

Material Characterization: The Full Spectrum

Anton Paar offers integrated solutions covering the full spectrum of material characterization. From structure and surface to mechanics and chemistry, we have the advanced tools you need to fully characterize your materials. Achieve complete insight into material properties and a deep understanding of structure, composition, and performance.



Material Characterization

Mechanicals



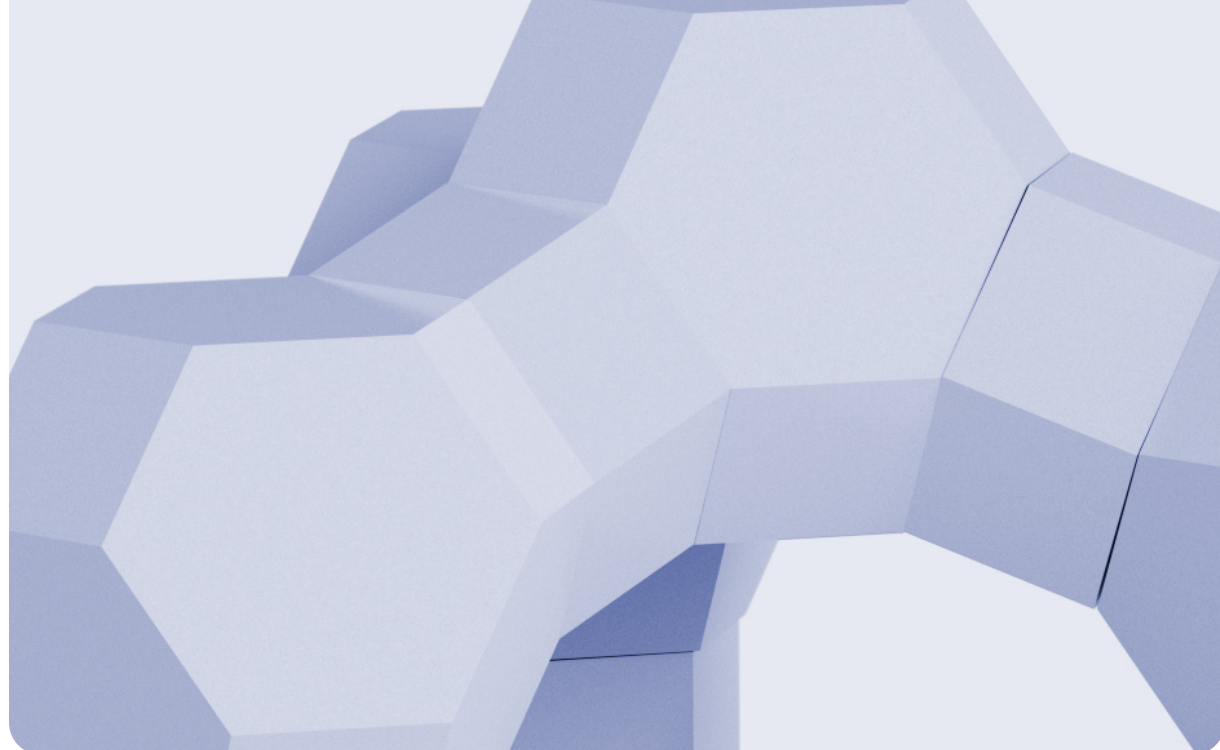
Particles



Instrument solutions



Structures



Surfaces



MCR

SmartMelt

SmartPave

FRS

HTR 7000

Rheometers



Thermodynamics



Chemicals



MCR 703 MultiDrive

Dynamic mechanical analyzer



Julia DSC

Thermal
analyzers



Lyza

FTIR
spectroscopy
instruments



MCR Rheometer + Cora 5001

Cora 5001

Cora 101

Monowave 400 R

Raman
spectroscopy
instruments



Brabender Aquatrac-V

Brabender MT-CA

Moisture
analyzers



Ultratap

Ultrapyc

MCR for Envelope Density Measurements

Density
analyzers



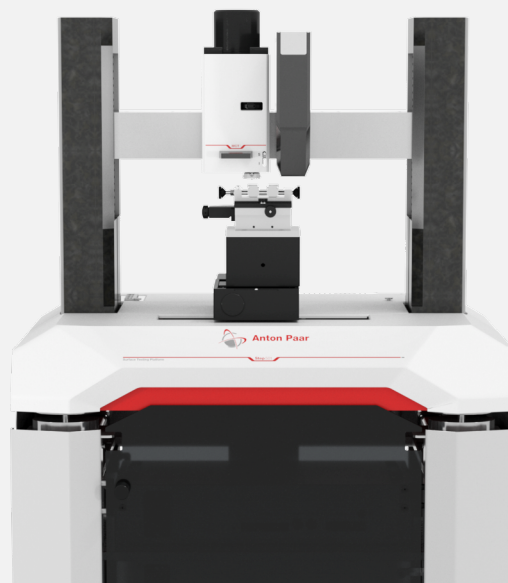
Step

MCT³

NST³

RST

Scratch
testers



Hit 300

Step

MCT³

UNHT³

UNHT³ Bio

NHT³

Instrumented
Indentation
Testers



TRB³

THT

TRB V / THT V

MCR

Tribometers



Litesizer DIF

Litesizer DIA

Litesizer DLS

Particle size
analyzers



XRDynamic 500

X-ray
diffraction
instruments



SAXSpoint

Saxs
instruments

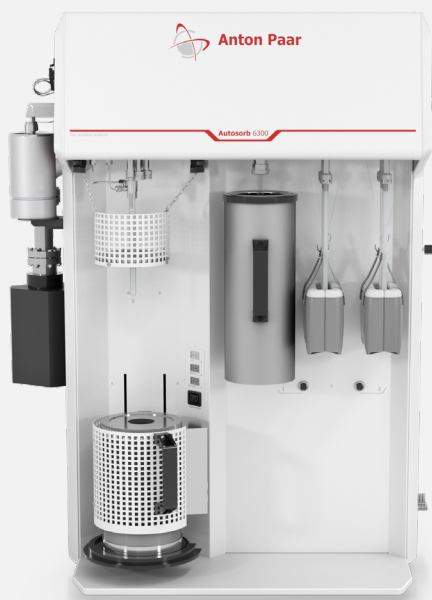


Autosorb

Nova

iSorb

Surface area
and pore size
analyzers



Mechanical and flow properties

↓ Rheometers: How and what do they measure?

[Find out more](#)

↓ Comparison of nanoindentation and conventional hardness

[Find out more](#)

When materials fail under stress

Products may deform, flow inconsistently, or fail under load.

Understanding how materials respond to forces during processing and use is essential for reliable performance.

How Anton Paar helps

- Rheometers characterize viscoelastic and flow behavior.
- Powder rehometry measurement are useful for evaluation of bulk handling and flowability.
- Indentation, scratch, and tribology testing reveal surface mechanical properties.

Your benefit

Predict deformation, optimize processing conditions, and prevent mechanical failure before production.



Particle and morphological properties

↓ Accuracy, repeatability and reproducibility of Litesizer DIF 500

[Find out more](#)

↓ Performing nanometer-scale measurements

[Find out more](#)

When particle size affects product quality

Milling, agglomeration, or dispersion instability can strongly influence performance and processing behavior.

How Anton Paar helps

- Laser diffraction provides robust particle size distributions.
- Dynamic light scattering analyzes submicron particles.
- Image analysis reveals particle size and morphology.

Your benefit

Control particle size, detect agglomeration early, and maintain consistent product performance.



Structural properties

↓ Nanoparticle analysis: real-world insights in record time

[Find out more](#)

↓ Automated and evacuated X-ray optics for improved qualitative and quantitative phase analysis

[Find out more](#)

When performance is hidden in the structure

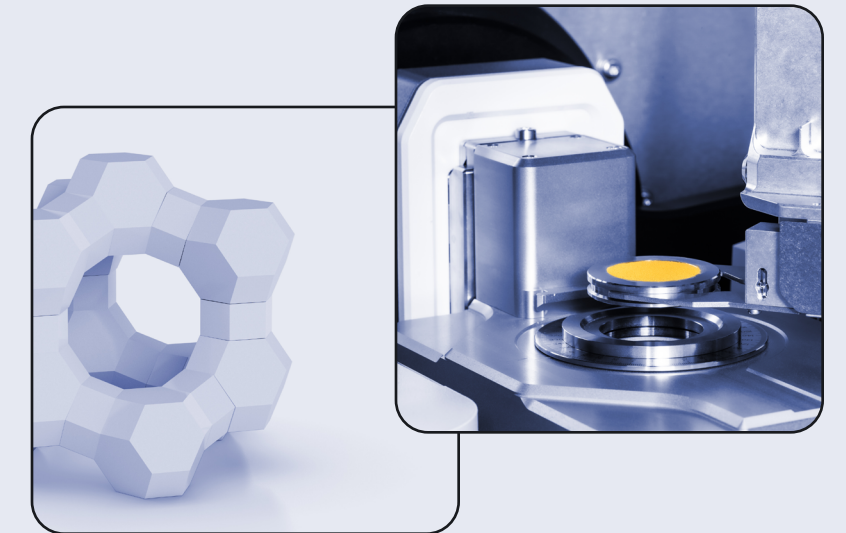
Changes in internal structure often drive material performance but remain invisible without advanced analysis.

How Anton Paar helps

- X-ray diffraction identifies crystalline structure and phase composition.
- Small-angle X-ray scattering reveals nanoscale organization.

Your benefit

Understand how crystal and nanostructure influence strength, stability, and functionality.



Surface and porosity

↓ How to appropriately characterize the BET are of a microporous material

[Find out more](#)

↓ Performing nano-scale measurements

[Find out more](#)

When surface and pore structure matter

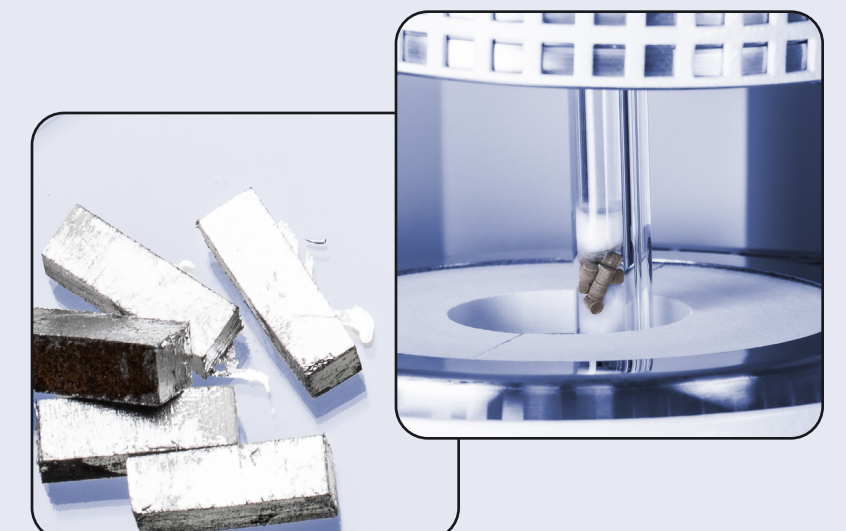
Adsorption, catalytic activity, and reactivity depend strongly on accessible surface and internal pore architecture.

How Anton Paar helps

- BET surface area analysis measures accessible surface.
- Pore size distribution reveals internal pore networks.
- True and envelope density provide insight into material packing.

Your benefit

Optimize surface-driven performance and improve material efficiency.



Chemical and molecular composition

↓ Plastics moisture determination

[Find out more](#)

↓ How to choose the right resolution

[Find out more](#)

↓ Boosting the signal with surface-enhanced Raman scattering

[Find out more](#)

When chemical changes impact quality

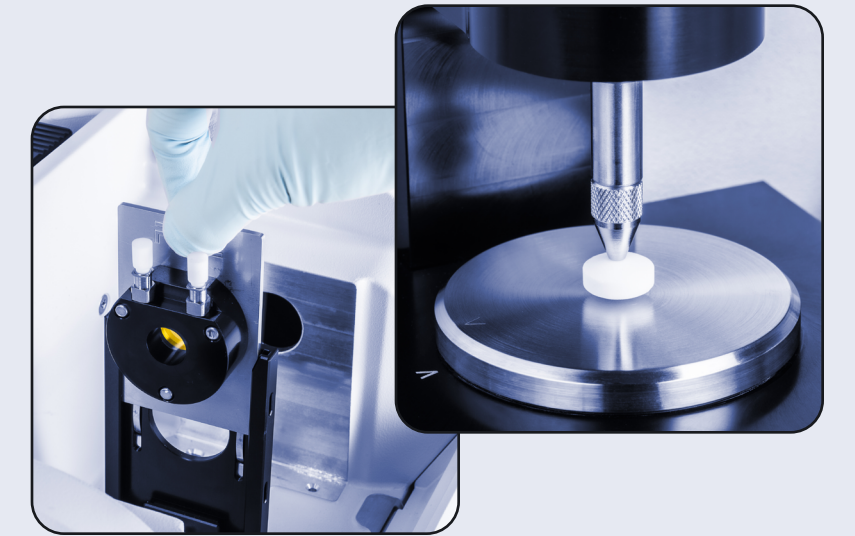
Variations in composition, including moisture content, contamination, or degradation can lead to inconsistent material properties.

How Anton Paar helps

- FTIR spectroscopy identifies molecular composition.
- Raman spectroscopy provides detailed chemical fingerprinting.
- Moisture analyzers quantify water content to detect contamination and ensure consistent composition.

Your benefit

Verify composition, ensure purity, and detect chemical changes early.



Thermal Behavior

↓ DSC characterization of thermoplastics and thermosets

[Find out more](#)

↓ Measurement possibilities in DMA with linear drive configuration

[Find out more](#)

When temperature controls material stability

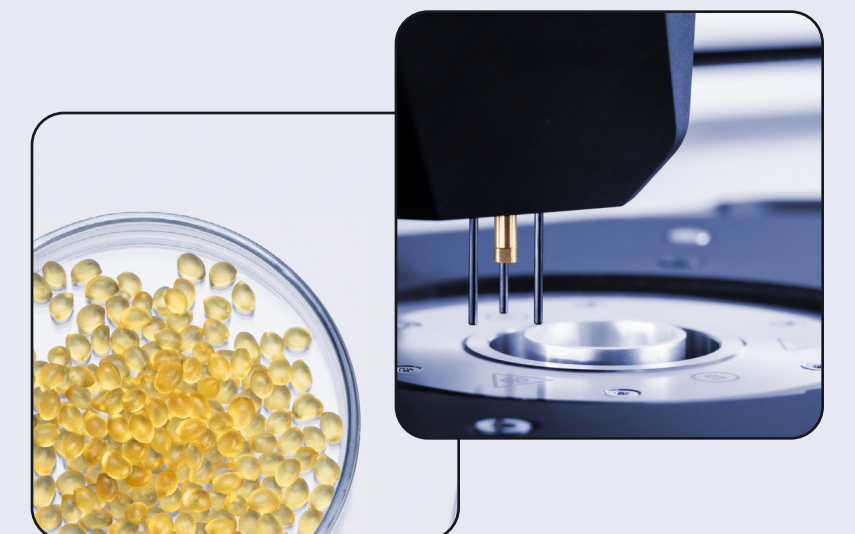
Thermal transitions such as melting, crystallization, or glass transition strongly influence processing conditions and final product performance.

How Anton Paar helps

- Differential scanning calorimetry (DSC) analyzes thermal transitions and heat flow.
- Dynamic mechanical analysis (DMA) measures temperature-dependent mechanical properties and viscoelastic behavior.

Your benefit

Define processing windows, understand temperature-dependent material behavior, and ensure long-term thermal stability.



Property	Key question	Anton Paar technologies				Your benefit
Mechanical	How does it deform?	Rheometer, mechanical surface analyzers Find out more	Instrumented indentation testers Find out more	Scratch testers Find out more	Tribometers Find out more	Predict performance
Particle	How large are the particles?	Laser diffraction analyzer, dynamic light scattering analyzer, dynamic image analyzer Find out more				Stable formulations
Structural	How is it organized?	X-Ray diffractometer Find out more	SAXS instrumentation Find out more			Structure–property link
Surface	How accessible is it?	Gas sorption analyzers Find out more	Gas pycnometers Find out more			Optimized reactivity
Chemical	What is it made of?	FTIR spectrometers Find out more	Raman spectrometers Find out more	Moisture analyzers Find out more	Assured composition	
Thermal	How does it respond to heat?	Differential scanning calorimeters, dynamic mechanical analyzers Find out more				Safe processing

DSC

- Melting temperature (Tm)
- Crystallization temperature (Tc)
- Glass transition temperature (Tg)
- Solid–solid transition temperatures
- Denaturation temperature
- Heat flow
- Enthalpy of fusion (ΔHf)
- Enthalpy of crystallization (ΔHc)
- Reaction enthalpy
- Specific heat capacity (Cp)
- Reaction kinetics (conversion vs. time/temperature)
- Purity (via melting behavior)
- Composition (qualitative/quantitative via transitions)
- Oxidation onset temperature (OOT)
- Oxidation induction time (OIT)
- Thermal stability (from decomposition/oxidation behavior)
- Reversing heat flow (modulated DSC)
- Non-reversing heat flow (modulated DSC)
- Enthalpic relaxation
- Residual curing

DMA

- Storage modulus (E')
- Loss modulus (E'')
- Complex modulus (E*)
- Phase angle (δ)
- Damping factor (tan δ)
- Stiffness
- Frequency-dependent behavior
- Strain-dependent behavior (LVR, amplitude sweeps)
- Glass transition temperature (Tg, from tan δ / modulus change)
- Relaxation behavior (time-dependent modulus)
- Creep (deformation under constant load)
- Recovery (elastic recovery after load removal)

Rheometry

- Shear stress (τ)
- Shear rate (γ̇)
- Viscosity (η)
- Complex viscosity (|η*|)
- Storage modulus (G')
- Loss modulus (G'')
- Complex modulus (G*)
- Phase angle (δ)
- Normal force / normal stress differences (N1, N2)
- Yield stress
- Thixotropy
- Creep (deformation vs. time under constant stress)
- Recovery (elastic recovery after deformation)
- Relaxation modulus (E(t))
- Frequency-dependent behavior (ω sweeps)
- Strain-dependent behavior (amplitude sweeps, LVR limits)
- Internal friction angle
- Wall friction angle
- Consolidation/compaction behavior (density vs. load)
- Permeability

Tribology

- Friction force (Ft)
- Normal force (Fn)
- Coefficient of friction (COF = Ft / Fn)
- Angular velocity / sliding speed
- Shear rate (in lubricated contacts)
- Stribeck curve (COF vs. speed)
- Wear

Particle analysis

- Particle size
- Particle size distribution
- Mean particle size
- Particle concentration
- Molecular mass
- Zeta potential
- Multimodal particle size
- Shape descriptors

Gas sorption

- Adsorption / desorption isotherm
- Specific surface area (e.g., BET)
- Pore volume
- Pore size distribution
- Micropore volume
- External surface area
- Heat of adsorption
- Active surface area
- Dispersion (metal dispersion)
- Surface site density

Density

- Skeletal density
- Tapped density
- Carr index
- Hausner ratio
- Bulk density
- Envelope density

Scratch testing

- Normal force (Fn)
- Lateral force (Ft)
- Critical load(s)

Indentation testing

- Force (load)
- Displacement (penetration depth)
- Hardness
- Elastic modulus (Young’s modulus)
- Reduced modulus
- Creep
- Elastic recovery
- Plastic deformation
- Contact stiffness

Spectroscopy

- Substance identity
- Substance quantity
- Molecular bond change
- Crystallinity
- Degree of reactive completion
- Regulatitve state

SAXS

- Particle size, size distribution
- Particle shape
- Internal structure
- Porosity, specific surface area
- Crystallinity
- Orientation

XRD

- Phase identification
- Phase quantification (Rietveld refinement)
- Amorphous content
- Crystallite size
- Residual stress and texture
- Pair distribution function

