THE microReport

MICROMERITICS INSTRUMENT CORPORATION VOLUME 23 NO. 1

50 YEARS

In This Issue

CERTIFIED QUALITY MANAGEMENT SYSTEM ISO 9001:2008 DNV

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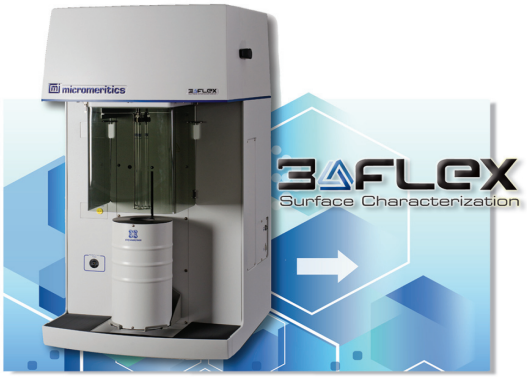
Micromeritics' New 3Flex - Versatile High-Throughput Surface Area, Mesopore, and Micropore Surface Characterization

The **3Flex™ Surface Characterization Analyzer** is a fully automated, three-station instrument capable of high-throughput surface area and pore size analyses with superior accuracy, resolution, and MicroActive™ data reduction. Each analysis station is upgradeable from mesopore to micropore with its own transducers for current or future high-throughput needs. A single 3Flex with its minimal footprint and three configurable analysis stations eliminates costly investment in multiple instruments and additional bench space. The 3Flex provides a remarkable savings on analysis time compared to a single- or two-station instrument. Micropore ports include krypton capability for low surface area materials. Heated vapor analysis capability is standard and an extended-range vapor option is also available.



Capturing the filling of micropores can be a challenge because, at cryogenic temperatures, micropores begin to fill at very low pressures (around 10^{-6} torr). A single dose of gas, such as nitrogen, could completely fill micropores such as those contained in zeolites. A detailed isotherm gives rise to a detailed pore size distribution. The instrument also delivers a reproducible isotherm collection from station to station.

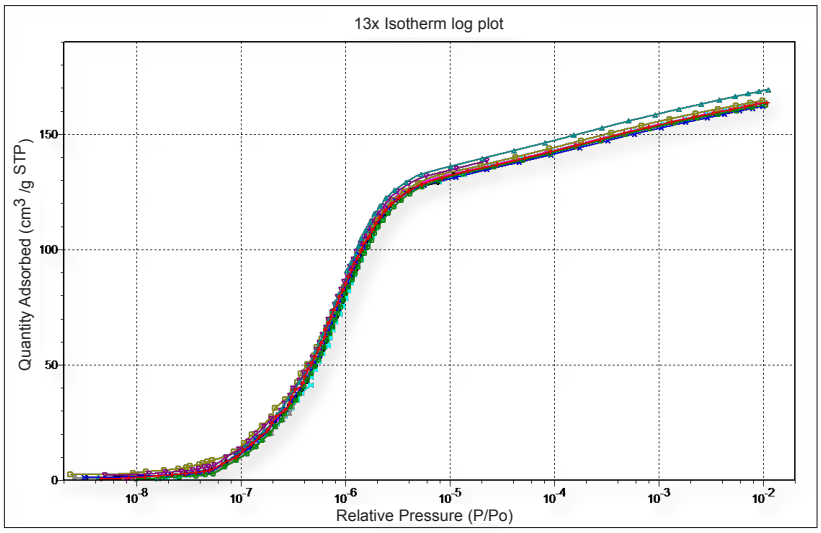


Figure 1. Logarithmic isotherm overlay of 13X zeolite isotherms

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3Flex continued

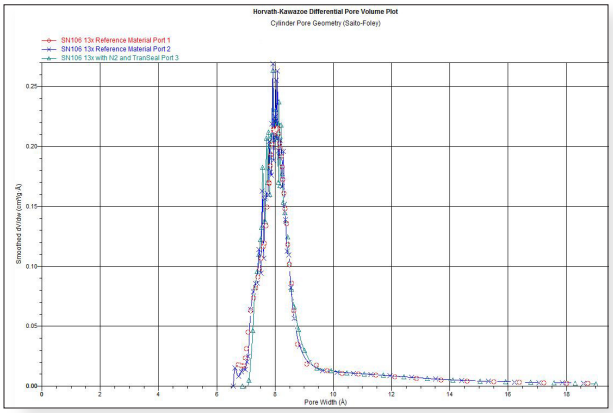


Figure 2. Pore size distribution of three 13X zeolite samples analyzed simultaneously

The 3Flex contains many design features that ensure superior performance and mark a major advancement in surface characterization analyzers. Servo control for dosing and evacuation provides a higher degree of gas management and speeds the collection of data points through reduction of dosing overshoot. Pneumatically actuated, hard seal valves provide ultra-clean instrument operation. Stainless-steel construction, metal seals, manifold, and gaskets eliminate interference from contaminates and outgassing associated with elastomer seals. These chemically resistive surfaces also allow the use of a greater selection of adsorptives. The 3Flex boasts proven isothermal jacket technology and a new dewar design that provide the many hours of continuous temperature control required when running micropore analyses.

The 3Flex also includes enhanced software capabilities, data reduction features, and instrument monitoring. An innovative dashboard monitors and provides convenient access to real-time instrument performance indicators and maintenance scheduling information. The intuitive MicroActive for 3Flex software gives the user the ability to interactively evaluate isotherm data and reduce the time required to obtain surface area and porosity results. It is not necessary to generate reports to view results.

Calculations, such as the BET surface area transform plot, can be easily generated and adjusted. The selection bars allow for a range of data points to be quickly and easily selected. As a result, the summary of values derived from the calculations is instantly updated. Figure 3 demonstrates that either some or the entire isotherm can be used for calculations. Within the calculation window(s), the range of data used can be further refined.

New dosing options added to the pressure table give the user the ability to change the pressure increment, volume dose increment, and equilibration interval time between data points. Figure 4 demonstrates this feature. A detailed isotherm can be collected by specifying that a data point be recorded after a certain amount of gas is dosed, increasing the relative pressure by a small amount, or both.

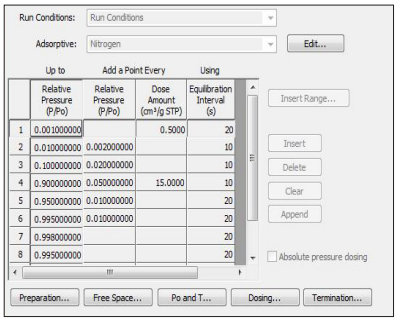


Figure 4: The 3Flex pressure table allows data points to be taken in small increments of pressure, quantity dosed, or both

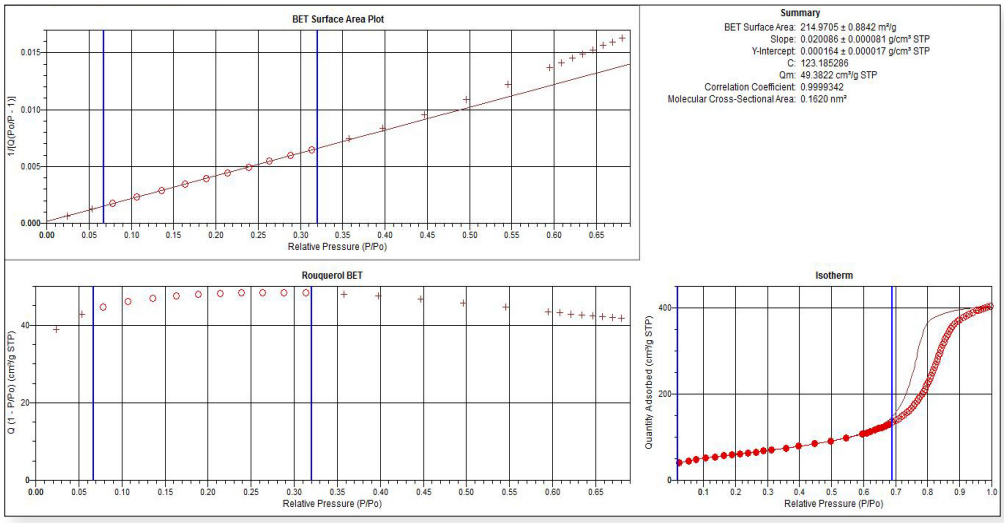


Figure 3. Interactive selection of the BET surface area calculation range

Dosing small amounts of gas during a micropore analysis is very important. Pore size measurement is directly related to the relative pressure at which the pore is filled. Therefore, when lower relative pressures are achieved, smaller sizes of pores can be determined. The 3Flex is capable of collecting data at relative pressures as low as 10^{-9} with N_2 at 77 K with its 0.1-torr pressure transducer coupled with a high-vacuum system.

3Flex continued

Additional software options include the ability to determine free space after analysis. As a result, the sample will not be exposed to helium prior to analysis. In some cases, helium can be retained by the presence of micropores and could mask a portion of the isotherm collected at very low relative pressure. MicroActive for 3Flex software also includes a powerful utility that allows the user to overlay a mercury porosimetry pore size distribution with a pore size distribution calculated from gas adsorption isotherms (Figure 5). This new import function allows users to rapidly view micropore, mesopore, and macropore distributions in one easy-to-use application.

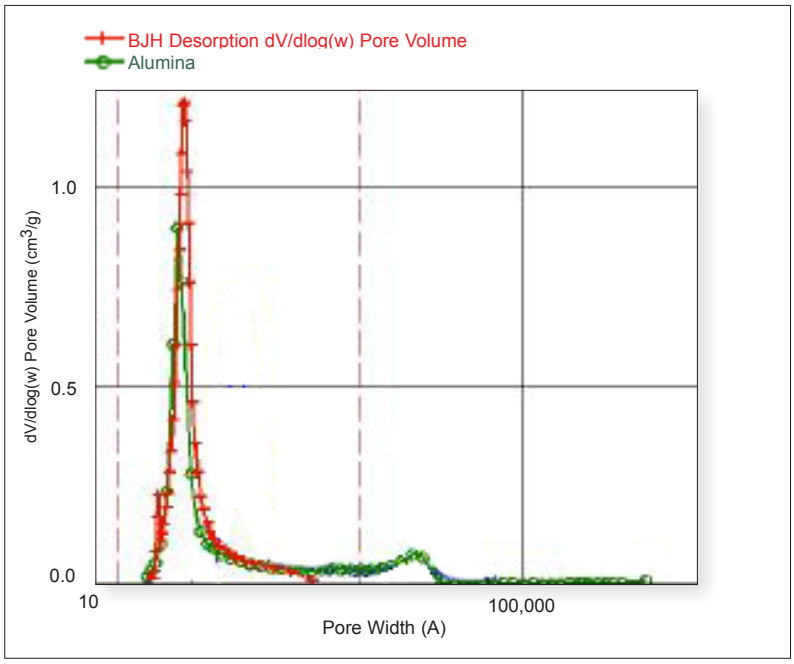


Figure 5. Overlay of BJH desorption and mercury intrusion pore size distributions for alumina pellets

Particulate Systems' NanoPlus™ DLS Nano Particle Size and Zeta Potential Analyzer

The NanoPlus is a unique instrument that utilizes photon correlation spectroscopy and electrophoretic light scattering techniques to determine particle size and zeta potential. The instrument can measure the particle size of samples suspended in liquids in the range of 0.6 nm to 10 µm with sample suspension concentrations from 0.00001% to 40%. This instrument also has the ability to measure the zeta potential of sample suspensions in the -200 mV to +200 mV range with concentrations from 0.001% to 40%. The instrument makes use of Field Focus Technology, providing an excellent solution for measuring samples with high conductivities. The patented FST (Forward Scattering through Transparent electrode) method allows measurements to be carried out on concentrated suspensions.

The NanoPlus is compact and easy to use with an extended analysis range, intuitive software, and multiple sample cells to fit the user's application. The instrument is available in three model configurations: the NanoPlus-1 – nano particle sizing instrument; NanoPlus-2 – zeta potential instrument; and NanoPlus-3 – combination nano particle sizing and zeta potential instrument.

The NanoPlus has an array of compatible sample cells for both zeta potential and nano particle size measurements. Each sample cell provides additional measurement capabilities of samples in liquid suspensions. For example, the

NanoPlus solid sample cell allows the determination of zeta potential on flat surfaces and permits the use of the NanoPlus AT for additive/pH studies.

The optional NanoPlus AT is used to titrate sample suspensions in a pH range from 1 to 13. The instrument automatically controls the pH of these suspensions and conducts titrations during zeta potential or nano particle size analysis measurements.

Micromeritics to Showcase its Extensive Line of Materials Characterization Instruments and Services at Pittcon 2013

Pittcon, a premier annual conference devoted to laboratory science and instrumentation, takes place from March 17 through March 21, 2013, at the Pennsylvania Convention Center in Philadelphia, PA. Micromeritics will be located in three locations at this year's conference and will be displaying a variety of instruments including our new 3Flex Surface Characterization Analyzer in booth **2024**. Micromeritics Particulate Systems Division will highlight its new NanoPlus DLS Nano Particle Size and Zeta Potential Analyzer in booth **1224**. Micromeritics Analytical Services (MAS) and Micromeritics Pharmaceutical Services (MPS) will showcase their wide range of contract materials characterization services in booth **2924.**

Micromeritics (booth 2024) is highlighting its new 3Flex Surface Characterization Analyzer, a fully automated, three-station instrument capable of high-throughput surface area, mesopore, and micropore analyses. Each analysis station is upgradeable from mesopore to micropore with its own set of pressure transducers. A single 3Flex with its minimal footprint and three configurable analysis stations eliminates costly investment in multiple instruments and additional bench space. Micropore stations include krypton capability for low surface area materials. Vapor is standard and an extended-range vapor option is also available. The 3Flex includes Micromeritics' intuitive MicroActive for 3Flex software which gives the user the ability to interactively evaluate isotherm data and reduce the time required to obtain surface area and porosity results.

MicroActive Data Analysis Software is also available for Micromeritics' ASAP®, TriStar®, and Gemini® gas adsorption instruments. Users can easily include or exclude data, fitting models to the desired range of experimentally acquired data points. Interactive data manipulation minimizes the use of dialog boxes to specify calculation parameters, allowing accurate and efficient determination of surface area and porosity. It is not necessary to generate reports to view results.

PITTCON™ CONFERENCE & EXPO 2013 PHILADELPHIA MARCH 17-21

Micromeritics is also showcasing the Saturn DigiSizer® II High-Definition Digital Particle Size Analyzer, a highly advanced tool for those faced with challenging particle size distributions. If process variability is affecting the desired yield, performance, or quality of your product, take control of your process with the Saturn DigiSizer. Superior resolution and sensitivity allows the user to characterize outlier particles not visible to other particle sizing systems. With unique design and data reduction features, this instrument measures particle size in a range of 40 nanometers to 2.5 millimeters with an extremely high level of resolution, reproducibility, repeatability, and sensitivity from unit to unit and site to site.

The TriStar II 3020 Surface Area and Porosity System is an automated, three-station instrument capable of increasing the speed of quality control analyses, with the accuracy, resolution, and data reduction to meet most research requirements. The instrument includes a dedicated saturation pressure port and three analysis ports that operate simultaneously and independently of one another. A krypton option allows surface area measurements in a very low surface area range (below 0.1 m^2/g).

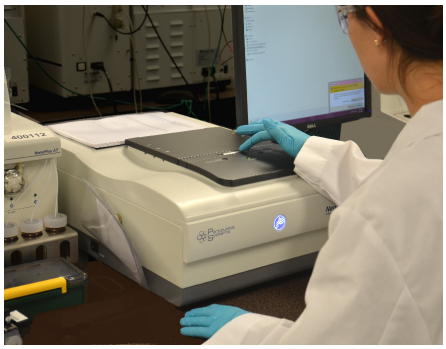
The low-cost Gemini VII Series Surface Area Analyzers utilize a patented reference-sample tube design to produce accurate and repeatable surface area and porosity results. Their low cost, small footprint, speed, accuracy, simplicity of use, reliability, and ruggedness make the Gemini an ideal tool for teaching, research, and quality control environments. The Gemini VII permits low to high surface area measurements without requiring the use of krypton. Three model options are available.

Micromertics' AccuPyc® II 1340 Gas Displacement Pycnometry System is a fast, fully automatic analysis system that provides high-speed, high-precision volume measurements and density calculations. The AccuPyc determines absolute density of powders, solids,

and slurries having volumes from 0.01 to 350 cm^3 with superior accuracy. For those who require high throughput, an integrated control and analysis module can operate up to five additional external analysis modules. Custom-sized modules can be configured to suit unique applications providing even more versatility.

Particulate Systems (booth 1224) offers instruments that are complementary to Micromeritics' core product line. Materials characterization analyses include: nano particle size, zeta potential, particle shape, high-pressure adsorption isotherms, dynamic vapor sorption, activity and selectivity of catalysts, surface energy, segregation testing, and determination of low levels of iron content in a variety of materials.

Micromeritics and Particulate Systems offer six instruments that use a different method of determining particle size distribution of powdered material, including one for characterizing particle shape. Methods include X-ray Monitored Gravity Sedimentation, Static Laser Light Scattering, Dynamic Laser Light Scattering, Electrical Sensing Zone, Air Permeability, and Dynamic Image Analysis. Particulate Systems will exhibit particle size models to include the new NanoPlus DLS.



The NanoPlus Nano Particle Size and Zeta Potential Analyzer utilizes photon correlation spectroscopy and electrophoretic light scattering techniques. Compact and easy to use with an extended analysis range, intuitive software, and multiple sample cells to fit the user's application, the instrument can measure particle size in the range of 0.6 nm to 10 µm with sample suspension concentrations from 0.00001% to 40% and zeta potential of sample suspensions in the -200 mV to +200 mV range with concentrations from 0.001% to 40%. The NanoPlus is available in three model configurations: the NanoPlus-1 – nano particle sizing instrument; NanoPlus-2 – zeta potential instrument; and NanoPlus-3 – combination nano particle sizing and zeta potential instrument.

Particle Insight™ Dynamic Image Analyzer is ideal for applications where the shape, not just the diameter, of raw materials is critical to the performance of the final product. The Particle Insight offers up to 28 different shape parameters analyzed in real-time in either aqueous or organic solvent suspensions. Three size range model options are available: 1 - 150 µm, 3 - 300 µm, and 10 - 800 µm.

The Elzone® II 5390 Particle Size Analyzer determines the size, number, concentration, and mass of a wide variety of organic and inorganic materials. Unlike other measurement techniques, the electrical sensing zone method (Coulter Principle) is capable of accurately sizing samples of varying optical properties, densities, colors, and shapes. The Elzone determines particle size in a range suitable for a wide variety of industrial, biological, and geological specimens down to 0.4 micrometer.

Particulate Systems will also showcase the DVS-Intrinsic. Dynamic vapor sorption, commonly known as DVS, is based on the gravimetric determination of the quantity of vapor adsorbed or desorbed from the sample material. By varying the vapor concentration surrounding a sample and measuring the change in mass it produces, the rate and quantity of solvent adsorbed by a sample can be measured. Surface Measurement Systems, represented by Particulate Systems, offers a wide range of Dynamic Vapor Sorption instruments that utilize dynamic gas flow and the gravimetric technique to produce high-resolution adsorption and desorption isotherms of water and organic vapors on solid materials. Humidity can adversely affect a range of materials to include food, pharmaceuticals, fuel cells, packaging, high-energy materials, polymers, building materials, filtration materials, and personal care products. Knowing how water vapor interacts with these materials can yield vital information for their proper formulation, processing, and storage. The DVS-Intrinsic is an entry level, water vapor instrument for adsorption. It has a small footprint and operates in the 20 to 40 °C temperature range.

Micromeritics Analytical Services (MAS) (booth 2924) and Micromeritics Pharmaceutical Services (MPS) both provide contract sample analyses and consulting services. Featuring products manufactured by Micromeritics, they also offer services outside Micromeritics' current product line. Materials characterization services include: particle size distribution, particle shape, particle count, nano particle size, surface area, micropore analysis, pore volume distribution, total pore volume, density, surface energy, dynamic water vapor sorption, TGA, DSC, active surface area, percent metal dispersion, crystallite size, high-pressure adsorption isotherms, magnetic content, zeta potential, isosteric heat of adsorption, microscopy, method development, method validation, and consulting services.

Micromeritics Pharmaceutical Services (MPS) enables Micromeritics to expand its analytical service capabilities and meet the growing demand for contract services from the pharmaceutical industry. MPS utilizes a DEA-licensed, FDA-registered, cGMP/GLP-compliant contract analytical laboratory and provides a comprehensive service program to provide additional services. These services include API characterization, excipient screening, powder flow properties, batch variability, identification of critical quality attributes, and QbD/PAT implementation.

Carbon Dioxide Characterization of Carbons with the TriStar II 3020

Andrew D. D'Amico and Yundi Jiang
Micromeritics Instrument Corporation

Introduction

The use of carbon dioxide allows for rapid, high-resolution characterization of microporous materials. The Micromeritics TriStar II 3020 can be used to characterize micropores below 10 angstroms within 8 hours using CO_2 as the adsorptive gas and an ice bath (273 K) for the analysis bath. Isotherms from CO_2 adsorption were compared with N_2 adsorption isotherms at 77.3 K. Density functional theory (DFT) models for nitrogen and carbon dioxide on slit-pore carbon were used for the pore-size-distribution calculations.

Slow diffusion (equilibration) rates—on the order of hours to days—may be observed during adsorption at cryogenic temperatures on materials with small pores. Strong adsorption potentials in confined pores result in high uptake of adsorptives, such as nitrogen, which corresponds to the filling of micropores at very low pressures that can challenge the lower sensitivity limits of one-torr pressure transducers. Analysis with carbon dioxide addresses both of these issues by having faster equilibration rates, due to increased temperature, and gas uptake at much higher pressures.

Experimental

Two readily available carbon samples, Carboxen® 1012 from Supelco and a sample of MAST synthetic carbon, were used. A Micromeritics TriStar II 3020 was the principle instrument used for CO_2 analyses up to 760 torr (relative pressure of 0.03). A Micromeritics ASAP 2050 high-pressure sorption analyzer was used to measure CO_2 isotherms up to 7600 torr, and a Micromeritics ASAP 2020 was used to verify micropore sizes using DFT calculations from nitrogen isotherms at 77 K. Bone-dry carbon dioxide, prepurified nitrogen, and ultra-high purity helium were used during the analyses.

Results and Discussion

Figure 1 shows the nitrogen and carbon dioxide isotherms of the Carboxen 1012 and MAST synthetic carbon. Nitrogen adsorption on Carboxen 1012 displays type I isotherm behavior, while the MAST carbon displays type IV isotherm behavior. The trend of enhanced gas uptake by the Carboxen 1012 is observed with the carbon dioxide sorption as well. Mesopores of the MAST carbon and larger micropores, between 10 and 20 angstroms, of the Carboxen 1012 carbon are not shown for clarity.

The resolution of the micropore distributions is shown in Figure 2. When compared to nitrogen physisorption, features of the pore size distribution are captured in much greater detail with DFT calculations from carbon dioxide sorption, and pore filling below 7 Å is observed.

Figure 3 shows the isotherms of carbon dioxide up to 760 torr compared with the measurements up to 7600 torr—demonstrating the agreement of high-pressure and "low-pressure" adsorption.

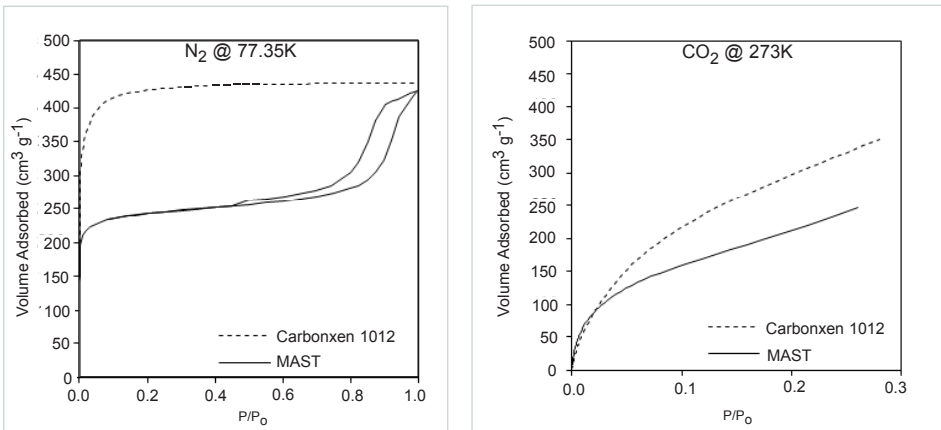


Figure 1. N_2 and CO_2 adsorption isotherms for the Carboxen 1012 and MAST synthetic carbon analyzed in this study.

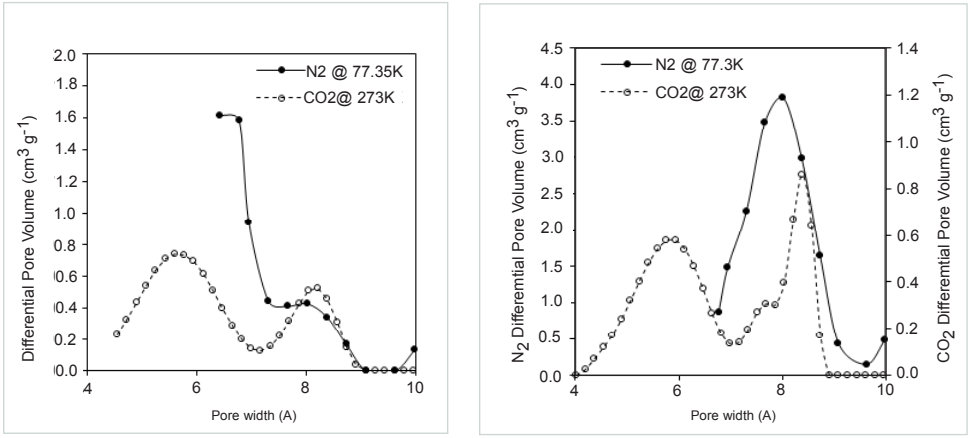


Figure 2. Pore size distribution calculated by N_2 adsorption at 77 K and CO_2 adsorption at 273 K on MAST carbon (left) and Carboxen 1012 (right).

Table 1. Surface areas for CO_2 and N_2 physisorption

	Langmuir (CO_2)	BET (N_2)
Carboxen	1660	1692
MAST	945	940

Table 1 shows the surface area calculations from carbon dioxide sorption compared with calculations from nitrogen sorption. BET surface area calculations were performed below 0.1 relative pressure in order to make the results physically meaningful, a common procedure for microporous materials. The Langmuir surface areas from CO_2 adsorption were calculated over an absolute pressure range of 600-3000 torr. Langmuir surface areas (not shown) from N_2 adsorption, calculated using pressures up to an absolute pressure of 50 torr, agreed within 6% with the nitrogen BET surface areas.

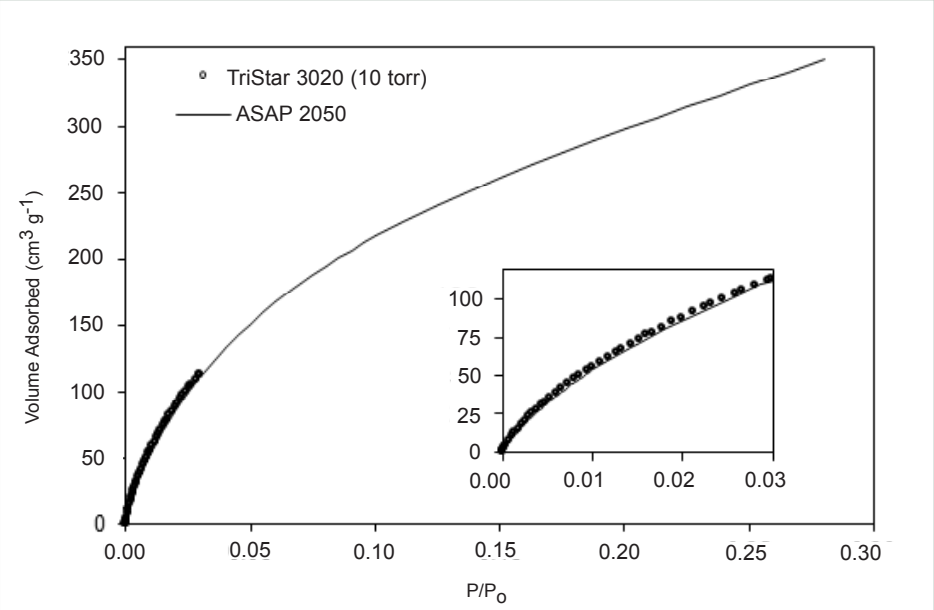


Figure 3. CO_2 adsorption isotherm at 273 K at 760 torr and 7600 torr for Carboxen 1012.

Conclusions

From the data presented, it can be concluded that the TriStar II 3020, as well as other Micromeritics physisorption instruments, can be used to obtain rapid, high-resolution characterization of micropores in carbons. The technique of carbon dioxide physisorption at 273 K can be extended to high pressure, allowing for Langmuir and BET surface areas to be calculated. For the two materials analyzed in this work, the Langmuir surface areas calculated from CO_2 adsorption at 273 K are comparable to BET surface areas calculated from N_2 adsorption at 77.3 K.

Recently Introduced

New Product Family Brochures
for both Micromeritics and Particulate Systems

Link to both by clicking on the images

Particle Characterization Solutions for Appearance and Structure Assessment of Lyophilized Biopharmaceutical Compounds

There is an expanding emphasis in the area of lyophilized products in the pharmaceutical and biopharmaceutical industries. Pharmaceutical companies are increasingly using lyophilization technologies and production processes to produce a final dosage form that has a longer shelf life, enhanced stability, and fewer restrictions on transportation and storage. It has recently been reported that 40% or more of pharmaceutical industry R&D and revenue now involves biopharmaceuticals. Close to 60% of biopharmaceuticals (such as enzymes, proteins, and monoclonal antibodies) must be lyophilized as they are insufficiently stable for ready-to-use solution dosage forms. Micromeritics' TriStar II Surface Area Analyzer, AutoPore® IV Mercury Porosimeter, and AccuPyc II 1340 Gas Displacement Pycnometer are essential tools for determining the integrity of biopharmaceutical lyophilized cake.

The structure of the cake, including density, total pore volume, pore size, and surface area needs to be tightly controlled in production. Any variability in the production process, such as the freeze temperature, primary drying temperature, or secondary drying temperature can impact the physical and chemical properties of the lyophilized cake. The three most commonly used characteristics to release or approve a batch are appearance, thermal properties, and surface area. BET surface area, mercury intrusion porosimetry, and gas pycnometry provide a more quantitative solution to visual inspection of the lyophilized cakes.

BET surface area generated by the gas adsorption analytical technique can be used to determine shrinkage, collapse, and optimal cooling/drying rates as indicators for product performance and manufacturing process optimization.

The inner cake morphology of freeze-dried products can act as a gauge for process conditions such as freezing rate or shelf temperature/pressure settings during the primary and secondary drying phases. It is well documented that physio-chemical activity as well as long-term stability of protein-based pharmaceuticals are directly influenced by ice crystal formation and their contribution to surface area. Surface area data provide important information on structure and reconstitution of the cake by presenting a picture of the morphology of the solid phase.

Mercury intrusion porosimetry can provide information on the internal cake structure. Total pore volume and pore size distribution are directly related to the integrity of the cake and its reconstitution properties. The correlation of pore size to surface area data can quantify the degree of cake shrinkage during freeze-drying and determine the final pore size of the dried cake.

Micromeritics' TriStar II is based on the well-established static gas adsorption technique. It is a fully automated, three-station analyzer capable of increasing the speed and efficiency of quality control analyses with the accuracy, resolution, and data reduction features to meet most production and R&D requirements. The TriStar II can provide BET surface area data that can help predict the effect of freeze-drying variations and enhance process control steps to prevent cake collapse.

Micromeritics' AutoPore IV mercury porosimeter uses mercury intrusion and extrusion to determine total pore volume, pore size distribution, percent porosity, density, and compaction/compression. The instrument collects extremely high-resolution data. It can either be equipped with two low-pressure stations and one high-pressure station or four low-pressure stations and two high-pressure stations for increased sample throughput.

The AccuPyc II is a gas displacement pycnometer that produces high-speed, high-precision volume measurements and density determinations of powders, solids, and slurries. Helium pycnometry is recognized as one of the most reliable techniques for obtaining true density.

MICROMERITICS ANALYTICAL SERVICES The Particle Testing Authority

Application Highlight

www.particletesting.com

Physical Characterization of Shale

Recent economic conditions have led researchers and companies to investigate the possibility of extracting gas and oil from shale reserves in the U.S. and around the world. Shale samples are unique because of the complexity of their porosity and the potential problems associated with cleaning the samples prior to analysis. As is always the case with any sample, the key to properly characterizing shale is thorough cleaning of the material prior to any measurement. This is typically accomplished using a soxhlet extraction procedure prior to testing.

Mercury intrusion porosimetry is commonly used to provide pore size information as well as total pore volume, porosity, and density measurements of shale. The data are used to calculate pore tortuosity, diffusion parameters, and other geological parameters.

BET surface area using the gas adsorption technique is another common test used to characterize shale samples. Surface area is used to predict the amount of free gas stored within pores, the amount of adsorbed gas or dissolved gas on the surface or in pores, and kinetics for rate of gas production.

Gas displacement pycnometers measure the skeletal volume of shale. When combined with other density measurements, skeletal volume can be used to determine porosity of both crushed and intact shale samples.

High pressure gas adsorption isotherms using methane, carbon dioxide, or nitrogen can be used to model kinetic data and determine volume adsorbed at simulated shale depth conditions.

Micromeritics Analytical Services (MAS) offers these sample analyses to the shale gas industry on a contract basis with fast turn-around times and outstanding customer service. Featuring products manufactured by Micromeritics, MAS also provides additional services outside of Micromeritics' current product line. A full list of materials characterization services includes: particle size distribution, particle shape, particle count, nano particle size, surface area, micropore analysis, pore volume distribution, total pore volume, density, surface energy, dynamic water vapor sorption, TGA, DSC, active surface area, percent metal dispersion, crystallite size, high-pressure adsorption isotherms, magnetic content, zeta potential, isosteric heat of adsorption, microscopy, method development, method validation, and consulting services.

News

Greg Thiele, General Manager of MAS, recently presented a technical paper at the US Biochar Conference, titled "Analytical Options for Characterizing Biochar." A copy of this paper is available for download at the link below.
http://www.micromeritics.com/Repository/Files/Analytical_Options_for_Biochar_full_paper_2012.pdf

Events

MAS will be exhibiting at the upcoming **Pittcon,** booth number 2924. Please stop by our booth to learn how we can help you solve your challenging material characterization problems.

MICROMERITICS PHARMACEUTICAL SERVICES

www.micrx.com

Our areas of expertise include particle size distribution analysis (micrometer and nano particles), particle shape and morphology, surface area, surface energy, vapor sorption, porosity, density, thermal analysis, and material flow properties.

Method Development / Validation

- Method Development Services for all analytical tests
- Method Validation Services for all analytical tests
- Method transfer documentation
- Secure Method and Validation storage for future projects

Analytical Services

- Particle Size, Particle Shape (Light Scattering, Dynamic Light Scattering, Electrical Sensing Zone, Dynamic Image Analysis, Microscopy)
- Surface Area (Gas adsorption, BET)
- Density (True, Apparent, Bulk, TAP, Carr index)
- Porosity (Gas Adsorption, Mercury Porosimetry)
- Thermal Analysis (DSC/TGA)
- Dynamic Vapor Sorption (DVS)
- Volumetric Vapor Sorption
- Surface Energy (IGC)
- Surface Energy (Volumetric Gas Adsorption-Density Functional Theory)
- Zeta Potential

MPS is a DEA-licensed, FDA-registered, cGMP/GLP-compliant contract lab service organization

Learning Center

Micromeritics' representatives provide basic start-up training for most instruments during installation. However, when operators wish to maximize their proficiency and broaden their capability with their Micromeritics instrument, more advanced training is needed. To achieve this goal, Micromeritics offers, for most instruments, targeted classes in which customers may expand their ability and improve their understanding by learning from the experts. These classes, periodically held at Micromeritics' headquarters near Atlanta, Georgia, include:

Theory Overview
Learn about the science upon which each instrument is based and how this science applies to successful sample preparation, analysis, and results interpretation.

Detailed Operations
Effective sample file creation, use of analysis parameters, and manual sample entry are all covered. Increase efficiency and learn to use the full power and flexibility of the operating software.

Automatic Analyses
Develop correct analysis procedures to optimize collection of accurate, reproducible data. Much class time is spent performing analyses in a hands-on, interactive environment.

System Utilities
Learn instrument software utilities which help manage sample files and directories, protect data, and select system options.

For additional information or to register for the class of your choice, visit www.micromeritics.com. Early registration is recommended since class space is limited.

Report Optimization
Learn to configure reports and obtain the most useful information, as well as improve report comprehension.

Troubleshooting
Learn techniques to quickly locate and resolve instrument related problems.

User Maintenance
Under the guidance of a Micromeritics Maintenance Specialist, attendees learn routine maintenance and troubleshooting techniques which improve operation, reduce downtime, and increase data accuracy.

Course Enrollment
Training courses last from two to four days and are designed to provide hands-on, performance-based instrument skills and knowledge. Small classes allow individual instruction and peer interaction. Course materials include a Study Guide, a complimentary copy of *Analytical Methods in Fine Particle Technology*, relevant application notes, and a wealth of other educational material. A Certificate of Completion is awarded to each trainee.

Advanced Training
Offered as one-to-two day sessions that can be taken as a stand-alone course or in conjunction with a relevant instrument training course, these courses are excellent options for those looking to achieve a greater depth of understanding in the analytical capability of their Micromeritics instrument and theory of materials characterization. Advanced courses are conducted by a member of Micromeritics' Scientific Services staff and contain a thorough examination of each topic in a classroom environment. While there are no prerequisites, attendees should either have a basic understanding of their instrument and its daily operation, or take the standard instrument training course prior to the advanced course.

Students attending a recent Training Course

Training Courses April - August 2013

ASAP 2020
Physi and Chemi
April 8 - 11

Advanced Course:
Textural Characterization of Porous Materials using NLDFT
April 12

Saturn DigiSizer II
June 4 - 6

Advanced Course:
Using Shape and Size to Characterize Particle Morphology
June 7

3Flex
July 16 - 18

AutoChem II
August 5 - 7

Advanced Course:
Characterization of Supported Heterogeneous Catalysts by Temperature-Programmed Surface Reactions
August 8 - 9

TriStar II
August 20 - 22

Upcoming Events

Pittcon 2013
3/17/2013 - 3/21/2013
Pennsylvania Convention Center
Philadelphia, PA

ACS 2013
4/07/2013 - 4/11/2013
Morial Convention Center
New Orleans, LA

MIC / KIT Workshop
4/16/2013 - 4/17/2013
Stadthalle Frickenhausen
Hotel Meintzinger
Frickenhausen, Germany

Analytica Vietnam
4/17/2013 - 4/19/2013
Saigon Exhibition Center
Ho Chi Minh City, Vietnam

Advanced Porous Materials Workshop 2013
4/18/2013 - 4/19/2013
National Institute of Chemistry,
Ljubliana, Slovenia

Interphex 2013
4/23/2013 - 4/25/2013
Javits Center
New York, NY

POWTECH 2013
4/23/2013 - 4/25/2013
Exhibition Centre Nuremberg
Nuremberg, Germany

IMMS 2013
5/20/2013 - 5/24/2013
Awaji Yumebutai International
Convention Center
Awaji Island, Hyogo, Japan

Forum Labo Biotech
6/04/2013 - 6/07/2013
Porte de Versailles
Paris, France

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Attention Authors

We welcome articles and information concerning particle technology applications performed with Micromeritics instrumentation. Everything from a single plot with operating conditions to an in-depth article on physisorption, chemisorption, etc. with supporting graphs will be considered. If your material is published in The microReport, you will receive a copy of Analytical Methods in Fine Particle Technology by Paul A. Webb and Clyde Orr.

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