

mi M I C R O M E R I T I C S

TriStar II Series

Surface Area and Porosity Analyzers



TriStar II Plus

www.micromeritics.com

TriStar II Surface Area and Porosity Analyzer

Analytical Versatility/ High Throughput/ Small Footprint

Surface area and porosity are important physical properties that influence the quality and utility of many materials and products. Therefore it is critically important that these characteristics be accurately determined and controlled. Likewise, knowledge of surface area and especially porosity often is an important key to understanding the formation, structure, and potential application of many natural materials.

High Sample Throughput/ Analytical Versatility

The TriStar II is a fully automated, three-station, surface area and porosity analyzer that delivers high-quality data at an affordable price. It is capable of increasing the speed and efficiency of routine quality control analyses, yet has the accuracy, resolution, and data reduction capability to meet most research requirements. The TriStar II also features a Krypton Option, allowing measurements in a very low surface area range. The instrument combines versatility in analysis methods and data reduction to allow the user to optimize analyses to specific applications.

A Small Footprint Packed with Features

- Three analysis ports can operate simultaneously and independently of one another. Three BET surface area measurements can be performed in less than 20 minutes. For additional throughput, four TriStars can be operated with one computer
- Surface areas as low as $0.01 \text{ m}^2/\text{g}$ can be measured with the standard nitrogen system. The TriStar II accommodates the use of argon, carbon dioxide, and other non-corrosive gases such as butane, methane, or other light hydrocarbons. A Krypton Option can extend surface area measurements to as low as $0.001 \text{ m}^2/\text{g}$
- A dedicated P_0 port is standard, allowing the measurement of saturation pressure on a continuous basis. Saturation pressure can be entered manually, measured continuously, or collected over the sample. The TriStar II provides the flexibility to control and fine-tune analysis speed and accuracy
- Incremental or fixed dosing routines prevent overshooting pressure points while minimizing analysis time
- Free space can be measured, calculated, or manually entered providing maximum flexibility in accommodating special sample types and emphasizing speed when needed. Helium is not required
- Enhanced product support features include: video clips; Ethernet communication between the computer and TriStar; bar code reader capability; diagnostic software; ability to perform remote diagnostics via the internet; and the ability to read and compare historical TriStar data to TriStar II data
- A 2.75-liter dewar and extended length sample tubes allow complete adsorption and desorption isotherms to be collected without operator intervention
- The TriStar II can collect up to 1000 data points. Fine details of the isotherm can be observed and recorded providing high resolution and revealing pore structure details
- Intuitive and powerful Windows®-based software allows more versatility in data archiving and networking. However, the most powerful features of this software are found in its expanded range of data reduction and reporting. SPC reports, isotherm and thickness models, isosteric heat of adsorption, and integrated DFT models are included
- Optional sample preparation devices are available combining flowing gas and/or vacuum with heat to remove atmospheric contaminants, such as water vapor and adsorbed gas, from the surface and pores of the sample
- An attractively designed cabinet combines a small footprint with easy accessibility



TriStar II



TriStar II

Operating Software

The TriStar II Windows interface provides a familiar environment for the user. It is easy to collect, organize, archive, reduce isotherm data, and store standardized sample information for later use. The reports may be generated to screen, paper, or spreadsheet file. Cut-and-paste graphics, scalable and editable graphs, and customized reports are easily generated.

In addition to controlling instrument operation, the Windows software also reduces the isotherm data collected during analysis. The reduced data can be reviewed or printed in a variety of easy-to-interpret tabular and graphical reports.



Tabular and Graphical Reports:

- Single and multipoint BET surface area
- Total pore volume
- Langmuir surface area and Isotherm reports
- t-Plot
 - Harkins and Jura Thickness Equation
 - Halsey Thickness Equation
 - Carbon STSA
 - Broekhoff-de Boer
 - Kruk-Jaroniec-Sayari
- BJH adsorption and desorption
 - Standard
 - Kruk-Jaroniec-Sayari correction
- Dollimore-Heal adsorption and desorption
- Mesopore
 - Volume and area distributions by pore size
- MP-Method
- HK
- Saito-Foley
- Chang-Yang
- DFT pore size
- DFT surface energy
- Summary Report
- SPC reports
- Validation reports



TriStar II Plus Surface Area and Porosity Analyzer

Micromeritics' TriStar II Plus is a state-of-the-art instrument suited for use in both quality control and research environments. Intended for laboratories that require high throughput and the highest quality data, it contains all the capabilities of the TriStar II with additional hardware and software features.

Advanced Hardware and Software Features

- The unique stainless steel analysis manifold is corrosive resistant and designed for highly-accurate gas management
- Improved dewar design provides more than 40 hours of continuous temperature control
- Available in a krypton capable model for the analysis of very low surface area materials
- Intuitive MicroActive software gives the user the ability to interactively evaluate isotherm data and reduces the time required to obtain surface area and porosity results
- User-defined reporting options allow direct modeling
- Powerful Python scripting language allows users to develop extensions to the standard report library available within the TriStar II Plus software application
- An innovative dashboard monitors and provides convenient access to real-time instrument performance indicators and maintenance scheduling information
- Capable of utilizing two isotherms (CO₂ and N₂) for calculating pore size diameter via NLDT for micropore analyses of carbons

Data Reduction Benefits

- Interaction with adsorption data is direct. By simply moving the calculation bars, the user is immediately updated with new textual properties. One-click access to important parameters allows the user to focus on the result rather than the parameters
- Interactive data manipulation minimizes the use of dialog boxes and tunneling of dialogs to specify calculation parameters. This allows the user to accurately and efficiently determine surface area and porosity of their materials
- Improved ability to overlay files (up to 25) including mercury intrusion data with a file add and subtract feature
- User selectable data ranges through the graphic interface allows direct modeling for BET, t-Plot, Langmuir, DFT interpretation, and much more
- Report Options editor allows the user to define up to five reports with on-screen previews. Each report has the ability to possess multiple summary, tabular, and graphical information panes

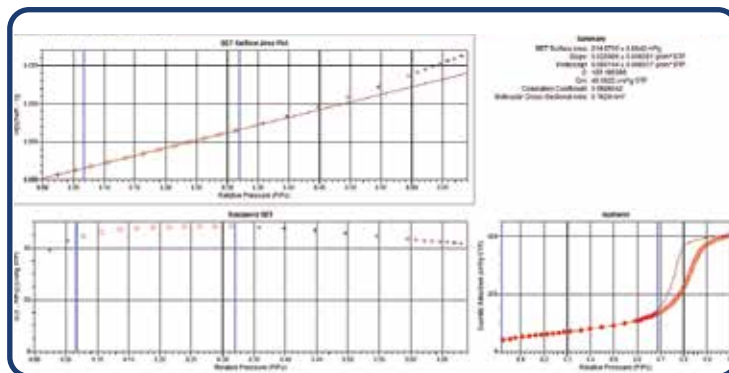


TriStar II Plus

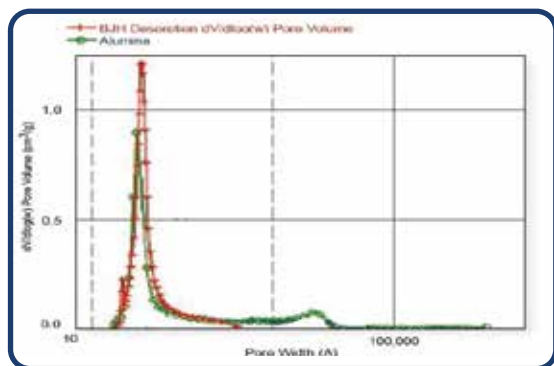
Enhanced Software Capabilities, Data Reduction Features, and Instrument Monitoring

MicroActive for TriStar II Plus Software

The intuitive MicroActive for TriStar II Plus 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. Within the calculation window(s), the range of data used can be further refined.



Interactive selection of the BET surface area calculation range



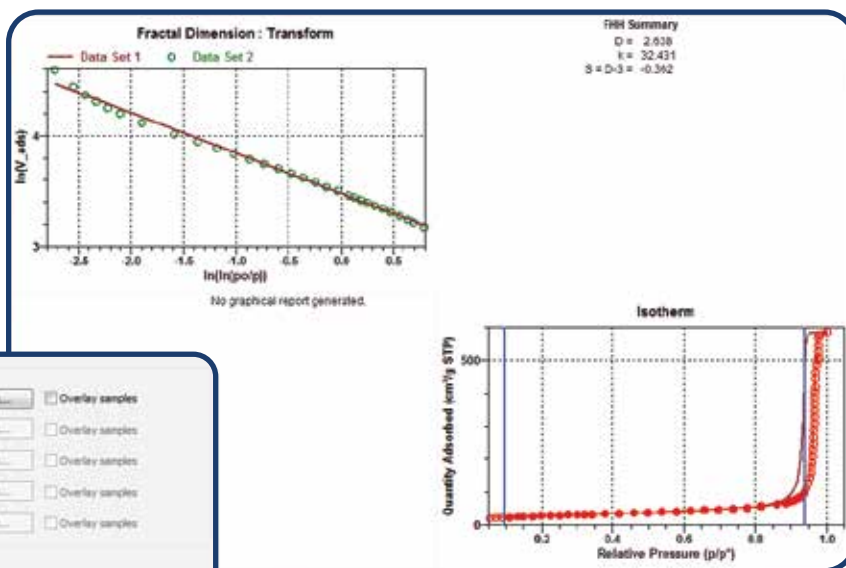
Overlay of BJH desorption and mercury intrusion log differential pore size distributions for alumina pellets

Gas Adsorption and Mercury Intrusion Overlay Capability

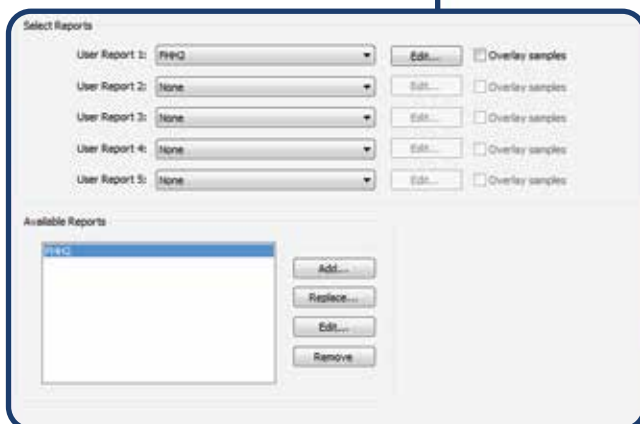
MicroActive for the TriStar II Plus software also includes a powerful utility that allows the user to overlay a mercury porosimetry pore size distribution with a pore size distribution calculated from gas adsorption isotherms. This new import function allows users to rapidly view micropore, mesopore, and macropore distributions in one easy-to-use application.

Python Programming Language Included

The Python programming language has been incorporated into the TriStar II Plus software. This powerful scripting language allows users to develop extensions to the standard report library available within the TriStar II Plus application.

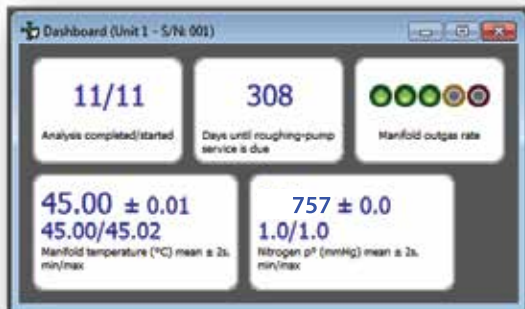


New isotherm models or calculations are easily added to the report system. The Python interface to MicroActive allows users to customize their reports and extend the utility of MicroActive.





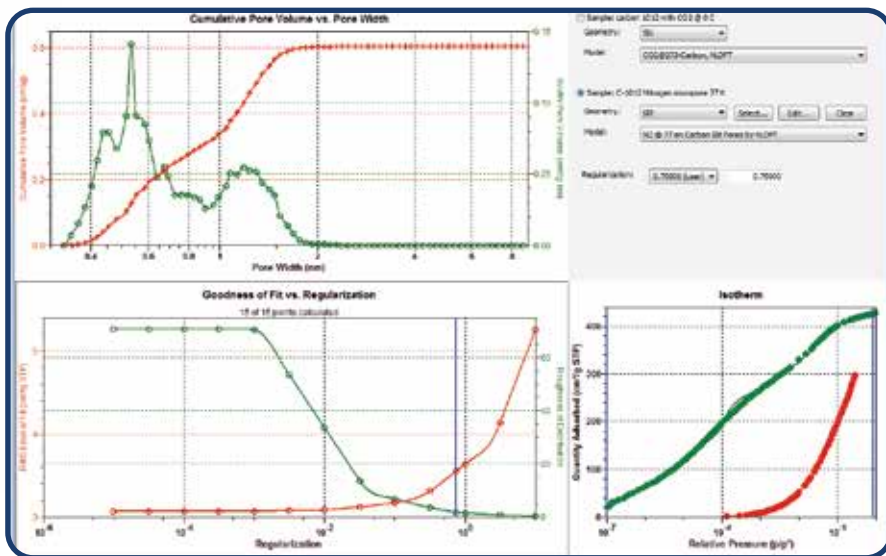
TriStar II Plus



With a single click, the TriStar II Plus provides a powerful suite of information that allows the user to maintain the instrument in peak operating condition with real-time analysis views.

Dual DFT

The Dual DFT NLDFT model allows the user to combine the information gathered from nitrogen and carbon dioxide isotherms to deliver a full pore size distribution on materials (such as carbon slit pores) where pores of molecular sizes are present. The range of pore size analysis in this method is extended to smaller pore sizes compared to the standard nitrogen analysis. This is due to the fact that CO₂ can access some very small micropores that are not accessible to N₂ at cryogenic temperatures due to size restrictions, connectivity problems, or extremely slow diffusion.



This advanced NLDFT method allows users to determine the pore size distribution of their sample using two isotherms. In this example CO₂ adsorption (red) at 273 K and nitrogen adsorption (green) at 77 K are used to calculate a single pore size distribution. Users do not have to cut and paste distributions from CO₂ and nitrogen - a single distribution is determined using both isotherms.



External Sample Preparation Devices



Micromeritics' sample preparation devices prepare batches of samples for surface area and pore volume analysis. They combine flowing gas and/or vacuum with heat to remove atmospheric contaminants, such as water vapor and adsorbed gas, from the surface and pores of the sample. The quality of the data produced by surface area and pore volume analyses depends greatly on the cleanliness of the sample surface. All Micromeritics' sample preparation devices accept helium, nitrogen, argon, and other non-corrosive gases.

The FlowPrep™ 060 applies both heat and a stream of inert gas to the sample for removal of adsorbed contaminants from the surface and pores. With six degassing stations, this sample preparation unit lets you choose the temperature, gas, and flow rate best suited for your sample material and application. Needle valves allow the user to introduce the flowing gas slowly to prevent fluidization of samples.

The VacPrep™ 061 offers two methods for removing adsorbed contaminants. In addition to flowing gas, this sample preparation unit provides vacuum to prepare samples by heating and evacuation. The VacPrep offers the user a choice of vacuum or gas flow on each of the six degassing stations. Needle valves allow the user to introduce the flowing gas or vacuum slowly to prevent fluidization of samples.

The SmartPrep™ 065 applies a stream of flowing gas over the sample at elevated temperatures to remove adsorbed contaminants. Temperature, ramp rates, and soak times of each sample are individually controlled on the six degassing stations by a computer. This sample preparation unit contains two serial ports, one for connecting to the computer and the other for connection to an additional SmartPrep. Up to five ramps and soaks are allowed. All degas information is integrated into the sample data file for future reference.

Model 021 LN₂ Transfer System

Micromeritics' Model 021 LN₂ Transfer System is useful for any number of tasks where frequent needs arise for relatively small volumes of liquid nitrogen or argon. The LN₂ Transfer System makes it easy to fill dewars with liquid cryogen for laboratory or general purposes. The system includes a large storage dewar with a 47-liter capacity that can hold liquid nitrogen or argon up to 30 days allowing convenient and cost-efficient use of your cryogen.

The 021 LN₂ Transfer System operates at ambient pressure and replaces typical cryogen storage vessels which are pressurized to force the cryogen through the discharge line. With Micromeritics' system, cryogen is transferred by a centrifugal pump. Flow starts and stops immediately when the pump is turned on or off. The discharge rate is continuously adjustable to a maximum flow of 3 L/min. The discharge line is insulated to prevent frosting and icing during use, and flexible to allow easy positioning for discharge into almost any type of receiving vessel. The system includes a mobile platform which easily rolls from location to location.

Additional accessories are available for special applications.



LN₂ Transfer System

To request a quote or additional product information, visit Micromeritics web site at www.micromeritics.com, contact your local Micromeritics sales representative or our Customer Service Department at (770) 662-3636

Applications



Pharmaceuticals - Surface area and porosity play major roles in the purification, processing, blending, tableting, and packaging of pharmaceutical products as well as their useful shelf life, dissolution rate, and bioavailability.

Ceramics - Surface area and porosity affect the curing and bonding of greenware and influence strength, texture, appearance, and density of finished goods. The surface area of glazes and glass frits affects shrinkage, crazing, and crawling.

Adsorbents - Knowledge of surface area, total pore volume, and pore size distribution is important for quality control of industrial adsorbents and in the development of separation processes. Surface area and porosity characteristics affect the selectivity of an adsorbent.

Activated Carbons - Surface area and porosity must be optimized within narrow ranges to accomplish gasoline vapor recovery in automobiles, solvent recovery in painting operations, or pollution controls in wastewater management.

Carbon Black - The wear lifetime, traction, and performance of tires are related to the surface area of carbon blacks used in their production.

Catalyst - The active surface area and pore structure of catalysts influence production rates. Limiting the pore size allows only molecules of desired sizes to enter and exit, creating a selective catalyst that will produce primarily the desired product.

Paints and Coatings - The surface area of a pigment or filler influences the gloss, texture, color, color saturation, brightness, solids content, and film adhesion properties. The porosity of a print media coating is important in offset printing where it affects blistering, ink receptivity, and ink holdout.

Projectile Propellant - The burn rate of propellants is a function of surface area. Too high a rate can be dangerous; too low a rate can cause malfunction and inaccuracy.

Medical Implants - Controlling the porosity of artificial bone allows it to imitate real bone that the body will accept and allow tissue to be grown around it.

Electronics - By selecting high surface area material with carefully designed pore networks, manufacturers of super-capacitors can minimize the use of costly raw materials while providing more exposed surface area for storage of charge.

Cosmetics - Surface area is often used by cosmetic manufacturers as a predictor of particle size when agglomeration tendencies of the fine powders make analysis with a particle-sizing instrument difficult.

Aerospace - Surface area and porosity of heat shields and insulating materials affect weight and function.

Geoscience - Porosity is important in groundwater hydrology and petroleum exploration because it relates to the quantity of fluid that a structure can contain as well as how much effort will be required to extract it.

Nanotubes - Nanotube surface area and microporosity are used to predict the capacity of a material to store hydrogen.

Fuel Cells - Fuel cell electrodes require high surface area with controlled porosity to produce optimum power density.



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