Quantachrome INSTRUMENTS

autosorb® iQ

Autosorb® iQ-XR version Gas Sorption Analyzer

The top-of-the-line surface area and pore size analyzer, the Autosorb-iQ, is available with a 0.1torr transducer for extended low pressure capability and enhanced resolution to meet the demands of state-of-the-art nanoporous materials research.

The acronym *XR* refers to both Extended Range and Extra Resolution.

By employing a 0.1 torr transducer in place of the standard 1 torr transducer, the low pressure physisorption capability of MP(micropore) and C(chemisorption) models of the Autosorb iQ is extended down by a factor of 10, down to the 10^{-8} P/Po range in their respective *XR* versions. These new models retain the additional 10 and 1000 torr transducers required for higher pressure measurements. The dual sample iQ_2 model is offered with dual 0.1 torr transducers, one for each sample manifold, to maintain its simultaneous measurement capability across all pressure ranges.

The 0.1 torr transducer is internally heated for improved stability and reproducibility. The sensitivity and resolution of the new optional 0.1 torr transducer is ten times that of the standard 1 torr transducer at relative pressures below 1 x 10^{-4} P/Po. This benefits, for example, those researchers working with specially synthesized nano- and microporous materials often only available in very small quantities.

0.1 torr Transducer Specifications	
Wetted Surfaces	Inconel®
Internally thermostatted[1]	45°C
Temperature stability ratio[2]	35
Temperature coefficient(span)	0.005% FS/°C
Accuracy[3]	+/- 0.15% reading
Overpressure limit[4]	45 psia(>23,000 x full scale)
Resolution[5]	1 x 10^{-7} torr
P/Po range used[6]	10^{-8}, 10^{-7}, 10^{-6} , 10^{-5}

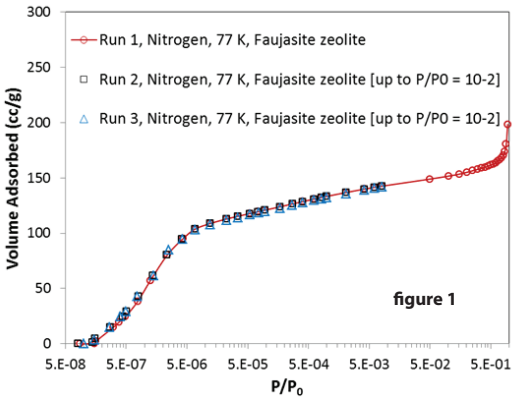

figure 1

The Autosorb iQ-*XR* is able to reproduce even the most challenging nitrogen sorption isotherms as can be seen in figure 1. No extraordinary precautions were taken in order to obtain such high quality data. That is, the sample was outgassed in the normal way, and helium gas was used to obtain free space volumes (cold zone and warm zone). The iQ's metal O-rings and metal sealing gaskets in critical measurement zones have proven to be ideally suited to the challenge of ultra-low pressure measurements.

Furthermore, the quality of data at higher pressures using the 10 torr transducer is not compromised when using the 0.1torr transducer for lower pressures as can be seen in figure 2. Argon adsorption at liquid argon temperature (preferred when analyzing zeolites) is usually done with a 1 torr and 10 torr transducer (plus 1000 torr for higher pressures); the combination of 0.1 torr and 10 torr transducers reproduces perfectly the data from the 1 torr, 10 torr combination.

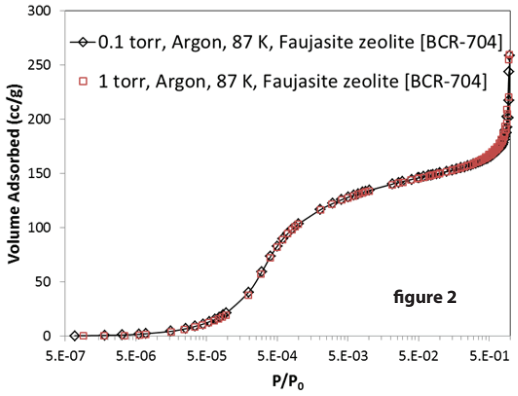

figure 2

Available option on all new iQ's* and as upgrade for existing iQ customers.

* MP + C Models. [1]For increased zero and span stability. [2]A 35°C change in ambient temperature produces less than 1°C change internally. [3]Non-linearity, hysteresis and non-repeatability. [4]Without damage: minimal or no shift in output over entire measurement range. Burst pressure 90psia. [5]Based on 22bit A/D. [6] Refers to Nitrogen adsorption at 77K (LN_2).

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The Autosorb-iQ's associated software (ASiQWin) includes no less than 23 density functional theory (DFT) models for accurate pore size calculations of carbons, zeolites and silicas of different geometries (e.g. slit, cylindrical, spherical plus some combinations thereof) and a variety of adsorbate/temperature combinations.

DFT/GCMC Kernel Files	Application Pore Width Range	Example
NLDFT– N2 carbon equilibrium transition kernel at 77K based on a *slit-pore model.*	0.35 - 40 nm	Activated carbons, activated carbon fibers, novel micro/mesoporous carbons of type CMK-1 etc.
NLDFT- N2 carbon equilibrium transition kernel	0.35 - 40 nm	Novel micro/mesoporous carbons(e.g. CMK-3, carbon nanotubes, carbon aerogels) etc.
NLDFT– N2 carbon equilibrium transition kernel at 77K based on a *slit-pore model* for pore widths < 2nm, and a *cylindrical model* for pore widths > 2nm	0.35 - 40 nm	Novel micro/mesoporous carbons (some CMK's), certain activated carbons.
NLDFT– N2 silica equilibrium transition kernel at 77K based on a *cylindrical pore model.*	0.35 - 100 nm	Siliceous materials, e.g.some types of silica gels, porous glasses, MCM-41, SBA-15, MCM-48 and other adsorbents which show type H1 sorption hysteresis.
NLDFT-N2 silica adsorption branch kernel at 77K based on a *cylindrical pore model* for pores of diameter <5nm, and *spherical pores of diameter* > 5nm.	0.35 - 40 nm	Novel siliceous materials with hierachically ordered pore structure, SBA-16 silica, some types of porous glasses and some types of silica gels.
NLDFT– N2 silica adsorption branch kernel at 77K based on a *cylindrical pore model.*	0.35-100 nm	Siliceous materials such as controlled pore glasses, MCM-41, SBA-15, MCM-48 and others. Produces an accurate pore size distribution even in cases of type H2 sorption hysteresis.
NLDFT–Ar zeolite/silica equilibrium transition kernel at 87K based on a *cylindrical pore model.*	0.35 -100 nm	Zeolites with cylindrical pore channels such as ZSM5, mordenite, and mesoporous siliceous materials e.g., MCM-41, SBA-15, MCM-48, some porous glasses (e.g. CPG) and silica gels which show type H1 sorption hysteresis.
NLDFT – Ar zeolite/silica adsorption branch kernel at 87K based on a cylindrical pore model.	0.35 -100 nm	Zeolites with cylindrical pore channels such as ZSM5, mordenite etc., mesoporous siliceous materials such as MCM-41, SBA-15, MCM-48, porous glasses and some silica gels etc. Produces an accurate pore size distribution even incases of H2 sorption hysteresis.
NLDFT – Ar zeolite/silica equilibrium transition kernel at 87K based on a *spherical pore model* (pore diameter < 2nm) and *cylindrical pore model* (pore diameter > 2 nm).	0.35 - 100 nm	Zeolites with cage-like structures such as faujasite, 13X etc.
NLDFT – Ar zeolite/silica adsorption branch kernel at 87K based on a *spherical pore model* (pore diameter < 2 nm) & *cylindrical pore model* (>2 nm).	0.35 - 100 nm	Zeolites with cage-like structures such as faujasite, 13X etc.
NLDFT Ar carbon equilibrium transition kernel at 87K based on a cylindrical pore model.	0.35 - 40 nm	Novel micro/mesoporous carbons (e.g. CMK-3), carbon nanotubes, carbon aerogels and others.
NLDFT – Ar carbon equilibrium transition kernel at 77K based on a *slit-pore model.*	0.35 - 7 nm	Activated carbons,activated carbon fibers, novel micro/mesoporous carbons of type CMK-1 and others.
NLDFT – Ar carbon equilibrium transition kernel at 87K based on a *slit-pore model.*	0.35 – 40 nm	Activated carbons, activated carbon fibers, novel micro/mesoporous carbons of type CMK-1 and others.
NLDFT - CO2 carbon equilibrium transition kernel at 273K based on a *slit-pore model.*	0.35 - 1.5 nm	Ultra-microporous activated carbons, activated carbon fibers.
QSDFT N2 carbon equilibrium transition kernel at 77K based on a *slit-pore model.*	0.35 - 40 nm	Disordered micro/mesoporous carbons with heterogeneous surface chemistry (eg. activated carbons, activated carbon fibers).
QSDFT Ar carbon equilibrium transition kernel at 87K based on a *slit-pore model.*	0.35 - 40 nm	Disordered micro/mesoporous carbons with heterogeneous surface chemistry (eg. activated carbons, activated carbon fibers).
GCMC-CO2 carbon equilibrium transition kernel at 273K based on a slit-pore model.	0.35 - 1.5 nm	Ultra-microporous activated carbons, activated carbon fibers.
QSDFT – N2 – carbon equilibrium transition kernel at 77 K based on a *cylindrical pore model*	0.5 - 50 nm	Templated (soft and hard templates such as zeolites, or mesoporous molecular sieves), micro/mesoporous carbons with heterogeneous surfaces. Micro/mesoporous activated carbons. Applicable to materials which exhibit reversible pore condensation and type H1 hysteresis
QSDFT – N2 – carbon adsorption branch kernel at 77 K based on a *cylindrical pore model*	0.5 - 50 nm	Templated (e.g. soft and hard templates such as zeolites, or mesoporous molecular sieves) micro/mesoporous carbons with heterogeneous surfaces. Activated carbons with hierarchical pore structure. Allows obtaining an accurate pore size distribution even in case of pore network effects such as pore blocking and cavitation which affect the desorption branch (i.e. materials with type H2 , H3, H4 hysteresis).
QSDFT – N2 – carbon equilibrium transition kernel at 77 K based on a *slit-pore model* (pore diameter < 2 nm) and a *cylindrical pore diameter* (pore diameter > 2 nm)	0.4 - 50 nm	Templated (e.g. soft and hard templates such a mesoporous molecular sieves) micro / mesoporous carbons with heterogeneous surfaces (e.g. some CMKs). Micro/meso-porous activated carbons. Applicable to materials which exhibit reversible pore condensation and type H1 hysteresis
QSDFT – N2 – carbon adsorption branch kernel at 77 K based on a *slit-pore model* (pore diameter < 2 nm) and *cylindrical pore model* (pore diameter > 2 nm)	0.4 - 50 nm	Templated (e.g. soft and hard templates such a mesoporous molecular sieves) micro/meso-porous carbons with heterogeneous surface (e.g.some CMKs). Chemically and physically activated carbons, with hierarchical pore structure. Produces accurate pore size distribution even in case of pore network effects such as pore blocking and cavitation which affect the desorption branch (i.e. materials with type H2 , H3, H4 hysteresis).
QSDFT – N2 – carbon adsorption branch kernel at 77 K based on a *cylindrical pore model* (pore diameter < 5 nm) and *spherical pore model* (pore diameter > 5 nm)	0.5 - 50 nm	Hierarchically structured micro/mesoporous carbons with heterogeneous surfaces and cage-like/spherical mesopore structure (i.e. carbon synthesized by using nanoparticles, colloidal crystals etc. as templates). Produces an accurate pore size distribution even in case of pore network effects such as pore blocking and cavitation which affect the desorption branch (i.e. materials with type H2 or H3 hysteresis).
QSDFT – N2 – carbon adsorption branch kernel at 77 K based on a *slit-pore model* (pore diameter < 2 nm) and a *cylindrical pore model* (pore diameter 2-5 nm) and a *spherical pore model* (pore diameter > 5 nm)	0.4 - 50 nm	Micro/mesoporous carbons with heterogeneous surface chemistry and cage-like/spherical mesopore structure such as hierarchically ordered carbons (i.e. carbon synthesized by using nanoparticles, colloidal crystals etc. as templates). Allows obtaining an accurate pore size distribution even in case of pore network effects such as pore blocking and cavitation which affect the desorption branch (i.e. materials with type H2 or H3 hysteresis).