THE microREPORT

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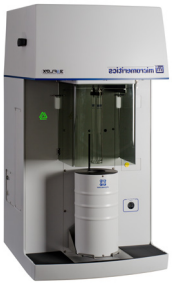
micromeritics®

MICROMERITICS NEW PRODUCTS



3Flex™

Micromeritics 3Flex Surface Characterization Analyzer is a fully automated, three-port instrument capable of high-performance physisorption (mesopore and micropore) and chemisorption analyses with superior accuracy, resolution, and data reduction. Each analysis station is upgradeable from mesopore to micropore with the option of designating one station for chemisorption analyses. All analysis stations can be configured for krypton analysis of low surface area materials. Vapor sorption capability is standard. A single 3Flex with its minimal footprint and three configurable analysis stations eliminates costly investment in multiple instruments and additional bench space.

ASAP® 2020 Plus

The ASAP 2020 Plus integrates a variety of automated gas sorption techniques into a single, but powerful table-top instrument. The system is designed to provide high-quality physisorption data (surface area, porosity, etc) as well as chemisorption isotherm data to materials analysis laboratories with expanding analytical requirements. Two independent vacuum systems permit simultaneous preparation of two samples while analyzing another. The instrument features a dedicated saturation pressure (Po) sensor for continuous Po monitoring and Po values under the same conditions as the adsorption measurement. The chemisorption model includes the ability to obtain valuable information about the physical and chemical properties of catalysts, catalyst supports, adsorbents, and other materials. Its unique design provides a high level of system cleanliness to permit low pressure chemisorption isotherms. *In situ* chemisorption sample preparation and activation provide a fully automated analytical method that does not require user intervention.

ASAP® 2460

The ASAP 2460 Surface Area and Porosimetry Analyzer is a unique expandable system designed for high-performance and high sample throughput. This versatile surface characterization instrument can be configured as a two-, four-, or six-station bench top system depending on the user's throughput needs. The base ASAP 2460 is a two-port master control unit. For additional throughput, two-port auxiliary units can be connected to the master unit expanding the system to either a four-port or six-port analyzer. Optimized for walk-up sample screening, all analysis ports can be operated independently and concurrently, allowing the user to load and unload samples at any time, regardless of the preparation or analysis stage of other ports.

TriStar® II Plus

The TriStar II Plus is a fully automated, three-port surface area and porosity analyzer intended for laboratories that require the combination of high throughput and the highest quality data. Suited for use in both quality control and research environments, the TriStar II Plus 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. The three analysis ports operate simultaneously and independently of one another. A dedicated saturation pressure (Po) port is standard. The instrument also features a krypton option, allowing precise measurements in the very low surface area range.

MicroActive Software

Each of these gas adsorption instruments includes user-defined reports and MicroActive software that allows interactive evaluation of isotherm data. Easily adjust the data range, fitting the desired range of experimentally acquired data points using interactive, movable calculation bars. The isotherm can be viewed real-time on either a linear or logarithmic scale, available under each calculation model.

Smart VacPrep

The Smart VacPrep is an advanced six-port system that utilizes heat and vacuum to prepare samples for gas adsorption analysis. Each degas port may be operated independently and samples may be added or removed without disturbing the treatment of other samples undergoing preparation. Sample preparation automatically terminates when the samples have completed all programmed steps. Either use a set of default ramp and temperature parameters or manually program each port with a different set of parameters. Starting or terminating the degas program can be done with analysis instrument software or push-buttons on the instrument. A 'Rapid-Start' push-button on each port gives you the ability to walk up to the instrument, attach the sample tube with heating mantle, and immediately start sample preparation.

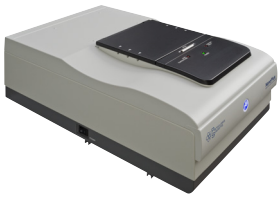
AutoPore® V

Micromeritics' AutoPore V Series Mercury Porosimeters can determine a broader pore size distribution more quickly and accurately than other methods. These instruments also include enhanced safety features and offer new data reduction and reporting choices that provide additional information about pore geometry and fluid transport characteristics. The AutoPore V is available in two models to best match the requirements of quality assurance and research labs. The instrument also allows the development of a methodology that provides speed or precise detail. An equilibration mode delivers detail-rich, highly accurate measurements for in-depth porosity analysis. A scanning mode approximates equilibrium by increasing pressure continuously for a fast analysis. Interactively manipulate data, define custom reports, and quickly achieve data results with standard MicroActive software.

SediGraph® III Plus

The SediGraph III Plus particle size analyzer combines the proven SediGraph analytical technique with advanced instrumentation features to provide superior repeatability, accuracy, and reproducibility in the size range of 0.1 to 300 micrometers. Complete particle accountability assures that all introduced sample is accounted for. The SediGraph III directly measures mass by x-ray absorption and determines particle size by direct measurement of setting velocity. Direct measurements require no modeling. This new model features enhancements to the electronics and the detection system. The SediGraph III Plus features a lifetime (7 years) warranty on the X-ray tube, a significant long-term savings on the cost of operation.

PARTICULATE SYSTEMS NEW PRODUCTS



NanoPlus

The NanoPlus utilizes photon correlation spectroscopy and electrophoretic light scattering techniques to determine particle size and zeta potential. 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 0.1 nm to 12.30 μm with sample suspension concentrations from 0.00001% to 40% and zeta potential of sample suspensions in the – 500 mV to +500 mV range with concentrations from 0.001% to 40%. The instrument is available in three model configurations: a nano particle sizing instrument; a zeta potential instrument; and a combination nano particle sizing and zeta potential instrument.

HPVA II

The HPVA II gas adsorption analyzer uses the static volumetric method to obtain high-pressure adsorption and desorption isotherms. Utilizing such gases as nitrogen, hydrogen, methane, argon, oxygen, and carbon dioxide, gas mixtures of up to three components can be used. Excellent reproducibility and accuracy are obtained by using separate transducers for monitoring low and high pressures. Free space can be measured or entered. The HPVA II operating pressure ranges from high vacuum to 100 or 200 bar. The span of the sample temperature during analysis extends from cryogenic to 500 °C. The instrument features precise control of sample temperature via a recirculating temperature bath, cryogen dewar, or a furnace.

Microactivity Effi

The Microactivity Effi is a highly-advanced modular laboratory system for measuring the activity and selectivity of catalysts. The standard platform can be easily adapted to the user's catalytic testing needs with a variety of configurations and options. The system is compact, completely automated, and equipped with innovative process-control technology. A series of experiments can be programmed on a personal computer to obtain real-time results with the highest degree of reproducibility and accuracy. Save time and resources at both the catalyst development stage and the factory reporting process during the screening. The Microactivity Effi accommodates a wide variety of reactions including hydrocracking, hydrotreating, isomerization, hydrogenation, hydrodesulphurization (HDS), oxidation, hydrodenitrogenation (HDN), reforming (aromatization), GTL (Fischer-Tropsch), and steam reforming, to name a few.

SSSpinTester

The fully automated SSSpinTester uses centrifugal force in the determination of the unconfined yield strength of fine powders. Requiring a very small amount of sample, the instrument provides repeatable and consistent data by first employing centrifugal force to consolidate the material and compress the sample inside the sample holder. After the initial compaction step, the SSSpinTester then completes the analysis routine using the same centrifugal force to determine the yield strength of the material. The SSSpinTester is capable of fast results, collecting a single data point in as little as three minutes and a five-point flow function in as little as 15 minutes. Only a small amount of sample is required (0.5 cc).

HOW TO ADMINISTER INSOLUBLE ACTIVE PHARMACEUTICAL INGREDIENTS

Solid dosage forms (tablets and capsules) are the most common and effective way to administer drugs, making up about 60% of all drug delivery methods.

These range from treatment of cold symptoms to head aches to allergies to gastrointestinal discomfort, and so on. Brands like Tylenol and Advil have become household names. Once tablets or capsules are taken whole, they dissolve in the digestive tract and are then distributed throughout the body in the blood to reach their target area. However, some active pharmaceutical ingredients are not soluble. In fact, more than 40% of new chemical entities developed in the pharmaceutical industry have little or no solubility in water (due to the non-polar or very small polar nature of the chemical composition of the drug). Sometimes,effective drugs cannot be taken through tablets or capsules because of their inability to dissolve in water and disperse in the body. Considering the magnitude of drugs that are not completely soluble in water, a method of administering these drugs is needed to utilize the full advantages of new innovation in the pharmaceutical field. These insoluble drugs can still be used by administering them throughout the body with a different method that has been made possible with modern technological improvements.

One of the simpler ways of administering the drug is to simply change its physical size. By grinding drugs into powder form, we increase the surface area to volume ratio which can increase the solubility potential. Smaller particle size may create improved absorption through increased solubility and improve delivery efficiency. However, for completely insoluble drugs, milling the drug or ingredient down to a powder with particle sizes in the nanometer range (around twenty to thirty nanometers)can also create particles small enough to directly distribute throughout the body. This nano suspension process effectively eliminates the need for the dissolution of the drug after it has entered the body. Then, by suspending the powder in a saline solution that has a similar composition to that in the human body, the drug can be delivered directly into the blood stream through an injection or aerosol spray. While there are other methods of applying a nano suspension, using media milling for micronizations is the simplest and most cost-effective. Creating smaller particle sized APIs not only creates benefits for insoluble drugs, but can also make the administration of other drugs more effective. However, when milling down drugs to nanometer particle size, it is important to keep in mind that the significant amounts of physical and possible thermal stress that the drugs are put under may cause degradation.

When considering this method, zeta potential plays a crucial role in whether the process will work. Zeta potential is a measure of charge in a suspension that characterizes attractive and repulsive forces between suspended particles. A zeta potential value closer to 0 mV means that the particles are likely to be attracted to each other, agglomerate, and possibly settle out of the suspension, while values further away from 0 mV indicate that the particles are likely to repel each other and remain in suspension. Zeta potential can be modified by pH or additives, such as surfactants or certain salts. A drug nano suspension with low zeta potential may cause the particles to agglomerate, or clump, in the saline and inhibit the ability of the drug to be properly and evenly distributed or prevent entry into target cells. This can reduce or eliminate the desired therapeutic effect. Therefore assessing the zeta potential of a drug is a crucial step when considering this process.

With new technology that can assess particle size and zeta potential, this technique of administering drugs is easier and more precise than it's ever been. Insoluble? No problem!

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2014 GRANT RECIPIENTS

Micromeritics grant recipients in 2014 included Professor Dr. Javier Pérez-Ramírez, Institute for Chemical and Bioengineering at ETH Zurich, Switzerland and Professor Jin Li, Department of Chemistry and Chemical Biology at Rutgers University. Both grant winners received a Micromeritics 3Flex Surface Characterization Analyzer.

Micromeritics' Instrument Grant Program provides an outlet for deserving non-profit universities and research organizations to acquire expensive state-of-the-art material characterization instruments that may not be available through other means. The program is international in scope. Types of instrumentation that qualify include particle size analyzers, gas adsorption analyzers, mercury porosimeters, gas pycnometers, and chemisorption instrumentation.

Link to grant policy/application (Click here to learn more about it)

Professor Dr. Javier Pérez-Ramírez

Prof. Pérez-Ramírez has been head of the institute since 2012 and has delivered more than 150 lectures, published over 250 articles, and holds 13 patents. The 3Flex is a tool for precise assessment of porous properties of solids, perfect for Prof. Pérez-Ramírez's research on fundamental design and technical development of new catalytic materials and reactor engineering concepts. According to Prof. Pérez-Ramírez, "The 3Flex will give us the ability to measure three samples simultaneously and the upgrade from meso- to micropore will be essential in providing the required resolution for our research work with zeolites, metal-organic frameworks, and carbons. We are very thankful to Micromeritics for the donation of this instrument, which will contribute to the continued development of our research program."

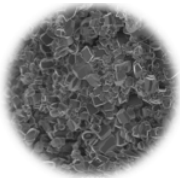
Professor Jing Li

Dr. Li has published over 250 papers and has 8 patents. Her recent awards include the first-ever DOE Clean Energy Education and Empowerment (C3E) Award for women in 2012, elected Fellow of American Association for the Advancement of Science in 2012, and a 2013 Humboldt Research Award. She is currently Associate Editor for The Journal of The Solid State Chemistry and member of the Editorial Advisory Board for Crystal Growth & Design. According to Professor Jing Li, "Our main research areas are the development of novel and efficient nanostructured and nanoporous materials potentially capable of several important applications, including adsorption-based separation of small gases and hydrocarbons, water splitting, and carbon dioxide reduction. The 3Flex will be essential for the characterizations of various materials and reactions, for understanding the adsorption mechanism, activity of catalysts, as well as their relationship with structures and particle morphology."

THE UTILITY OF SPECIFIC SURFACE AREA MEASUREMENT FOR PHARMACEUTICAL MATERIALS

Myke Scoggins | Senior Pharmaceutical Scientist | Micromeritics Instrument Corporation

In the pharmaceutical world, particle size analysis has traditionally been the method of choice to "characterize" raw materials. Beginning with sieve analyses all the way to more current technologies like laser light scattering, this physical characteristic has been used to set incoming raw material specifications, help determine which excipients will be used in a formulation, and troubleshoot product performance issues such as dissolution. While particle size analysis is, without a doubt, an important piece of the puzzle, it is exactly that – a piece. Other measurements can provide essential and useful information as well and, when paired with other techniques, assist the pharmaceutical scientist to more fully characterize their Active Pharmaceutical Ingredients (API) and excipient materials. Among these techniques is the determination of surface area.



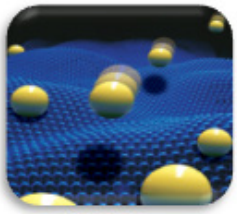
More comprehensive material characterization can aid the scientist in developing meaningful specifications for a particular material with respect to how it will behave in your process and product. A supplier's specification may be adequate in some cases, but in other instances a material manufactured in conformance to one extreme of the supplier's specification tolerance band may behave completely differently than a subsequent lot that is produced at the other extreme. While both lots may meet the supplier's specification and be deemed acceptable, receiving the material from both ends of this "specification spectrum" may cause unwanted process or performance shifts in your operation. As a quality control tool, surface area measurement can be added to the battery of incoming raw materials tests to ensure the materials you are using are consistent in terms of the attributes you have identified as critical to your process and product performance.

The surface area of a material can change as a result of particle size reduction. This could be the result of having different grades of the same material or from material processing steps. As a material is mechanically sieved or milled, the material will break apart into smaller discrete particles. Since particle size and surface area are inversely proportional, any reduction in particle size corresponds to an increase in surface area. This increase may lead to uniformity issues where the increased surface area, and resultant increase in surface energy, alters the particle-particle interactions and may destabilize the blend causing ineffective or inefficient blending, demixing, or segregation – major causes of blend and content uniformity failures.

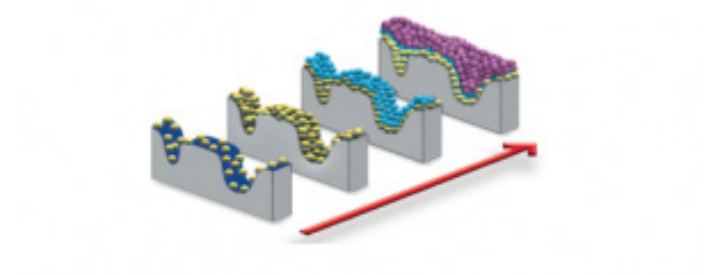
From the onset of pharmaceutical development, material characterization is essential in order to understand the system being developed. It is critical to understand how key functional ingredients and their properties can affect the product during the manufacturing process as well as whether the dosage form will perform as expected once administered. The surface area of the API, along with other factors such as salt selection, can play a role in solubility. Surface area of a superdisintegrant may determine the degree of tablet swelling that occurs. Surface area of a lubricant could alter its functionality and lead to dissolution issues or softer

than expected tablets. Arming yourself with this information from the beginning of the development process may save potential downstream headaches due to potential process re-designs, re-work of poor performing product, or product rejection. The surface area of particular ingredients in a formulation may be considered a Critical Quality Attribute (CQA) that, when performing Risk Assessment (under the guidance of ICH Q9), will place added importance on this parameter and may become part of your overall control strategy.

Another area of concern when it comes to variability of material surface area measurements is the rate an API goes into solution. As surface area increases, more surfaces are exposed to whatever the dissolution medium is. All else being equal, the material with higher surface area will go into solution more quickly and be available for absorption at a rate that could have negative pharmacodynamic implications. This could also lead to product rejections or recalls due to safety concerns.



To determine the surface area, solid samples are pretreated by applying some combination of heat, vacuum, and/or flowing gas to remove adsorbed contaminants acquired (typically water and carbon dioxide) from atmospheric exposure. The solid is then cooled, under vacuum, usually to cryogenic temperature (77 K, −195 °C). An adsorptive (typically nitrogen or krypton) is dosed to the solid in controlled increments. After each dose of adsorptive, the pressure is allowed to equilibrate and the quantity adsorbed is calculated. The quantity adsorbed at each pressure (and temperature) defines an adsorption isotherm, from which the quantity of gas required to form a monolayer over the external surface of the solid is determined. With the area covered by these adsorbed gas molecules known, the surface area can be calculated. This method complies with the current USP ‹846› methodology for measuring specific surface area.



When problems occur such as a failing blend or content uniformity, failing disintegration times, or unexpected shifts in dissolution profiles, evaluation of both materials and processes must be undertaken to determine a root cause. Analysis of material surface area can play an important role providing you with extremely useful information as early in the development process as possible. This is important in a Quality by Design (QbD) environment where experimental design may be used to create a design space that will allow the manufacturer to be agile and flexible in creating robust processes and products that lend themselves to the ever-elusive decrease in regulatory oversight while maintaining confidence that critical parameters have been adequately identified and controlled.

MICROMERITICS ANALYTICAL SERVICES

Micromeritics Analytical Services (MAS) provides contract sample analyses based on the following principles: high quality results, fast turn-around-times, and outstanding customer service. Primarily equipped with products manufactured by Micromeritics, MAS also provides analytical services performed by equipment outside of Micromeritics current product line.

Services include:
- Particle Size Distribution
- Density (Skeletal or Envelope)
- High-Pressure Adsorption Isotherms
- Particle Shape
- Surface Energy
- Magnetic Content
- Particulate Count
- Dynamic Water Vapor Sorption
- Zeta Potential
- Nano Particle Size
- Thermogravimetric analysis (TGA)
- Isosteric Heat of Adsorption
- B.E.T. Surface Area
- Differential Scanning Calorimetry (DSC)
- Microscopy
- Micropore Analysis
- Active Surface Area
- Method Development
- Pore Volume Distribution
- Percent Metal Dispersion
- Method Validation
- Total Pore Volume
- Crystallite Size
- Consulting Services

All results are thoroughly reviewed by highly qualified scientists and strict confidentiality is maintained at all times.

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MICROMERITICS PHARMACEUTICAL SERVICES

MPS is your complete solution for expert particle and powder characterization. We provide clients with essential data and consultation to achieve a comprehensive understanding of material properties during drug discovery and development.

Services include:
- Particle Analysis
- Thermal Analysis
- API Characterization
- Powder Flow Properties
- Excipient Screening
- Identification of Critical Quality Attributes
- Vapor Sorption
- Batch Variability
- Surface Area
- QbD/PAT Implementation
- Surface Energy
- Consultation
- Microscopy
- Analytical Method Development/Validation

Micromeritics Pharmaceutical Services is a cGMP/GLP laboratory, registered with the FDA, and DEA licensed.

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POROTECHNOLOGY

PoroTechnology, a business unit of Micromeritics, is located in Houston, Texas and specializes in providing rock property data to the international oil and gas industry. Services include:

- Rock pore aperture down to 4 angstroms
- Pore size distribution and characterization analysis using mercury injection capillary pressure and gas adsorption techniques. Data integration possible using industry leading MicroActive software
- Mineral and clay characterization using XRD and SEM-EDS
- Clay particle size analysis using the Micromeritics advanced SediGraph III analyzer
- Dean-Stark and soxhlet extraction available

porotechnology.com

CHARACTERIZATION OF PHYSICALLY MODIFIED GLASS BEADS AS POTENTIAL MODEL CARRIERS IN DPIS

Contributed by:
Sarah Zellnitza, Jakob Dominik Redlinger-Pohnq, Nora Anne Urbanetz | Research Center Pharmaceutical Engineering GmbH, Graz/Austria

Introduction

Dry Powder Inhalers (DPIs) are medical devices used for pulmonary drug delivery. The formulations used in DPIs typically consist of adhesive mixtures of the drug and a carrier. In order to reach the tiny airways of the deep lung the drug particles have to exhibit an aerodynamic diameter of 1 µm to 5 µm. Particles of this size are rather cohesive and show poor flow properties and thus poor dosing [1]. That is why carrier based formulations, where the drug is attached to the surface of coarser carrier particles (50 µm – 200 µm) of adequate flowability, have been invented.

Interparticle interactions between the drug and d the carrier play a crucial role in carrier-based dry powder inhalers (DPIs). It is important, that they are on the one hand high enough that the drug adheres to the carrier ensuring uniform dosing and on the other hand low enough that drug detachment during inhalation is guaranteed. From literature we can take that interparticle interactions are largely affected by the carrier surface topography [1]. Glass beads were chosen as model carriers because various prospects of chemical and physical surface modification may be applied without affecting other factors that also impact interparticle interactions like particle size and shape of the glass beads.

In the present work the impact of physical surface treatment by friction and impaction in a ball mill on glass beads is analyzed. By treating the glass beads with small hard grinding materials, very fine surface roughnesses that are only visible at large magnifications could be introduced (Fig. 1). As the introduction of surface roughnesses should also lead to an increase in the surface area the specific surface area of the glass beads was chosen as a parameter to quantify the changes.

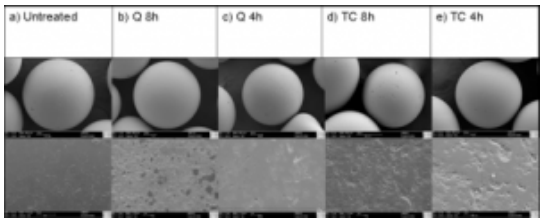

Fig. 1 SEM pictures of a) untreated and b), c), d), e) physically modified glass beads

Materials

Glass Beads (SiLibeads® Glass Beads type S) were used in the size range of 400 µm to 600 µm.The grinding materials used were tungsten carbide (TC) (x50=25 µm; Mohs hardness 9.5) and quartz (Q) (x50=32 µm; Mohs hardness 7). By comparison soda lime glass beads have a hardness of about 6 on the Mohs scale. The Mohs scale of hardness is a common means to rank minerals according to hardness and ranges from a value of 1 for talc to a value of 10 for diamond. Mohs hardness refers to the ability of the material to resist abrasion or scratching and is named after the German mineralogist Friedrich Mohs (1773-1839). Tungsten carbide was provided from Wolfram Bergbau und Huetten AG, St. Martin i.S./Austria and quartz was obtained from Quarzwerke Austria GmbH, Melk/Austria.

Preparation

Surface modification of glass beads was performed mechanically by friction and impaction in a ball mill (Ball Mill S2, Retsch, Haan/Germany). Glass beads were processed for 4 hours and 8 hours with quartz and tungsten carbide powder at 424 rpm. The ratio of grinding material and glass beads was 1:1 (V/V). After treatment glass beads were washed several times with deionised water and dried in an oven at 150 °C for 48 hours. Samples were stored in a desiccator prior to analysis.

Prior to the analysis samples were prepared by degassing with vacuum (0.05 mbar) at 100 °C for at least 4 hours.

Analysis

First analyses were made with nitrogen as adsorber gas, but as the specific surface area of glass beads of the size mentioned above is rather small and no satisfactory results could be obtained, further analyses have been carried out with krypton as adsorber gas. The sample tubes were filled to the maximum with glass beads to compensate for the small specific surface areas of the glass beads and to increase the absolute surface area. Consequently, the average sample mass was about 12 g glass beads. The analyses were carried out with a Tristar II surface area and porosity analyzer (Micromeritics Instrument Company, Norcross/U.S.A.). A 7-point analysis was made between 0.07 and 0.25 relative pressure and the specific surface area was calculated according to the Brunauer-Emmet-Teller (BET) equation. To evaluate the results of our measurements and to make sure that the instrument is capable to measure such small surface areas accurately, the Micromeritics Reference Material Alumina (Part. Nr. 004-16816-00) was weighed in, in such a small amount that the absolute surface area was in the range of the absolute surface area measured for the glass beads. By reducing the sample mass of the standard to about 0.5 g an absolute surface area of 0.105 m^2 was reached which is comparable to the absolute surfaces measured for the glass beads that were in the size range of 0.09 to 0.2 m^2. Despite of the small sample size of the standard the measurements still gave a specific surface area of 0.24 ± 0.06 m2/g (mean, n=3 ± SD) which is perfectly fine within the specified range (0.28 ± 0.03 m^2/g). Figure 2 shows an example of one of the Alumina standard BET surface area plots. In conclusion it could be shown that the instrument is capable to provide feasible results even below the measuring range specified by the manufacturer.

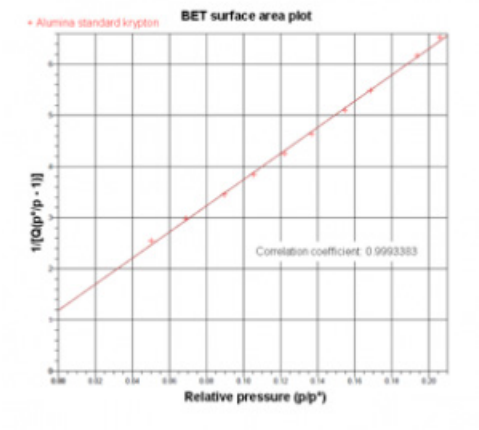

Fig. 2 BET surface area plot of Alumina standard analysed with krypton (10 point analysis between 0.05 and 0.025 relative pressure, weighed portion 0.5488 g)

Data

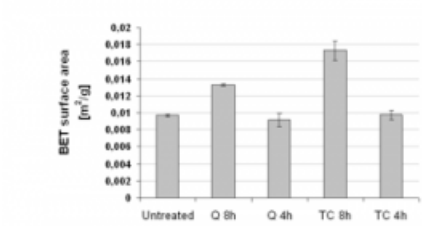

Fig. 3 Specific surface are of untreated and physical modified glass beads (mean of n=3 ± SD)

Figure 3 shows the results of the specific surface area measurements of untreated and physically modified glass beads. Glass beads treated with tungsten carbide for 8 hours exhibit the largest surface area and glass beads treated with quartz for 4 hours the lowest. Treating with quartz for 8 hours and treating with tungsten carbide for 4 hours lead to specific surface areas in between. Actually, the treatment with tungsten carbide for 4 hours leads to a lower surface area than the treatment with tungsten carbide for 8 hours and grinding with quartz for 8 hours leads to a higher specific surface area than grinding with quartz for 4 hours. The results are well in accordance with the hardness of the grinding materials and the processing time and as we would have expected from the SEM images (Fig. 1).

Concluding we can say that gas adsorption has been proved to be a suitable tool to quantify changes in the surface topography/roughness of glass beads even below the measuring range specified by the manufacturer. The measured surface areas are well in accordance with the hardness of the grinding materials, the processing time and the SEM images. By reducing the sample mass of the standard it could be demonstrated that the very small surface areas measured are accurate.

Acknowledgments:

This work is funded by the DFG (German Research Foundation) within the priority program "SPP 1486 – Particles in Contact".

References:

[1] M. Lohrmann, Adhaesionskraefte in interaktiven Mischungen für Pulverinhalatoren, PhD Thesis, Heinrich Heine University Duesseldorf, 2005.

MICROMERITICS LEARNING CENTER

Although Micromeritics' representatives give basic start-up training for most instruments during installation, we also offer additional training courses for many of our instruments to help you maximize your proficiency and capability with your Micromeritics instrument. Micromeritics' Learning Center has national accreditation as a Post-Secondary Avocational/Professional Development Institution by the Accrediting Council for Continuing Education and Training (ACCET), an accrediting body recognized by the United States Department of Education. These courses help expand your ability and improve your understanding of your instrument with help from the experts.

Courses offer in-depth theory lectures by staff scientists and hands-on instrument operation with applications experts. Some topics that these courses cover are theory overview, automatic analyses, system utilities, report optimization, trouble shooting, and user maintenance.

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03/10/2015-03/12/15	AutoPore IV 95XX Basic Operator Training
03/13/2015	AutoPore IV 95XX Advanced I Training
03/23/2015-03/25/15	Surface Area, Porosity, & Physical Adsorption, with applications in the ASAP 2020C and 3Flex 3500
03/26/15-03/27/2015	ASAP 2020C and 3Flex 3500 Advanced II Training
03/31/2015	ASAP 2020 Chemisorption
04/07/2015-04/09/15	Surface Area, Porosity, & Physical Adsorption with applications in the Tristar II 3020/3030, ASAP 2420, and ASAP 2460
06/02/2015-06/04/15	Saturn DigiSizer 5205 Basic Operator Training
06/05/2015	Saturn DigiSizer 5205 Advanced I Training
06/15/2015-06/17/15	Surface Area, Porosity, & Physical Adsorption, with applications in the ASAP 2020C and 3Flex 3500
06/18/2015-06/19/15	ASAP 2020C and 3Flex 3500 Advanced II Training
07/20/2015-07/22/2015	AutoChem II 2920 Basic Operator Training
07/23/2015-07/24/2015	AutoChem II 2920 Advanced II Training
08/18/2015-08/20/2015	Surface Area, Porosity, & Physical Adsorption with applications in the Tristar II 3020/3030, ASAP 2420, and ASAP 2460
09/08/2015-09/10/15	SediGraph III 5120 Basic Operator Training

UPCOMING EVENTS

27th Deutsche Zeolith Tagung	Oldenburg, Germany	2/25/2015-2/27/2015
4th International Conference on Hybrid Materials	Sitges, Spain	3/09/2015-3/13/2015
Pittcon	New Orleans, LA	3/08/2015-3/12/2015
48th Annual Meeting of German Catalysis	Weimar, Germany	3/11/2015-3/13/2015
4th CBNM4	Nagano, Japan	3/15/2015-3/18/2015
249th ACS National Meeting & Exposition	Denver, CO	3/22/2015-3/26/2015
Forum LABO and BIOTECH - France	Paris, France	3/31/2015-4/02/2015
INTERPHEX	New York, NY	4/21/2015-4/23/2015
2nd. Iberoamerican Symposium on Adsorption IBA-2	Cartagena de Indias, Colombia	4/26/2015-4/30/2015
Ceramics Expo	Cleveland, OH	4/28/2015-4/30/2015
NAM24	Pittsburgh, PA	6/14/2015-6/19/2015
ACHEMA World Forum 2015	Frankfurt am Main - Germany	6/15/2015-6/19/2015
89TH ACS COLLOID AND SURFACE SCIENCE SYMPOSIUM	Pittsburgh, PA	6/15/2015-6/17/2015
URTeC	San Antonio, TX	7/20/2015-7/22/2015

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