A new generation of NOVA high speed surface area and pore size analyzers for quality control and research applications

INTRODUCTION

The NOVAtouch™ surface area and pore size analyzer was designed to modernize and enhance surface area and pore size measurements. This was achieved through a touch-sensitive screen and a variety of technical improvements that maximize the speed, throughput, precision and accuracy of surface area and pore size distribution measurements on discrete powders and porous solids in general. Industrial and research applications abound, and extend to fields where surface properties can be assessed and/or tailored to enhance the quality and the performance of solid materials. These goals are non-exclusive, meaning that the NOVAtouch™ is designed to address all their requirements with utmost efficiency.

QUALITY CONTROL / ASSURANCE APPLICATIONS

Porous and non-porous solids produced and processed in bulk quantities need to be routinely tested for quality and consistency, and to rule out particle segregation effects. The high speed, high throughput NOVAtouch™ is ideally suited to meet this demand. Catalysts, ceramics, aluminas, silicas, minerals, adsorbents, carbon blacks, activated carbons, pharmaceutical actives and excipients, battery materials, filters, membranes, metal powders, graphenes and nanomaterials in general are but a few examples of applicable solids.

APPLICATIONS

- Catalysts
- Ceramics
- Carbon
- Pharmaceutical
- Energy (Batteries, Fuel Cells)
- MOFs
- Zeolites
- Mesoporous Materials
- Molecular Sieves

REFERENCES

- ASTM UOP964-11
- ASTM D1993-03
- ASTM B922-10
- ASTM C1274-12
- ASTM D6556-14
- ASTM D3663-03

KEY WORDS

- BET Surface Area
- Catalysts
- Carbon
- Ceramics
- Adsorption
- Energy Storage
- Gas Sorption
- Physisorption
- Pore Size
- Powders
- Pharmaceutical

RESEARCH AND DEVELOPMENT APPLICATIONS

The NOVAtouch provides the precision and flexibility demanded by more comprehensive and detailed sample analyses. For example, mesoporous materials such as tailored silicates, novel M41S solids (including MCM-41), PMOs, KITs, and SBAs can be examined using single or multiple adsorbates and temperatures in order to derive the most detailed pore size evaluations, backed by the most extensive list models based on classic thermodynamics and statistical mechanics (QSDFT, NLDFT, GCMC) available in the market.

REFERENCES

The NOVAtouch™ is designed to abide by international standard protocols (ASTM, ANSI, ISO, DIN, JIS, GB, etc.). An extended list of pertinent standard methods can be found in our Analytical Laboratory’s website at http://www.labqmc.quantachrome.com.

Basic information about surface area and pore size analysis techniques and applications can be found in reference textbooks (e.g., Lowell et al., “Characterization of Porous Solids and Powders: Surface Area, Pore Size and Density,” Springer, 2006), recent journal reviews (e.g., M. Thommes & K.A. Cychosz, Adsorption (2014) 20:233-250), and Technical Application Notes and references provided in Quantachrome’s Resource Library at www.quantachrome.com

If you have a material or application not listed, or a particular challenge in mind, do not hesitate to contact us. With over 45 years in the field, Quantachrome Instruments’ staff of scientists and engineers is committed to assisting you to establish the methods that best suit your materials and applications.
CATALYSTS

Catalysts are an important work horse of our continued technological revolution, and hold great promise for helping to solve some the world's most pressing problems such as air pollution, and development of novel energy sources. Surface area and pore size / volume distributions obtained with the NOVAtouch provide one of the best means of characterizing the structure of porous catalysts. One example is the higher the surface area of a catalyst support, since more active sites can be deposited on the carrier, increasing its activity per unit volume. Another is the role that pore size and pore volume play in the efficient diffusion of reactants to, and of products away from, the reactive sites deep within a catalyst particle.

REFERENCES:

ASTM D3663-03

ASTM D4222-03

ASTM D4365-95

ASTM D4567-03

ASTM D4641-12

ASTM C1274-12
Standard Test Method for Advanced Ceramic Specific Surface Area by Physical Adsorption.

ASTM D1993-03

Quantachrome Nova Research Catalysts Citations
CARBON

Surface area and pore size impact various performance characteristics of the different carbons used in tires, plastics and paints, stored energy applications such as batteries and super-capacitors, toners and inks, gas and water purification, gas separation and storage. Surface area quantitatively affects storage of electrical charge in activated graphene oxide for example, and the right pore size distribution can enhance gas storage capacity and gas separation selectivity. Carbons such as carbon blacks, especially those used in rubber products, are classified according to the surface area accessible to nitrogen molecules.

REFERENCES:
ASTM D6556-14
ASTM UOP964-11
Surface Area, Pore Volume, Average Pore Diameter, and Pore Size Distribution of Porous Materials by Nitrogen Adsorption.

PHARMACEUTICAL

Pharmaceutical dosage forms consist of active ingredients, excipients, binders, and lubricants. The surface area properties of each will determine performance characteristics such as:
- disintegration and dissolution rates
- adhesion properties
- crystallization
- surface energies
- particle to particle interactions
- and much more.

REFERENCES:
USP General Chapter<846>:Specific Surface Area.
Quantachrome Case Study: Magnesium Stearate - Solving The Surface Area Problem, 2005, by Martin Thomas Ph.D.
Surface Area: The Most Underutilized Particle Property in Pharma. Pharmaceutical Sciences, September 2012, Vol. 10., pp 2-5, by Dr. Martin Thomas Ph.D.
APPLICATION OVERVIEW

BATTERIES-FUEL CELLS-ENERGY STORAGE

The porosity and surface area of a solid directly impact a material’s ability to store and transport energy. Components of fuel cells and batteries such as electrodes and separators are made of porous materials, as are capacitors including supercapacitors. The surface areas of these materials will affect the rates of electron and ion transfer and of chemical reactions. Furthermore, the porosity and the pore structures will not only contribute surface area but also control the flow of liquid electrolytes and gases through the materials.

REFERENCES:

METAL-ORGANIC FRAMEWORKS (MOFs)

The potential for the use of micro- and mesoporous MOFs in gas storage/separations and catalytic applications is related to their structural properties such as surface area, pore volume, and porosity. In addition, isosteric heats of adsorption can be readily calculated with advanced software from measurements performed with the same gas at a minimum of two different temperatures.

REFERENCES:
ASTM B922-10

Quantachrome Nova Research:
Battery Citations
Fuel Cell Citations
Energy Storage Citations

Quantachrome Nova Research MOF’s Citations
Zeolites are well known microporous catalysts which are widely employed in the petrochemical and the (fine) chemical industry.

Hierarchically structured mesoporous zeolites exhibit micro/mesoporous pore networks which address diffusional limitations present in conventional zeolitic catalysts. The precise knowledge of pore dimensions and network topology, as well as the adsorption properties of these materials, are required to determine their catalytic potential. Physico-chemical features of (hierarchical) zeolites/zeotypes such as surface area (i.e., BET area), mesopore and total pore volume and micro- and mesopore size distributions can be accurately probed using Quantachrome’s NOVA touch.

Quantachrome Nova Research:
Zeolites Citations
Mesoporous Zeolites Citations
Hierarchically Structured Zeolites

Ordered mesoporous materials exhibit uniform pore structure and morphology and include a wide range of materials such as M41S silicas (e.g. MCM-41, MCM-48), SBA silicas (e.g., SBA-15, SBA-16, KIT-silicas (e.g. KIT-6, KIT-5), periodic mesoporous organosilicas (PMOs), CMK ordered mesoporous carbons, templated metal oxides and many others. They have potential for use in various applications such as separation, catalysis, biomedical, sensors, photonics, batteries and environment. The unique structural and textural parameters of these materials are closely linked to their performance (e.g. mass transfer / diffusion in nanoporous networks). A complete characterization of pore volume, pore size distribution, and specific surface area is of prime importance. Gas adsorption allows researchers to obtain reliable data using state-of-the-art data reduction methods (including a comprehensive library of DFT based methods for various adsorptive / adsorbent pairs and proper pore geometries).

Quantachrome Nova Research Mesoporous Molecular Sieves

REFERENCES:


ISO-INTERNATIONAL STANDARD ORGANIZATION - SELECTED STANDARDS

ISO 9277:2010
Determination of the specific surface area of solids by gas adsorption - BET method.

ISO 15901-2:2006
Pore size distribution and porosity of solid materials by mercury porosimetry and gas adsorption - Part 2:
Analysis of mesopores and macropores by gas adsorption.

ISO 15901-3:2007
Pore size distribution and porosity of solid materials by mercury porosimetry and gas adsorption - Part 3:
Analysis of micropores by gas adsorption.