ADVANCED MEASUREMENT INSTRUMENTS™

Nexus Series

Integrated XRD–Sorption Analysis Platform

What occurs when a material's crystal structure interacts with its pore adsorption characteristics? How can we eliminate the data barriers between different characterization methods, and advance research from single-parameter testing to comprehensive, multi-parameter analysis?

The Nexus Series Integrated XRD–Sorption Analysis Platform delivers the answer. It synchronously collects X-ray diffraction data during gas and vapor physisorption experiments, creating direct, meaningful correlations between structural changes and adsorption behavior. The system simultaneously records crystallographic data — including crystal structure, lattice parameters and phase composition — alongside key adsorption metrics such as adsorption isotherms, adsorption capacity, pore size distribution and average pore diameter.

This enables end-to-end characterization across crystal structure, microscopic pore architecture and macroscopic material performance. It reveals the causal links that govern material performance, improves the credibility of research results, and speeds up innovative development for catalysts, energy storage materials and porous adsorbents.

Main Functions

- Phase Search & Identification
- Rietveld Refinement
- Adsorption Kinetics
- Quantitative Phase Analysis
- Gas Adsorption-Desorption Isotherms
- Isosteric Heat of Adsorption
- Crystallinity Analysis
- Full-Range Pore Size Distribution Analysis
- In situ Structural Refinement During Adsorption

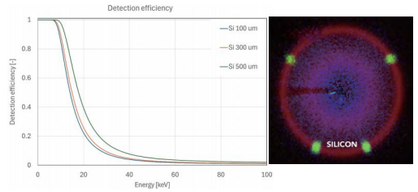
Key Features

Fully Automated Intelligent Workflow

XRD data acquisition is integrated into the adsorption measurement workflow. One-click operation enables fully automated experiments with unattended execution from start to finish.

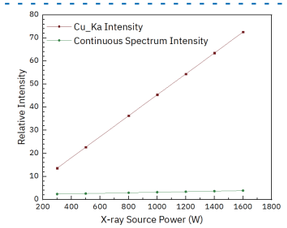
Direct Photon-Counting 2D Array Detector

Features a 256 × 256 pixel array for simultaneous signal acquisition. Provides high-resolution diffraction data with excellent signal-to-noise ratio (SNR). Selectable 0D, 1D, and 2D operating modes support a wide range of application requirements.



High-Power X-ray Source

Features continuously adjustable X-ray tube power from 600 W to 1600 W for high-quality diffraction data acquisition. Higher tube power improves the peak-to-background ratio and lowers detection limits for quantitative phase analysis.



Multi-Range High-Precision Pressure Measurement

Features high-precision pressure transducers with ranges of 1000 Torr, 10 Torr, and 1 Torr or 0.1 Torr, enabling accurate pressure measurement from high vacuum to atmospheric pressure.

Minimized Dead-Volume In Situ Sample Stage

Expandable Vapor Adsorption Capability

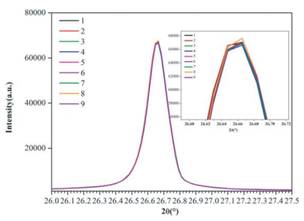
The vapor generation module is housed within a temperature-controlled enclosure with a cold-spot-free design. This prevents vapor condensation and ensures stable vapor pressure for accurate and reliable vapor adsorption measurements.

Turbomolecular Pump High-Vacuum System

Features a turbomolecular pump backed by a mechanical pump. An optimized, user-serviceable cold-trap manifold maintains an ultra-clean measurement environment for reliable micropore characterization.

Ultra-High Angular Accuracy

Achieves a 2θ angular accuracy of ±0.01°, ensuring precise peak positioning and excellent agreement with standard reference materials.



Peak Position Repeatability of the Quartz SiO_2 (101) Reflection at 2θ = 26.64° (n = 9)

Comparison of Theoretical and Measured Peak Positions for Corundum Standard Sample (NIST SRM 1976a)

Miller Indices	Theoretical Peak	MeasuredPeak Position	Difference
012	25.579	25.577	0.002
104	35.153	35.15	0.003
116	57.497	57.497	0
1010	76.871	76.872	0.001
0210	88.997	88.996	-0.001
0114	116.612	116.61	0.002

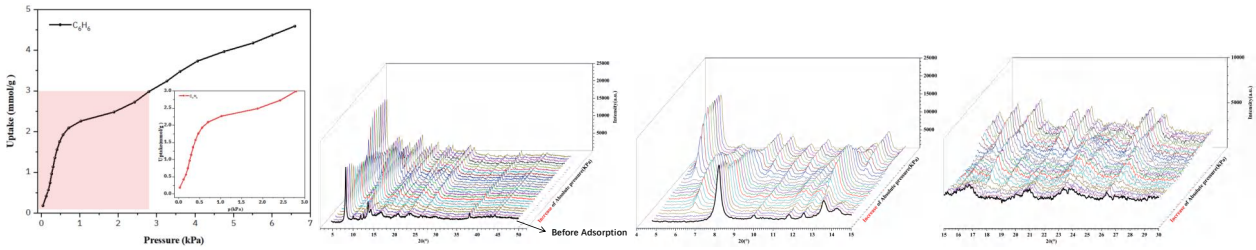
Expandable BET Surface Area and Full-Range Pore Size Distribution

Temperature-Controlled In Situ Transfer System

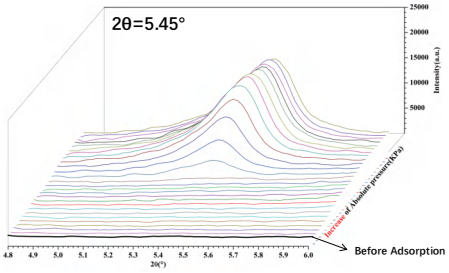
The transfer line features an independent temperature-control system that maintains a constant free volume throughout the experiment, ensuring accurate and reproducible measurements under in situ conditions.

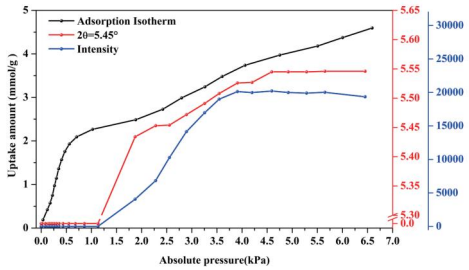
Typical Analysis Results

Unraveling the VOC Adsorption Mechanism in Organic Cage Materials

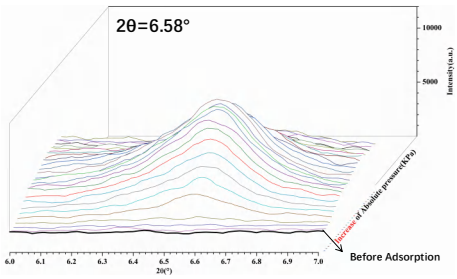


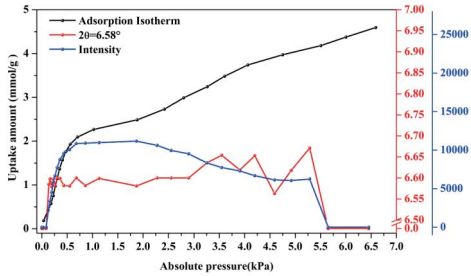
Adsorption isotherms of benzene on organic cage materials at 25°C, combined with in situ XRD patterns collected at each adsorption equilibrium point, reveal distinct and systematic structural evolution throughout the adsorption process.



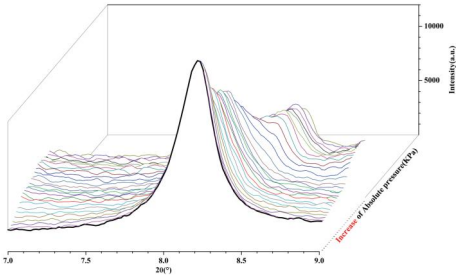


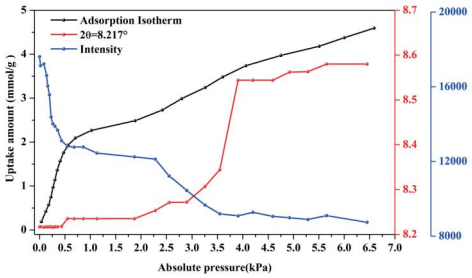
The diffraction peak at 2θ = 5.45° is nearly absent during the initial rapid adsorption stage below 1 kPa, indicating that the corresponding crystalline structure contributes negligibly to adsorption. Above 1 kPa, the peak emerges rapidly, suggesting the formation of a new structural arrangement that continuously contributes to adsorption as pressure increases.





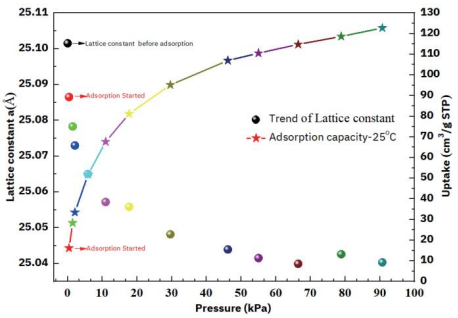
The diffraction peak at 2θ = 6.58° appears simultaneously with the sharp increase in adsorption uptake below 1 kPa, indicating that the corresponding structure plays a significant role in benzene adsorption. Above 1 kPa, the peak intensity remains relatively stable. However, once the pressure exceeds 5 kPa, the peak disappears abruptly, indicating the collapse or transformation of the associated structure and the loss of its adsorption contribution.

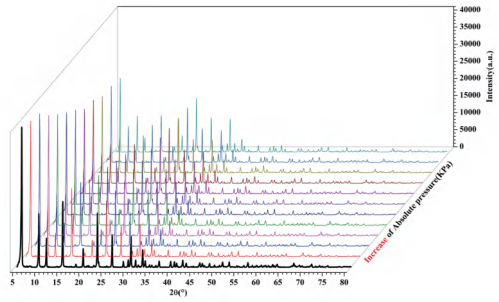




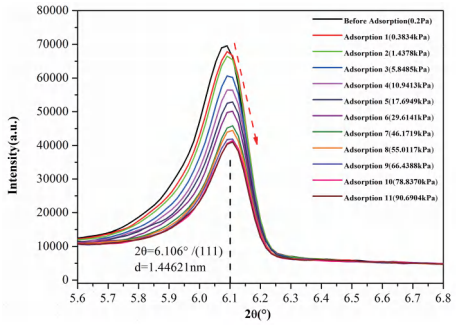
The intensity of the diffraction peak at 2θ = 8.22° decreases rapidly during the initial adsorption stage below 1 kPa, indicating progressive disruption of the corresponding crystalline structure. Above 1 kPa, the peak position gradually shifts toward higher 2θ values while the intensity remains relatively stable, reflecting a reduction in interplanar spacing. In the linear adsorption region above 3 kPa, the peak intensity decreases significantly and the peak continues to shift toward higher angles, indicating further contraction of the crystal lattice. Eventually, the peak disappears completely, suggesting the loss of the original structural ordering.

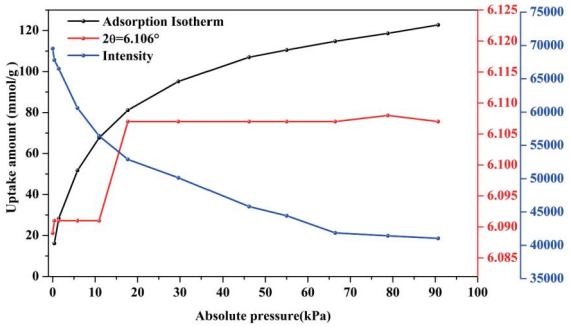
Structural Evolution of NaX Zeolite during CO_2 Adsorption



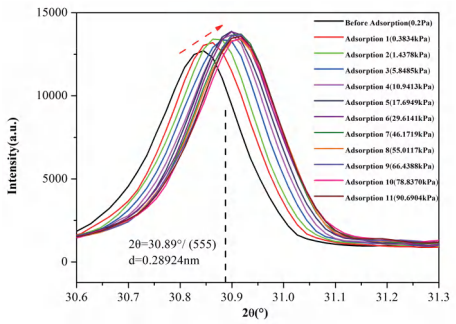


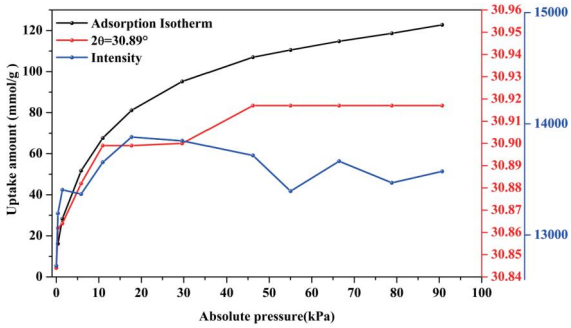
CO_2 adsorption isotherms of NaX zeolite at 25°C, combined with in situ XRD patterns and the corresponding unit-cell parameter (a) determined at each adsorption equilibrium point, reveal a gradual decrease in the unit-cell parameter throughout the adsorption process as CO_2 uptake increases.



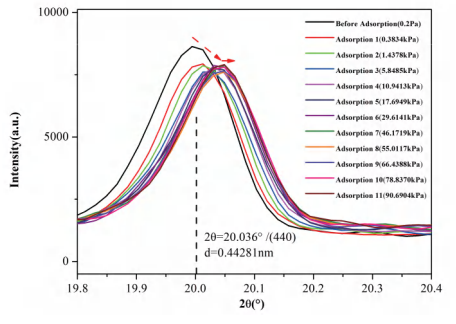


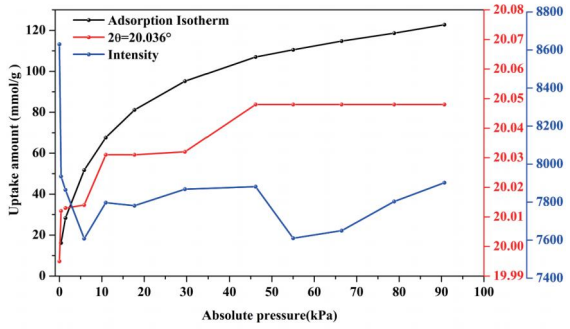
The diffraction peak at 2θ = 6.106° is assigned to the (111) reflection of NaX zeolite. Its intensity decreases continuously with increasing adsorption pressure, while the corresponding interplanar spacing decreases initially and then remains essentially constant after reaching a specific value.





The diffraction peak at 2θ = 30.89° corresponds to the (555) reflection. Its intensity increases during adsorption and reaches a plateau above 20 kPa. Meanwhile, the interplanar spacing decreases progressively and stabilizes at pressures above 50 kPa.





The diffraction peak at 2θ = 20.036° is assigned to the (440) reflection. Its intensity decreases rapidly during the initial adsorption stage, coinciding with the steep increase in CO_2 uptake, and becomes stable above 10 kPa. In contrast to the intensity trend, the corresponding interplanar spacing continues to decrease throughout the adsorption process.

Specifications

Model	Nexus G Core	Nexus G Cryo	Nexus GV Core	Nexus GV Cryo
Adsorbates	Non-corrosive gases		Non-corrosive gases and vapors	
Adsorption Temperature Range	RT to 623 K	85 K to 473 K	RT to 623 K	85 K to 473 K
Pressure Measurement System	≥ 5 high-precision pressure transducers 3 × 1000 Torr, 1 × 10 Torr, 1 × (1 Torr or 0.1 Torr)			
Vacuum System	Turbomolecular pump + mechanical pump			
X-ray Source	Sealed-tube Cu target; Co, Mo, and Ag targets available as options			
X-ray Tube Power	Continuously adjustable, 600 W to 1600 W			
Goniometer	θ-θ geometry, radius: 170 mm			
2θ Scan Range	-3° to 156°			
Angular Accuracy	≤ ±0.01° (NIST-1976a)			
Detector	Direct photon-counting 2D array detector; pixel pitch 55 × 55 μm; 256 × 256 pixel array; selectable 0D, 1D, and 2D operating modes			
Installation Requirements	L 80 in × D 52 in × H 40 in (L 2.0 m × D 1.3 m × H 1.0 m); minimum load-bearing capacity: 1100 lbs (500 kg)			

- G: gas adsorption
- GV: gas and vapor adsorption
- Core: ambient and elevated-temperature operation
- Cryo: cryogenic and temperature-controlled operation

Other Product Lines

Advanced Measurement Instruments (AMI) provides a comprehensive portfolio of solutions for materials characterization. Our product portfolio covers key segments including Gas Adsorption instruments, Thermal Analyzers, XRD, and Reactors. Selected product lines are listed below:

Breakthrough Curve and Mass Transfer Analyzers

Volumetric High-Pressure Adsorption Analyzer

MSB Gravimetric High Pressure Sorption Analyzer

Chemisorption Analyzer

Customized Microreactor

True Density Analyzer

Single Crystal/Powder X-ray Diffractometer

TGA/DSC/STA/TMA Thermal Analyzer

Quadrupole Mass Spectrometer

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