Quantachrome
INSTRUMENTS

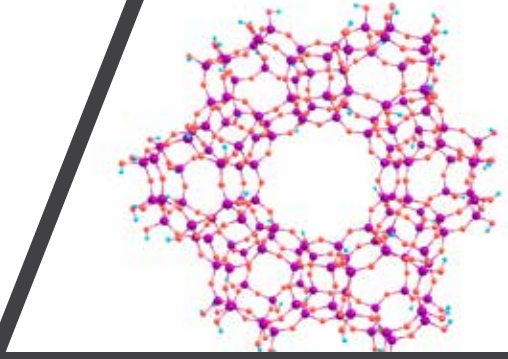
Powder and Porous Solid

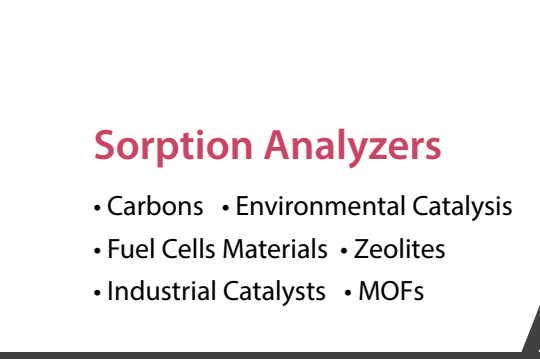
Chemisorption/Reactivity

by Gas, Water Vapor, and Organic Vapor Sorption

Sorption Analyzers

- Carbons
- Environmental Catalysis
- Fuel Cells Materials
- Zeolites
- Industrial Catalysts
- MOFs





AUTOSORB™ iQ-SERIES

The gold standard in gas sorption technology. Advanced chemisorption and physisorption capabilities combined in a single instrument. Includes all capabilities of **Autosorb iQ-MP** model as standard. Fully automated and easily programmable in-situ treatment of sample includes gas switching and heating profiles. User defined automatic protocols combine treatment and analysis for hands-off operation. Strong and weak chemisorption isotherms and temperature programming techniques enable the determination of active or catalyst surface metal area, catalyst dispersion, nanocluster size, hydride formation, spillover phenomena, and more. Detailed calculation and reporting software is provided for comprehensive active surface area and catalyst characterization. Integrated Mass Spectrometer (MS) and thermal conductivity (TCD), temperature programming capabilities (TPD/TPR/TPO), along with subambient operation, vapor sorption, CryoSync™ and calorimeter interface options are available. XR version features a 0.1 torr transducer and ultra-low pressure physisorption capability of the **Autosorb-iQ-MP-XR**.

Visit www.quantachrome.com for more detailed instrument specifications and downloadable brochures.

CHEMBET™- PULSAR™ TPR/TPD

Automated flow chemisorption analyzer designed to enable a wide range of methods of catalyst characterization, including temperature programmed desorption (TPD), oxidation (TPO) and reduction/reaction (TPR/TPX), as well as BET surface area and pulse titration for active surface area, catalyst dispersion and nanocluster size determination by rapid flow and pulse injection techniques. Automatic gas switching, furnace temperature ramping and forced air cooling, and automated titration loop are standard. A optional set of accessories is available for subambient experiments.

CHEMSTAR™ TPx

Quantachome Instruments is thrilled to add the **ChemStar-TPx™** series to its range of chemisorption analyzers! The **ChemStar™** is a fully automated dynamic flow chemisorption analyzer that provides easily programmable functions along with high precision mass flow controllers to carry out built-in gas mixing, calibrated loop injection, vapor introduction, heated components, temperature ramping, fast cooling, and all with minimal operator intervention. The software performs a virtually unlimited number of programmable steps to extract valuable information about surface and catalytic properties of a sample, such as active and reactive surface areas, metal dispersion, nanocluster particle size, acid/base site distribution, and sorption energetics. Its wide analytical flexibility makes the **ChemStar™** the ideal instrument to complement Quantachrome's line of chemisorption analyzers for those seeking the convenience of fully guided and complete automation in a fast, robust and versatile flow sorption analyzer.

Comprehensive Physical-Chemical Assessment of Your Materials

Developing hierarchical zeolites with tailored surface chemistry and pore structure is at the forefront of optimizing fluid catalytic cracking, reforming, and a huge variety of key industrial processes. Physisorption (used to determine micro-meso-macropore size distributions) combined with chemisorption (used to quantify reactive sites) and temperature programming (used to assess the chemical and energetic heterogeneity of surfaces) provides the most powerful approach to characterize zeolites, metal-supported catalysts, and many other solid materials whose performance is ultimately dictated by their physical-chemical properties.

VSTAR™ Series

There is a new star in the Quantachrome lineup of high precision sorption analyzers! The **VSTAR™** vapor sorption analyzer goes beyond water sorption to provide vapor sorption analysis using a wide variety of organic vapors at a wide range of temperatures. Meticulous control of the manifold temperature from the vapor source to the sample eliminates the possibility of local condensation of the adsorptive and ensures the most accurate analysis possible.

The **VSTAR™** measures complete adsorption and desorption isotherms, that is, the quantitative uptake of vapor, as a function of relative pressure / relative humidity at a user selectable, thermostatically controlled temperature. Such measurements are of critical importance to material scientists developing adsorption based technologies for chemical processes, pharmaceutical formulations, structural composites and environmental applications, to name a few.

AQUADYNE™ DVS-1 / DVS -2

The **Aquadyne DVS** is a fully automated, gravimetric, water vapor sorption analyzer. It measures adsorption and desorption isotherms of water vapor both accurately and sensitively with minimal operator involvement. Available with one or two sample balances.

Each balance head on the Aquadyne has an outstanding resolution of ± 0.1 µg for extremely precise and accurate measurements. Furthermore, they can accommodate samples with varying adsorption capabilities thanks to their wide dynamic range, which can be set to ± 500 mg, 0 to 1,000 mg, or anything in between by simply modifying the counterweight. If the samples to be analyzed are of irregular shape or heavier than the allowed maximum for one balance head, the **Aquadyne DVS-2** has the capability of combining both balance heads to share the load of a single sample, effectively doubling its total maximum capacity to 10 g.

iSORB™ HP1 | HP2

Automated single or dual station, high pressure, volumetric gas sorption analyzer. The instrument is capable of performing experiments up to 200 bar at a wide range of temperatures thanks to various thermostating options. It can be equipped with a furnace, a water bath, a Dewar, a cryocooler, etc. The instrument can be used for studies of gas storage properties, hydride formation, heats of adsorption, and more. The **iSorbHP** can also be equipped with a Booster system to ensure constant delivery pressure of gas to the instrument (up to 200 bar), while greatly extending the useful life of the gas tank, resulting in reduced costs and waste of "half-empty" gas cylinders.

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Comparison of Chemisorption/Reactivity Analysis Equipment at a Glance

Instrument Model	Analysis Stations	Built-in Sample Preparation Stations	Standard and Optional Features and Capabilities								
			Micro-porosity	Meso-porosity	Chemi-sorption	Water Sorption	Vapor Sorption	Sorption Kinetics	Gas Storage	Calorimeter interface	Subambient/ CryoCooler
ASiQ-Series	1- to-3 [d]	2- or-4	√	√	√	√	√	√	√ [b]	√	√
ChemBet Pulsar	1	1	--	--	√	--	--	√	--	--	√
ChemStar	1	a	--	--	√	√	√	√	--	--	√
Vstar	1- to-4	a	--	√	--	√	√	√	--	--	√
Aquadyne	1 or 2	a	--	√	--	√	--	√	--	--	√
iSorb- HP	1 or 2	a	√	√	--	--	--	√	√ [c]	--	√

[a] Sample preparation performed in-situ or extenally with transfer isolation value (VSTAR).
[b] Up to ambient pressures.
[c] Up to 100 bar or 200 bar models available.
[d] Chemisorption limited to one station

Catalyst Characterization by Chemisorption and Temperature Programming

Many heterogeneous catalysts are actually a combination of an active phase (normally a zero-valent metal) spread on an inert support (typically a refractory oxide or carbon). Therefore, the total area of the sample does not represent the catalytically active area. The latter is also determined by gas sorption, but adsorption of a reactive gas (at or around room temperature) instead of an inert gas. The gases most commonly used are hydrogen and carbon monoxide, and this technique is known as chemisorption. The ratio of surface metal atoms to the total number of metal atoms in the metal nanoparticles is called dispersion. The better the dispersion the more efficient the use of (expensive) metal.

Chemisorption catalyst characterization using temperature programmed techniques (TPD/TPO/TPR) and pulse titration is a popular means to characterize carbons and redox catalysts. Related temperature programmed (i.e. non-isothermal) methods such as TPR (temperature programmed reduction), TPD (temperature programmed desorption) and TPO (temperature programmed oxidation) are used to determine relative ease of reduction (of oxides), oxidation (of low valency species, particularly carbons) and desorption (of ammonia from acid sites for example). Activation energy for a given chemical process can be inferred, for example, from experiments performed at different heating rates.

Selected International Standards Applicable to Chemisorption Analysis

ASTM D4824-13
Standard Test Method for Determination of Catalyst Acidity by Ammonia Chemisorption.

ASTM D3908-03(2008)
Standard Test Method for Hydrogen Chemisorption on Supported Platinum Catalysts by Volumetric Vacuum Method.

WK17123
New Test Method for Carbon Monoxide Chemisorption on Supported Platinum on Alumina Catalysts using Dynamic Flow Method.

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Serving Porous Materials and Powder Characterization Needs Since 1968