THE PMI BET SORPTOMETER
BET-201AEL-2OSEL

Porous Materials, Inc.

Not just products...solutions!

Description

PMI's BET-Sorptometer is fully automated, volumetric gas sorption analyzer to measure accurately adsorption and desorption isotherms for the characterization of surface area, pore size distribution, pore volume and pore structure of micro and mesoporous materials.

Applications

PMI's BET Sorptometer has a multitude of applications in industries worldwide. Some applicable industries include Rubber, Automotive, Chemical, Ceramic, Paper, Battery Separator, Fuel Cells, Filtration, Pharmaceuticals, and Powder Metallurgy.

Principle

When clean surface is exposed to a gas, an adsorbed film forms on the surface. Adsorbed films also form on the surface of pores within a material and vapor can condense in the pores. At a constant temperature, the amount of adsorbed/condensed gas on a surface depends on the pressure of the gas. Measurement of the amount of adsorption/condensation as a function of pressure can give information on the pore structure. The PMI Sorptometers use gas adsorption/condensation to analyze pore characteristics.

Physical Adsorption

Weak van der Waal's type interaction of molecules with a pore surface leads to physical adsorption. The Brunauer, Emmett and Teller (BET) theory of physical adsorption is normally used for analysis of adsorption data to compute surface area.

$$\frac{P}{W(P_0-P)} = \frac{1}{CW_m}\frac{C-1}{CW_m}\frac{P}{P_0}$$

Where:
W = amount of adsorbed gas
W_m = amount of gas adsorbed in a monolayer
P = gas pressure
P_0= equilibrium (saturation) vapor pressure at the test temperature
C = dimensionless constant that depends on the temperature and the gas/solid system

When vapor pressure, P is low compared with P_0 ($0.05 < P/P_0 < 0.3$), the plot of $[P/W (P_0 – P)]$ verses $[P/P_0]$ is linear and the plot yields the magnitudes of C and W_m. The surface area S per unit mass, m, of the sample is computed using the cross-sectional area of the adsorbed gas molecule:

$$S = \frac{W_m N_o a}{m}$$

Where:
N_0 = Avogadro's number
a = cross – sectional area of the adsorbed gas molecule
W_m = amount of gas adsorbed in moles

Vapor Condensation

As the relative vapor pressure (P/Po) increases, vapor eventually condenses in the pores utilizing the surface free energy available due to replacement of the solid/vapor interface by solid/liquid interface. The amount of vapor condensed in pores gives the pore volume, and the Kelvin equation gives the pore diameter.

$$\ln\left(\frac{P}{P_0}\right) = -\frac{4\gamma V \cos\theta}{DRT}$$

Where:

g = surface tension of condensed liquid
V= molar volume of condensed liquid
q = contact angle
D = pore diameter
R = gas constant
T = absolute test temperature

Adsorbed layers of molecules form on the pore walls before condensation fills the pores. Therefore the actual pore diameters are computed by adding two times the thickness of the adsorbed gas layer to D.

A complete adsorption isotherm is determined by measuring the amount of vapor adsorbed as a function of increasing pressure. A desorption isotherm is determined by measuring the amount of adsorption as a function of decreasing pressure. Based on this technique, characteristics of materials related to adsorption, desorption, surface area and pore volume can be determined.

Pore Volume & Pore Diameter

Pore volume, pore diameter and pore volume distribution can be determined accurately by the PMI BET Sorptometer. The distribution function is such that area under the function in any pore diameter range is the volume of pore in that range.

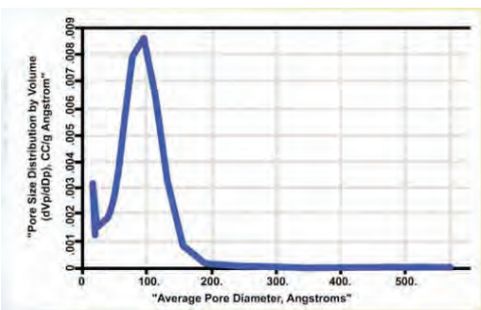

Figure 3
Pore Volume Distribution

Adsorption & Desorption Isoterms

Adsorption and desorption of gasses on samples can be accurately measured using our BET Sorptometer. The user has independent control over the quantity and spacing of pressures used in both adsorption and desorption testing. Many different kinds of analyses are available to interpret data using the supplied report generation software.

Chemisorption

Adsorption and desorption of gasses on samples can be accurately measured using our BET Sorptometer. The user has independent control over the quantity and spacing of pressures used in both adsorption and desorption testing. Many different kinds of analyses are available to interpret data using the supplied report generation software.

Specifications

- **Surface Area Range :** *0.0005 sq.m/gm to no known upper limit*
- **Temperature Range :** *Ambient to 400^{0}C*
- **Temperature selection :** *0.8 - 1 deg.C increment*
- **Ultimate Vacuum :** *10^{-10} torr achieved by dedicated turbomolecular pump*
- **Degas Monitor :** *0 to 1000 torr (Thermocouple Vacuum Range)*
- **Transducer Accuracy :** *0.15% of reading (0.1 torr, 10 torr and 1000 torr)*
- **Transducer linearity :** *0.20% of reading (0.10 torr)*
- **Sensitivity :** *< 1x 10^{-8} moles absorbed/ desorbed gas*
- **Ultimate Vacuum :** *10^{-10} torr achieved by dedicated turbo molecular pump.*
- **Power supply for the instrument :** *220 ± 20 VAC / 50 Hz*

Features

- *2 degassing ports each with access to turbo-pump level vacuum through a dedicated cold trap to ensure best possible reparation vacuum levels.*
- *Both degassing ports are equipped with dual-thermocouple eating mantles for over-temperature protectionheating mantle, independent digital temperature, controller and display.*
- *System has one analysis port with three pressure transducers (0.1 torr , 10 torr and 1000 torr) with accuracy of pressure transducer 0.15 % for 10 torr and 1000 torr and 0.2% for 0.1 torr. Simultaneous analysis of two samples must be available as an upgradation option.*
- **Analysis Station consisting of :** *Sample Cell (6mm, 8mm, 10mm-12mm) - l, each P_0 Cell, Sample Pressure Transducers, Thermistor coolant level sensor.*
- *Sample station is equipped with a pressure transducer set comprising 0.1torr, 10torr and 1000 torr to monitor sorption behavior and equilibrium pressures*
- **P0 Station :** *The instrument has separate port for continuous update of standard equilibrium vapour pressure.*
- *Dewar flask (isothermal jackets) maintain cryogen level on sample tube allowing over 70 hours continuous analysis*
- *Cryogenic coolant level is controlled to minimize cold free space, for enhanced sensitivity.*
- *The analysis station is served by a turbo-pump backed by a dry diaphragm pump to ensure oil-free analysis conditions.*
- *Adsorption kinetics with multi analysis of same sample.*
- *The unit shall be available with 6 nos. gas input port which may be upgradeable to up to twelve gas input ports (inaddition to helium and backfill gas) for use with physisorptionmeasurements to eliminate connecting/disconnecting gases for demanding applications and/or multi-user environments.*
- *The instrument should have option to upgrade into Chemisorption and integrated TCD (TPR/TPO/TPD) unit and 2nd. Analysis port (meso pore and micro pore facility).*
- *The system should have facility to perform vapor adsorption for vapors like water, alcohol, benzene, etc. Manifold should have heating arrangement by internal heater.*
- *Customized degassing (sample preparation) protocols may be stored in user files for later recall and degas file ID is identified within analysis reports.*

Computer & Printer

- *Branded PC (CPU with Intel Core i5, 2.50 GHz, OS Windows 7/XP (32 or 64 bit)-compatible with instrument operational software, HDD 500 GB, 4 GB DDR3-SDRAM, DVD-RW optical drive, 17" LED Flat Panel Monitor, appropriate number and types of ports such as USB2 for instrument operation, LAN.*
- *Colored laser jet printer (HP) 1025 or equivalent*
- *UPS for 20 mins backup of whole system 3KVA*

Software

User-friendly Microsoft Windows compatible software for instrument operation, data acquisition/analysis should be supplied . The software is capable of reporting following :

Surface area BET
Langmuir surface area
BJH, DFT analysis (no less than 23 density function theory)
Multi-point BET surface area
Adsorption isotherm / Desorption isotherms
Mesopore volume BJH
BJH mesopore area
Total pore volume
Micropore volume
Micropore area
DeBoer t-plot
MP method
Micropore size distribution
as Plot
f-Ratio plot
Heat of adsorption
Freundlich & Temkin isotherms
Density Functional Theory
Reference isotherms
Horvath-Kawazoe, Dubinin-Radushkevich, Dubinin-Astakhov.

Consumable items

i) *Standard sample for above mentioned high surface area measurement (250 – 300 sq.m/g).*

ii) *Samples cell : 6 nos*

iii) *Sleeves, jacket , O ring- 2 sets*

iv) *Liquid N2 sensor 1 no. All connections from cylinder to machine have appropriate tubing along with 2nos of regulator.*

Sales & Services

Our sales team is dedicated to helping our customers find which machine is right for their situation. We also offer custom machines for customers with unique needs. To find out what we can do for you, contact us. We are committed to customer support including specific service products, short response times & customer specific solutions. To quickly & flexibly meet our customer's requirement, we oller a comprehensive range of services.

Customize your machine today!

Disclaimer : ** Other specifications of this product are also available.*
** Specifications subject to change without notice. Design subject to change without notice.*

The most advanced, accurate, easy to use and reproducible Sorptometers in the world.

Celebrating

of solutions

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