

THERMOFISHER SCIENTIFIC SURFER TECHNICAL DESCRIPTION

ThermoFisher Scientific Surfer applies the principle of static volumetric gas adsorption (physical and chemical adsorption) under controlled conditions (temperature and pressure) to determine micro structural properties of solids and powders.



Surfer will determine, depending on the configuration and the type of experiment, the following physical properties:

- *Specific surface area (m²/g)*
- *Pore size distribution in the meso, micro, ultra-micro and extended mesopore ranges*
- *Total pore volume (cc/g)*
- *Exposed metal surface area and metal dispersion in catalysts*

Surfer is the ultimate evolution for surface area determination. The new Surfer features a number of unmatched advantages and features

- Improved design of stainless steel manifold (temp. control $\pm 0.01^{\circ}\text{C}$) to reach unmatched vacuum degree over the sample thus permitting investigation on new ultra-micro porous materials
- Extremely reduced manifold dead volume and new design sample temperature coolant level control (LN₂ level ± 0.02 mm) permit to improve gas detection sensitivity by extreme pressure stabilization.
- Reduced necessary sample load (i.e. special requirements in the pharmaceutical field, in metal powder and catalysts applications) reduces by almost 50% the experiment time
- New gas injection system based on a proprietary design to introduce precisely extremely small as well as very large amount of adsorptive. The injection system does not add any dead volume to the system during the gas equilibration.
- New long lasting liquid coolant level control for best stabilization of the pressure in the system

Wide range of available configurations:

o Surfer Rapid (low cost mostly for QC/QA applications: surface area and mesopore size)

o Surfer STD (for most of applications: surface area and mesopore size)

o Surfer Micro (for microporous materials or experiments using Kr with very low surface areas)

o Surfer Ultra (top of the line for ultra-microporous materials characterization & Kr)

New gas injection algorithm allows completely automatic analytical parameters setup. Available in these modes:

o Mode "Auto" – Surfer takes care automatically of the analytical parameters independently on the sample nature and mass

o Mode "Choose Points" – User defines pressures at which data must be collected

o Mode "Micropores" – Automatic special operation to give best resolution for micro and ultramicroporous materials

- New instrument design, bench top, chassis optimization reduces space on the bench
- New electronic allows complete instrument control by a PC connected through LAN/Serial port
- New A/D converter 24 bit, 6 channels for highest resolution in pressure reading
- New and improved pumping system permits to reach unmatched vacuum degree in the sample area thus enabling the investigation of ultra micropores
- Availability of a dry primary vacuum pump in alternative to the standard oil pumps for clean and precise investigation of ultra-micropores avoiding possible sample contamination

The degasser (part of Surfer)

- Extremely reduced bench space due to independent degasser (can be placed aside or under the Surfer bench or in a different lab)
- Degasser connectable to Surfer primary vacuum or to external vacuum system giving more possible customization
- Sample degasser with three stations up to 450°C with independent vacuum access and temperature control
- Two valve system permits to evacuate safely very fine powders in the degasser



Software

ADP Software	Advanced data processing
<i>Specific surface area</i>	BET 2 parameters, BET full equation (3 parameters) with non linear regression function, Langmuir model, Dubinin-Radushkevich-Kaganer, Excess Surface Work (ESW) model, t-Plot, α -S-Plot (Sing), MP-Plot (Mikhail-Brunauer-Bodor)
<i>Standard isotherms for t calculation</i>	Halsey, Fransil, Harkins-Jura, De Boer, Halenda, Lecloux, Hydroxylated silica, User defined standard
<i>Mesopore size distribution</i>	Barrett-Joyner-Halenda, Dollimore-Heal, Cranston-Inkley, Modelless method
<i>Micropore size distribution with potentials</i>	Horvath-Kawazoe, Saito-Foley, Dubinin-Stoeckli
<i>Available potential functions</i>	Nitrogen – Graphite (@ 77K), Argon – Graphite (@ 77K, 87K), Carbon dioxide – Graphite (194K, 273K, 298K), Argon – Zeolite (@ 87K, 77K), Nitrogen – Zeolite (@ 77K), User defined
<i>Chemisorption</i>	Subtraction procedure of isotherms for strong and weak chemisorption Back extrapolation to zero pressure for metal surface and dispersion calculation Langmuir model at variable exponent
<i>Available graphs</i>	All calculations are applicable in graphic format. All graphs can be edited in almost all their components and exported in high resolution graphic file
<i>Available reports</i>	Three main reports are available: summary, standard and extended. Each report type can be manually edited by the user
NLDFT Software Module	Non Local Density Functional Theory
<i>Main function</i>	The solver will minimize the free energy functional $[\mathcal{F}]$ with respect to (ρ) , using the Non Local Density Functional Theory (NLDFT method in the smoothed density approximation) for the determination of micropore - mesopore size distribution The solver run on a Windows (XP) based OS machine as a standalone application
<i>Available pore models</i>	Infinite slit and cylindrical shape
<i>Pore size ranges</i>	Set of pore sizes: 100 steps from 0.3 nm to 500 nm 20 steps range 0.3 nm to 1 nm , 40 steps range from 1 nm to 10 nm, 40 steps range from 10 nm to 500 nm
<i>Parameters for intermolecular potentials</i>	<ul style="list-style-type: none"> • N2 – carbon at 77K based on a <i>slit-pore model/ cylindrical pore model</i> • N2 – silica at 77K based on a <i>cylindrical pore model</i> • Ar – silica/ carbon at 87K based on a <i>cylindrical pore model</i> • Ar – carbon at 87K based on a <i>slit-pore model</i> • CO2 – carbon at 273K based on a <i>slit-pore model</i>
<i>Data display</i>	<ul style="list-style-type: none"> • Theoretical isotherm and calculated isotherm are overlaid in linear and logarithmic plot • Pore size distribution function in linear and logarithmic plot
<i>Results export format</i>	<ul style="list-style-type: none"> • Direct graph printing • graph export in electronic format • copy the graph on the clipboard and paste on a document or spreadsheet • Data export in tabbed text file