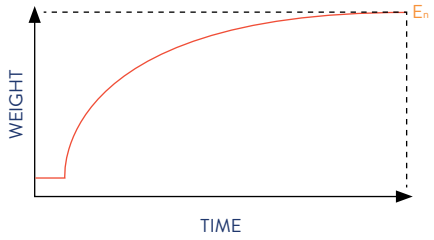
Hiden Isochema's unique **IGA** (Intelligent Gravimetric Analysis) method allows simultaneous, automated determination of sorption kinetics and equilibrium isotherms.



Equilibrium points are collected and plotted as an isotherm. The **IGA** method allows consistent and accurate measurements with faster overall process times.



Pressure/gas composition is changed and actively regulated during sorption at the set point P_n.

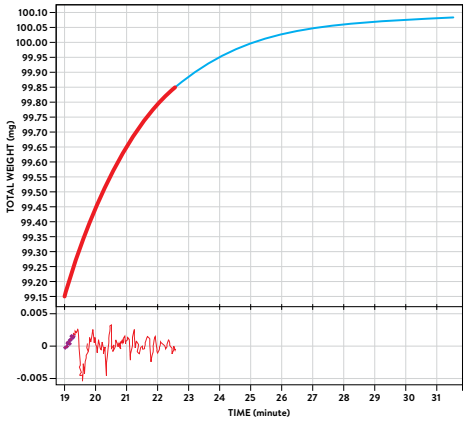


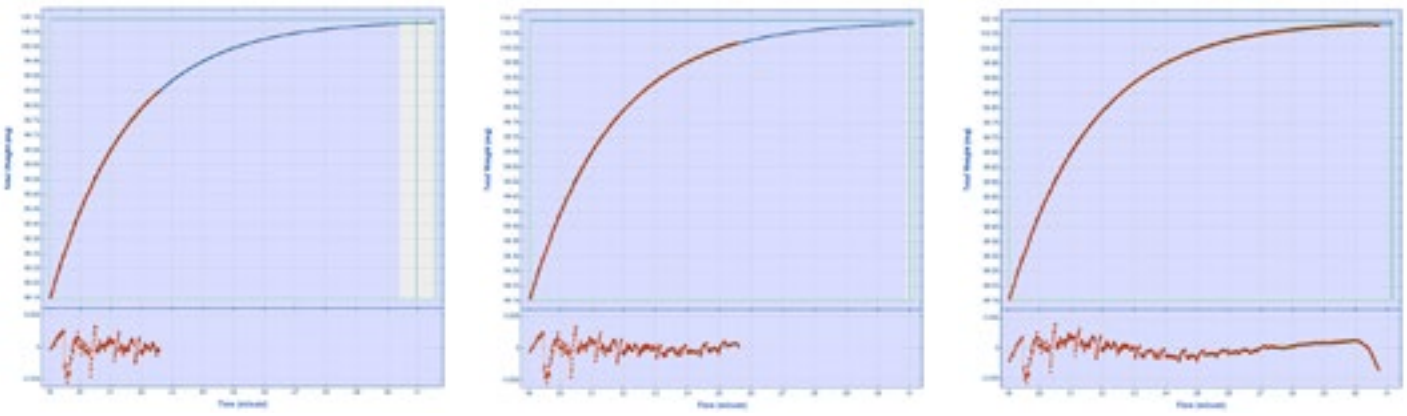
The weight data is analyzed in real time to determine kinetic parameters and simultaneously predict the equilibrium point, E_n.

KINETIC ANALYSIS

During an experiment, weight measurements are analyzed using the Real Time Processor (RTP). Parameters defining the fitting process are set by the user, with full flexibility, and end point uptake at each isotherm point is then predicted from the weight data and RTP parameters. The predicted equilibrium is continually refined as data is collected, and displayed both graphically and numerically.

The measurement and fitting process is illustrated in the accompanying screenshots, with the calculated residuals displayed below each kinetic plot indicating the quality of the fit. RTP analysis provides both accuracy and consistency for the acquisition of high quality equilibrium sorption isotherm data and allows the simultaneous extraction of detailed kinetic information.





Screen captures from HIsorp software showing measured data (red) and fit projection (blue).
The predicted endpoint and associated uncertainty (upper plot) and fit residuals (lower plot) are also shown.

IGA MODELS

IGA-001

Gravimetric gas sorption analyzer

OPERATING MODES

PURE GAS MODE

IGA-002

Gravimetric vapor sorption analyzer

OPERATING MODES

PURE GAS MODE

+

VACUUM VAPOR MODE

IGA-003

Dynamic mixed gas sorption analyzer

OPERATING MODES

PURE GAS MODE

+

DYNAMIC MIXED GAS MODE

OPTIONAL

DYNAMIC VAPOR

MASS SPECTROMETER

IGA-100

Dynamic gas and vapor sorption analyzer

OPERATING MODES

PURE GAS MODE

+

VACUUM VAPOR MODE

+

DYNAMIC MIXED GAS MODE

OPTIONAL

DYNAMIC VAPOR

MASS SPECTROMETER

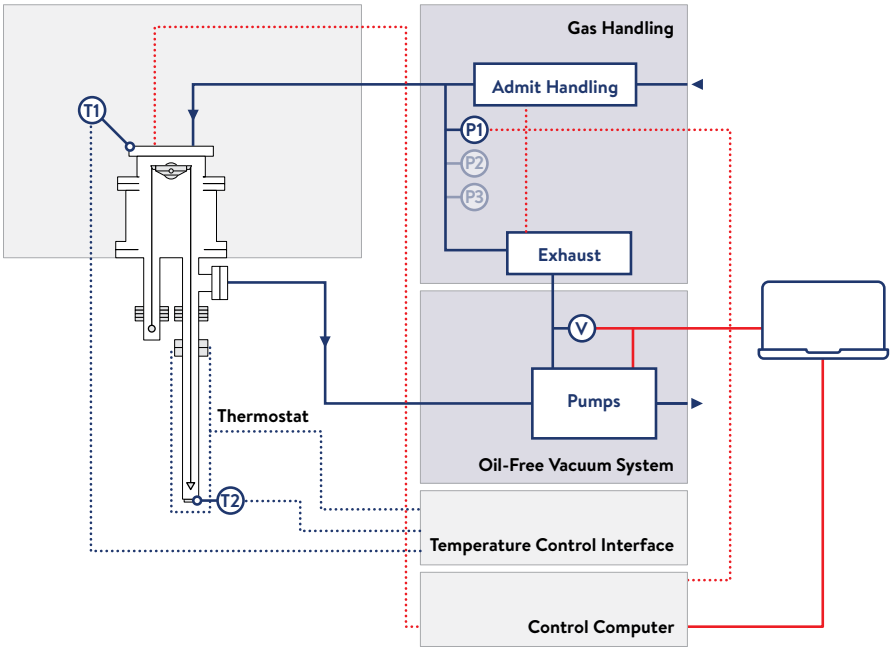
IGA-001

High accuracy gravimetric sorption analyzer, for precise characterization of gas sorption equilibria & kinetics.

The IGA-001 is a dedicated single component gas sorption analyzer for the study of gas interactions with both solids and liquids.

Typical application areas:

- Hydrogen and natural gas storage
- Gas solubility in ionic liquids
- Thermodynamic and kinetic studies



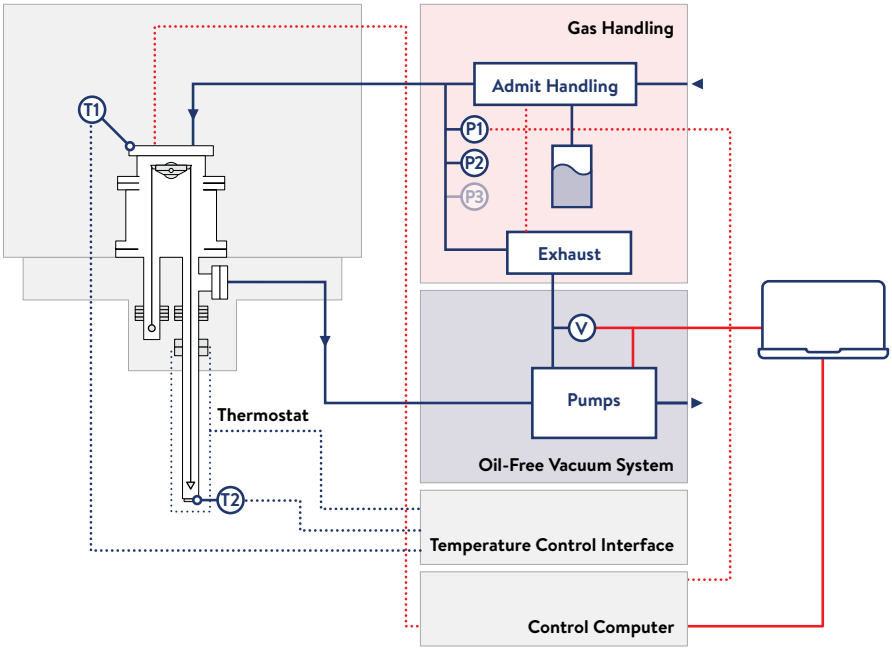
IGA-002

Single component gravimetric analyzer, for precise characterization of gas & vapor sorption equilibria & kinetics.

The IGA-002 is a high resolution vapor sorption analyzer for precisely characterizing vapor-solid interactions.

Typical application areas:

- Water and organic vapor sorption
- Diffusion coefficient determination
- Vapor sorption in polymers



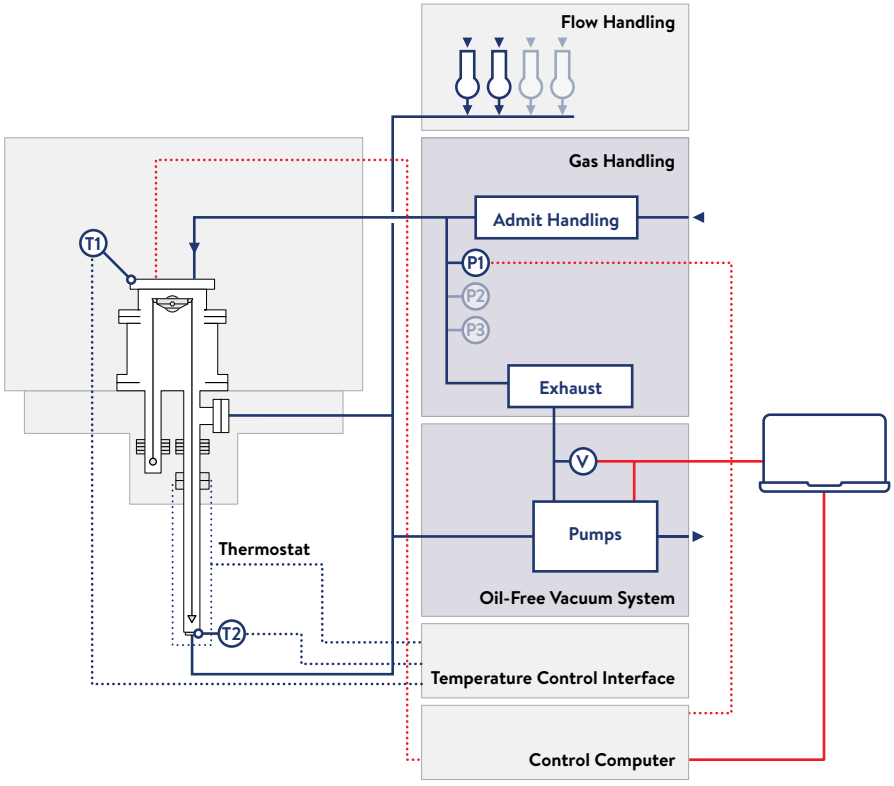
IGA-003

High accuracy gravimetric analyzer, with combined pressure & flow control for precise characterization of thermodynamics & kinetics.

An optional vapor generator module allows water or organic solvent vapor to be delivered as part of the gas mixture so more complex investigations can be performed.

Typical application areas:

- Temperature Programmed Desorption/ Oxidation/Reduction (TPD/TPO/TPR)
- Thermodynamic and kinetic studies
- Energy gas storage



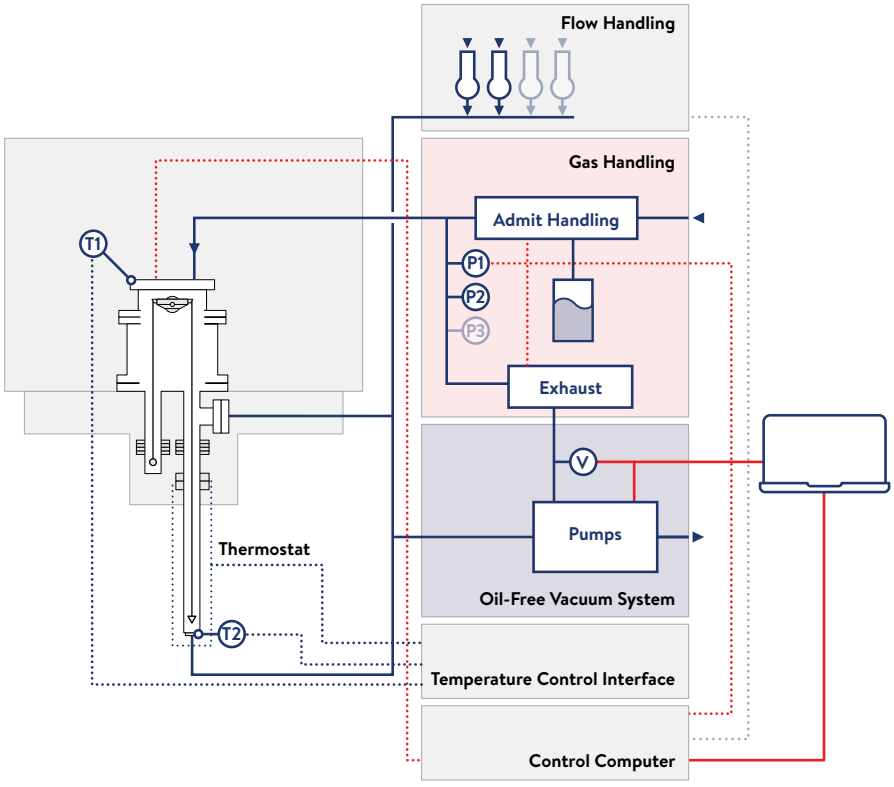
IGA-100

Advanced gravimetric analyzer for high resolution gas and vapor sorption combined with high pressure TGA.

An automated multiple inlet flow control system allows mixed gas experiments, while anti-condensation protection and active pressure regulation enable high resolution vapor measurements.

Typical application areas:

- Moisture and organic vapor sorption
- Diffusion coefficient determination
- Thermogravimetric Analysis (TGA) and Evolved Gas Analysis (EGA)
- Catalyst characterization



EXAMPLE APPLICATION DATA

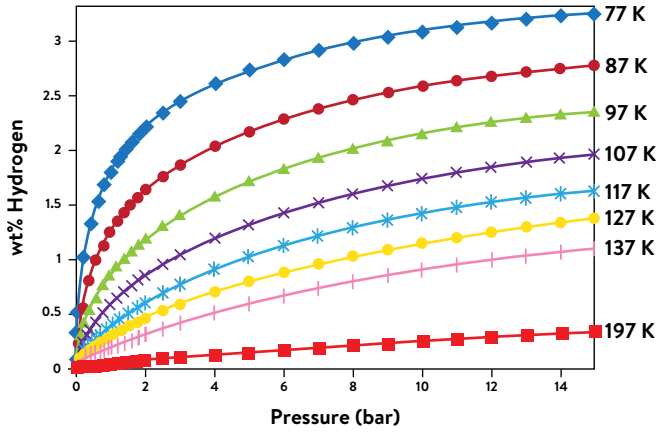


Figure 1: Hydrogen adsorption by a polymer of intrinsic microporosity measured at cryogenic temperatures.

Reproduced from S. Tedds et al, Faraday Discuss., 2011, 151, 75-9 with permission from The Royal Society of Chemistry.

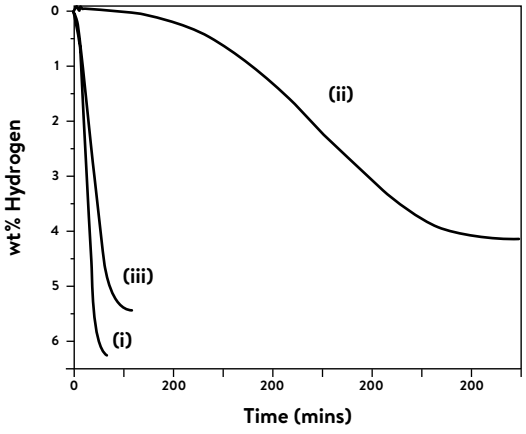


Figure 2: Hydrogen desorption kinetics at 10 mbar and 673 K for MgH_2 showing improvement in kinetics for treated samples (i) and (iii).

Reproduced from S. R. Johnson et al, Chem. Commun., 2005, 2823-2825 with permission from The Royal Society of Chemistry.

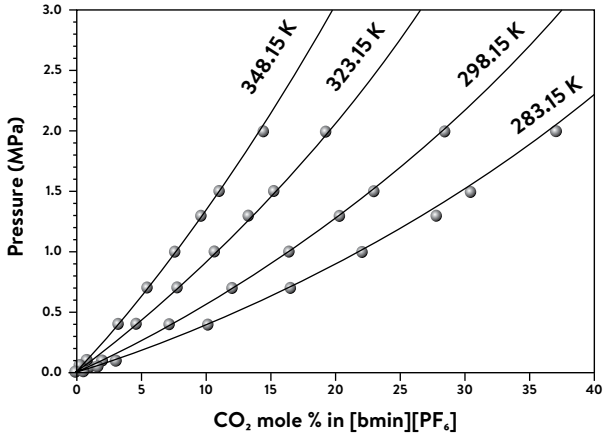


Figure 3: Experimentally determined CO_2 gas solubilities in ionic liquid [bmim][PF_4] compared with equation of state model.

Reprinted (adapted) with permission from M. B. Shiflett et al Ind. Eng. Chem. Res. 2005, 44, 12, 4453–4464. Copyright 2005 American Chemical Society.

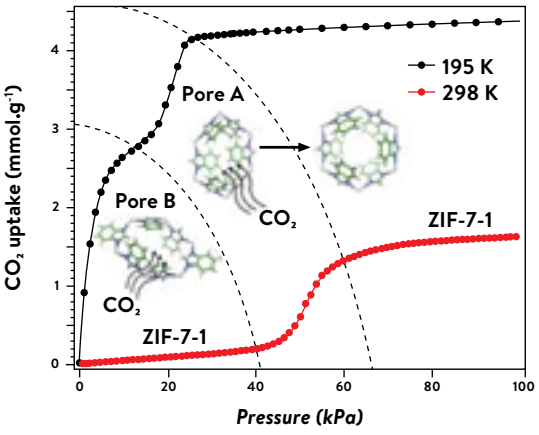


Figure 4: CO_2 adsorption by a metal-organic framework, ZIF-7, showing adsorption-induced structural dynamics.

Reproduced from P. Zhao et al, Nat Commun 10, 999 (2019) under CC BY 4.0.

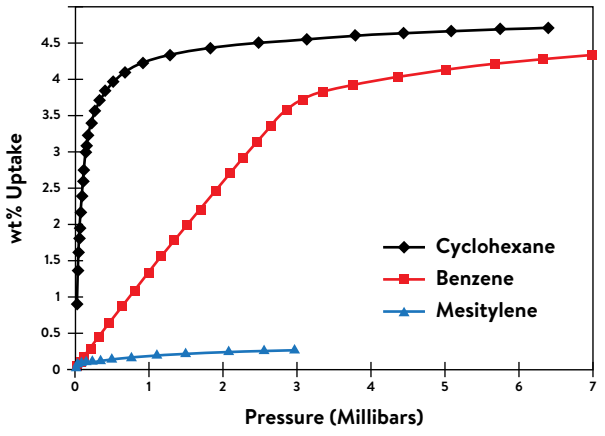


Figure 5: Cyclohexane, benzene and mesitylene organic vapor sorption by ZSM-5 zeolite, illustrating steric separation of vapor species.

Hiden Isochema unpublished data.

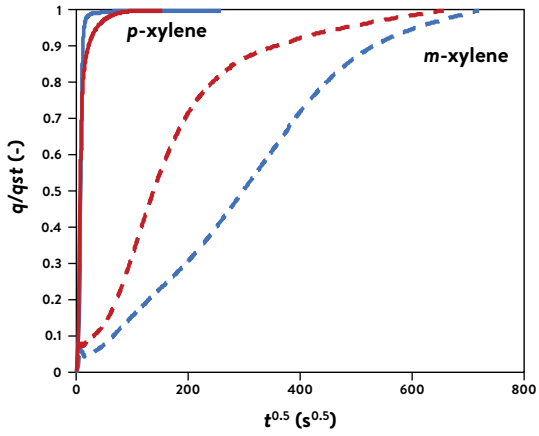


Figure 6: Kinetics of xylene isomer adsorption at 10 mbar and 323 K for pure ZSM-5 (red traces) and silicalite-coated ZSM-5 (blue traces).

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IGA TECHNICAL SPECIFICATIONS

WEIGHT	
Balance capacity	1 g (standard), or 5 g (optional)
Weighing range	0 – 200 mg (standard)
Resolution	0.1 µg (0.2 µg with optional 5 gram balance)
Stability	± 1 µg long term (± 0.1 µg short term)

PRESSURE	
Design pressure	10 bar (standard), or 20 bar (optional)
Typical accuracy	± 0.05 % of range
Transducer ranges (up to 3 per system)	1, 10, 20 bar 2, 10, 100 mbar
Base vacuum	< 10^{-6} mbar
Typical setpoint regulation accuracy	± 0.02 % of range

TEMPERATURE	
Measurement range	77 – 1273 K
Temperature sensors	Platinum Resistance Thermometer (Pt100) or Type-K Thermocouple
Measurement accuracy	± 0.1 K (Pt100) or ± 1 K (Type-K)
Typical setpoint regulation accuracy:	
Recirculating waterbath	± 0.05 K
Furnace options	± 0.1 – 1 K
Linear ramp TGA option	0.05 – 20 K/min programmable
Balance temperature regulation accuracy	± 0.1 K
Anti-condensation protection	50 °C (IGA-002 and IGA-100 models)

MASS SPECTROMETER OPTIONS	
Coupling method	Heated Quartz Inert Capillary (2 m)
Atomic mass range	1–200 AMU standard (1-300 AMU optional)
Detection limit	0.1 to 1 ppm, subject to spectral interference Better than 20 ppb (Triple Mass Filter option)
Detector	Dual Faraday/Electron Multiplier

Please refer to Hiden Isochema product specialists for detailed compatibility and laboratory safety advice.

It is Hiden Isochema's policy to continually improve product performance and therefore specifications are subject to change.

SUPPORT

Hiden Isochema offers unrivalled technical support free of charge, for the lifetime of the instrument.

Telephone and email access to our team of highly qualified engineers with a guaranteed response within 24 hours.

Full 12 month warranty as standard.

A range of service contracts available.

CONTACT US

If you have any questions about the IGA range or any of Hiden Isochema's products or services, please give us a call, we will be happy to help.

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