

Powder and Porous Solid

Surface Area

By Gas Sorption



Surface Area

- Carbon •Catalysts •Pharmaceutical •Batteries
- Fuel Cells •Minerals •Metal Powders •Ceramics
- Building Materials •Pigments



AUTOSORB® iQ Series

A complete multi-station sample degassing and analysis instrument. Designed and built around an internal dry, oil-free, turbo-pump high vacuum patented system. Enables easy preparation and analysis of even the most challenging samples without recourse to any external accessories or pumps. Highest vacuum level for degassing is assured by a dedicated and refillable cold-trap. Premium analysis vacuum conditions are attained using metal-to-metal seals and a user selectable option of classical helium or helium-free modes.

Measure very low area samples using krypton gas and high resolution 10 torr transducers on each Kr-capable station, or regular and high surface area materials using nitrogen, argon, and non-corrosive gases on any station, using dedicated 1000 torr transducers. Additional transducers (1 and 0.1 torr) can be supplied, or upgraded, to enable detailed micropore analyses with the most advanced methods available (DFT, GCMC). Fully capable of acquiring high resolution mesopore and micropore size distributions, this analyzer alone could fulfill all your physisorption characterization needs.



AUTOSORB® 6iSA

High throughput and extremely versatile bench-top or floor-standing gas sorption analyzer. Its remarkable versatility is assured by equipping each of its six analysis ports with dedicated measurement transducers, reference cell and coolant flask. Start any number of samples (up to 6) at one time, and reload fresh samples as soon as any one, or more, have finished.

Complete station-to-station independence includes mix-and-match analysis types: analyze BET areas alongside complete mesopore size distributions simultaneously. Its software offers automatic printing of detailed reports and archiving of data. Complemented by a range of sample preparation solutions to suit your specific lab needs, the **Autosorb 6iSA** is ideal for busy labs serving a wide variety of analytical requirements.



QUADRASORB™-evo- MP/Kr

Compact table-top four sample analyze for rapid BET area measurement in batch mode, using nitrogen, argon, krypton, etc., thanks to innovative programming and a built-in turbo-molecular pump. Converts to accommodate fully independent pore size analyses on each station with one click in the user-friendly software, without needing any hardware or other adjustments. Its innovative, time-saving hardware design decouples pressure measurements in the sample cells from reference pressure (P_0) measurements, for each coolant bath, with dedicated P_0 cells, dedicated multi-cell manifold and dedicated pressure transducer.

Available in two-, three-, and four-sample versions to best suit your own budget and analytical needs. Krypton units can also measure micropore size distributions thanks to the very same high vacuum and low pressure capability. Each version is also available without low pressure capability when nitrogen BET and mesopore size measurements are all that you need. Couple it with one of various Degasser models available (see Sample Preparation section) to create your own custom powder and porous material characterization solution.

BET Method for Surface Area Determination

By far the most popular and time-tested method for the determination of the specific surface area of porous solids is that developed in 1938 by Brunauer, Emmett and Teller (BET). The BET theory extends Langmuir's theory to account for multilayer physical adsorption of gases on solid surfaces. Experiments consist of collecting adsorption isotherms of inert gases (N_2 , Ar, Kr, CO_2 , etc.) at low relative pressures. The BET theory provides the number of gas molecules required to form an equivalent monolayer over the sample surface. Multiplying that number by the average cross-sectional area of the molecules yields the BET surface area of the sample. Specific BET surface areas are calculated by dividing the BET area by the weight of the sample following its pretreatment to clean its surface (by removing pre-adsorbed molecules). The BET theory forms the basis of numerous international standardization test methods employed by modern research and quality control laboratories worldwide. Quantachrome instruments also conform to recommendations made by IUPAC (Thommes et al., *Pure Appl. Chem.* **87** (2015) 1051-1069), and provide automated BET range selection assistant routines recommended by ISO for testing microporous materials (ISO9277-2010), and 21 CFR Part 11 regulatory protocols required within the pharmaceutical and allied industries by the US Food and Drug Administration (FDA).



NOVA touch™ Series

High speed and throughput gas sorption analyzer with enhanced features. Its advanced operational features combine with the best of the NOVA pedigree in the **NOVA touch** series. A larger Dewar provides enhanced pore size capability. A dedicated P_O transducer confers the ability to constantly update saturation pressure and still shorten overall analysis times. Programmable ramp-hold heating profiles give the built-in degassers the flexibility to perform customized degassing protocols for the available (flow, vacuum) preparation modes.

The characteristic touch-sensitive screen provides fingertip control of all essential data acquisition, data reduction and optional manual operation functions. Users can start degassing and analysis steps, display log messages and current analysis calculation updates in real time, and review previous runs, and can do so in English or in any one of no less than 10 other languages. Each model is available in 1-to-4 analysis station versions, and includes four built-in degassing ports, along with optional 21 CFR part 11 compatibility. Short versions are also available with shorter sample cells and Dewar to simplify handling and minimize liquid nitrogen consumption. Additional standard features include multiple analysis gas inputs for even more flexibility, ethernet connectivity, and advanced proprietary algorithms designed to minimize analysis times without sacrificing accuracy.

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



NOVA®e Series

High speed and throughput surface area analyzers. The **NOVAe series** encompasses the first commercial, simultaneous multi-sample, table-top, automatic gas sorption analyzer to include degassing. The instrument gave its name to its patented helium-free No Void Analysis method of analysis, which was subsequently incorporated into other analyzers. Designed with upgradability in mind: Start with one or two analysis stations and add more, up to a total of four, using it in classical helium mode or original **NOVA** mode!

Operated either as stand-alone or with PC. Built-in degassing stations mean that you only need to add a vacuum pump and attach nitrogen to have a complete BET area (and mesopore size) analyzer. Just like with our other volumetric analyzers, **NOVAe** units feature minimum-cold-zone technology, multiple P_O modes, multiple gas (argon, carbon dioxide, etc.) capability, and optional **21 CFR part 11** compatibility. Thanks to its small and ergonomic design, quality control, teaching, and R&D labs can all benefit from having one, or more than one, **NOVAe** analyzer on the bench.



MONOSORB™

Rapid, automated single-point BET surface area analyzer based on the dynamic flow technique. Simple and fast: Push a single button to start, and a direct readout of the BET area is displayed in a few minutes. Provides reliable and consistent performance with microprocessor controlled calibration. The Monosorb can be used with many different adsorbates besides nitrogen, including argon, krypton (recommended for low surface area analyses), carbon dioxide, and other non-corrosive gases. Standard features include self-sealing sample holders, motorized Dewar control, degassing temperature selector, and user-selectable flow path to accommodate samples of high surface area. Requiring no vacuum, and including a built-in sample preparation port, this single-point BET area analyzer provides both robustness and convenience that are ideally suited for highly dynamic industrial labs.

Sample Preparation

Consistent and reliable surface area results depend upon proper sample preparation procedures. In terms of BET analysis, the limitation in throughput is often sample preparation. The complete degassing of samples can often require several hours, while surface area measurements may require as little as a few minutes. Quantachrome manufactures several models of degassers to match and fulfill your sample preparation needs. These degassers provide a virtually continuous supply of properly prepared samples for all gas sorption analyzers to supplement the standard built-in degas ports for high throughput labs.

Comparison of Surface Area Analysis Equipment at a Glance

Instrument Model	Analysis Stations	Built-in Degassers	Helium-Free NOVA Option	BET Capable (for standard Areas) ^a	Kr Capable (for very low BET Areas) ^a	Additional Capabilities		
						Meso-porosity	Micro-porosity	Chemisorption
Autosorb-iQ	1- to-3	2- to-4	√	√	√	√	√	√
Autosorb-6iSA	6	--	--	√	--	√	c	--
Quadrascorb evo	2- to-4	--	√	√	√	√	√	--
NOVAtouch	1- to-4	4	√	√	--	√	c	--
NOVAe	1- to-4	2- to-4	√	√	--	√	c	--
Monosorb	1	1	--	√ ^b	√	--	--	--

^a BET= Brunauer-Emmett-Teller method (Brunauer et al., 1938), recommended by IUPAC, ASTM, ISO, etc.

^b By fast Single-Point BET method.

^c By CO₂ adsorption at non-cryogenic temperature and NLDFT/GCMC methods for carbons.

Selected International Standards Applicable to Surface Area Analysis

ASTM B922-10

Standard Test Method for Metal Powder Specific Surface Area by Physical Adsorption.

ASTM C1069-09(2014)

Standard Test Method for Specific Surface Area of Alumina or Quartz by Nitrogen Adsorption.

ASTM C1274-12

Standard Test Method for Advanced Ceramic Specific Surface Area by Physical Adsorption.

ASTM D1993-03(2013)

Standard Test Method for Precipitated Silica-Surface Area by Multipoint BET Nitrogen Adsorption.

ASTM D3663-03(2008)

Standard Test Method for Surface Area of Catalysts and Catalyst Carriers.

ASTM D4567-03(2013)

Standard Test Method for Single-Point Determination of Specific Surface Area of Catalysts and Catalyst Carriers Using Nitrogen Adsorption by Continuous Flow Method.

ASTM D4780-12

Standard Test Method for Determination of Low Surface Area of Catalysts and Catalyst Carriers by Multipoint Krypton Adsorption.

ASTM D5604-96(2012)

Standard Test Methods for Precipitated Silica—Surface Area by Single Point B.E.T. Nitrogen Adsorption.

ASTM D6556-14

Standard Test Method for Carbon Black—Total and External Surface Area by Nitrogen Adsorption.

ISO 9277:2010

Determination of the Specific Surface Area of Solids by Gas Adsorption - BET method.

USP <846>

U.S. Pharmacopeia General Chapter <846> Specific Surface Area.