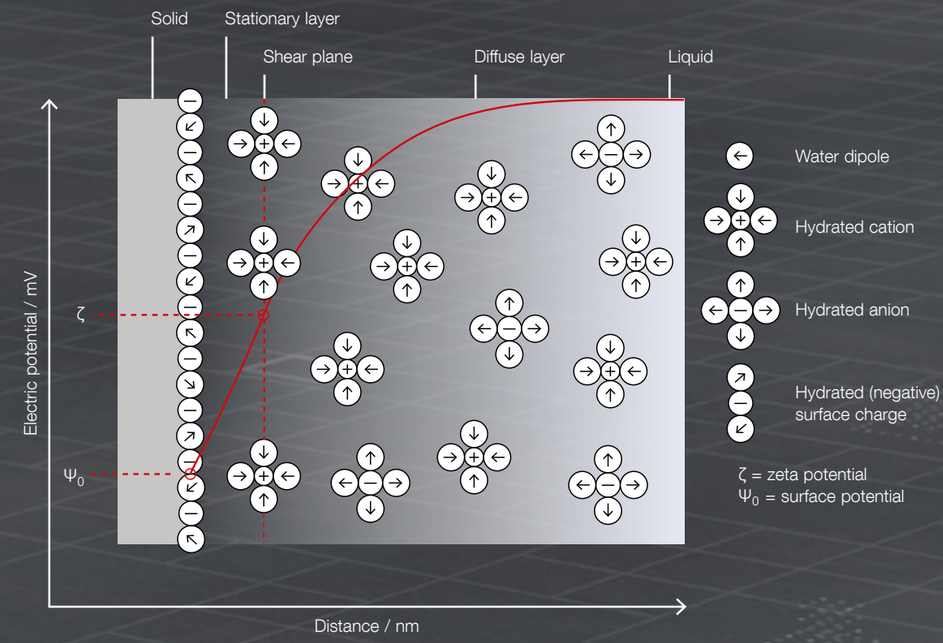
Anton Paar

Zeta Potential of Solid Surfaces

SurPASS 3

The Science Behind Surface Charge

From particles to macroscopic surfaces, the zeta potential is a key parameter to understand surface properties, develop new materials, and control process quality.



Find out more

Highlights

- → No model surfaces required – measure real samples with original geometry (fibers, wafers, implants).
- → Dynamic streaming potential measurements for real-time adsorption kinetics.
- → Integrated automated titration unit for rapid, fully automated pH scans.
- → Simultaneous recording of zeta potential, pH, conductivity, temperature, and pressure.

The electrochemical double layer
When a solid material comes into contact with a liquid, functional groups on its surface interact with the liquid medium, generating an interfacial charge. This creates an electrochemical double layer comprising:

- → A fixed surface charge layer.
- → A diffuse layer of counter-ions

The zeta potential (ζ) is the effective net charge at the shear plane between these layers, measured in millivolts (mV). It fundamentally governs material behavior in liquid environments.

Surface zeta potential reveals

- → Real-time adsorption/desorption behavior of additives, proteins, surfactants, or contaminants.
- → pH-dependent charging trends and isoelectric points (critical for stability).
- → Surface modification effectiveness (coatings, plasma treatments, etc.).
- → Wettability and adhesion properties influencing material performance.

Features and Benefits

Optimize your processes and maximize sample performance with the precision and versatility of SurPASS 3.

	SurPASS 3
Technique	Streaming potential and streaming current
Constant pressure (constant flow) measurement	Yes
Range and resolution	
Streaming potential	± 2,000 mV ± (0.2 % + 4 µV)
Streaming current	± 2mA ± (0.2 % + 1 pA)
Cell resistance	5 Ω to 20 MΩ ± (2 % + 0.5 Ω)
Differential pressure	
with the external pressure supply	3,500 mbar ± (0.2 % + 0.5 mbar)
without the external pressure supply	1,200 mbar ± (0.2 % + 0.5 mbar)
Channel dimensions	Resolution = 1 µm
Conductivity	0.1 mS/m to 1,000 mS/m
pH measurement	pH 2 to 12
Temperature*	5 °C to 40 °C ± 1.5 °C
Repeatability	Standard deviation <2 %
Compliance	ISO 13100:2024 (zeta potential determination in porous materials)

* For measurement below or above room temperature, connection of an external water bath is required.

Direct measurement of real samples
No need for model surfaces – SurPASS 3 analyzes your actual materials, regardless of geometry, size, or surface roughness. This means true-to-life results for every application.

Versatile sample compatibility
From planar solids and fibers to porous materials and soft lenses, SurPASS 3 adapts to virtually any sample, delivering reliable zeta potential data in all cases.

Automated, user-friendly operation
Integrated titration and automatic cell recognition streamline your workflow. Start measurements with a single click – no expert knowledge required.

Multi-parameter data in one run
Simultaneously record zeta potential, pH, conductivity, temperature, and pressure. Instantly track adsorption and desorption in real time with high time resolution (>5 Hz).

Outstanding sensitivity and reproducibility
Achieve zeta potential reproducibility of ±0.5 mV and isoelectric point reproducibility of ±0.1 pH – even for challenging, low-charge surfaces.

Robust, low-maintenance design
Pressure-driven flow with no moving parts in the liquid path ensures long-term reliability and minimal maintenance, even under high-pressure conditions.

ISO 13100:2024-compliant
Meets the latest international standard for zeta potential analysis of porous solids, supporting regulatory and quality requirements.

Key Applications of SurPASS 3

1. Membranes

→ Directly monitor membrane surface charge.

→ Reveal fouling, cleaning efficiency, and modification results.

→ Track zeta potential changes to optimize performance and extend membrane lifetime.

→ Reduce operational costs through improved cleaning processes.

→ Support effective anti-fouling strategies for water treatment, biotech, and energy.

→ Fully ISO 13100:2024-compliant for regulated, quality-focused labs.

2. Biomaterials

→ Assess biocompatibility of implants, sensors, and medical devices.

→ Measure protein adsorption and cell adhesion on material surfaces.

→ Aid development of materials minimizing immune responses and bacterial adhesion.

→ Detect surface modifications to ensure desired biological performance.

→ Support safer, longer-lasting biomaterials for healthcare and research.

3. Cosmetics

→ Measure interactions of ingredients with skin, hair, and textiles.

→ Quantify effects of shampoos, conditioners, and skincare formulations on surface charge.

→ Optimize product efficacy and mildness.

→ Track treatment effects on dye uptake or residue removal.

→ Support development of gentler, more effective cosmetic products.

4. Textiles & fibers

→ Reveal effects of dyeing, washing, and softening agents on fiber surfaces.

→ Measure zeta potential before and after treatment for process optimization.

→ Improve color fastness and fabric softness.

→ Enhance fiber functionalization for superior product performance.

→ Promote more efficient production with reduced waste.

5. Polymers & coatings

→ Provide direct feedback on success of surface modifications like plasma treatment or coatings.

→ Track changes in zeta potential to fine-tune adhesion, wettability, and chemical resistance.

→ Support development of advanced polymers and coatings for packaging, automotive, and electronics.

→ Ensure materials meet demanding specifications.

6. Semiconductors & cleaning validation

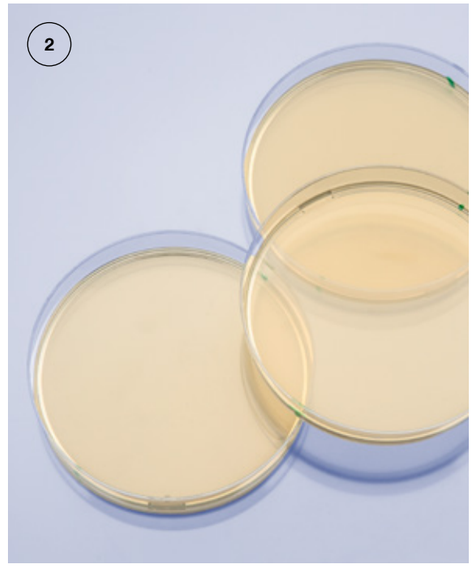
→ Detect trace contaminants on wafers and semiconductor layers.

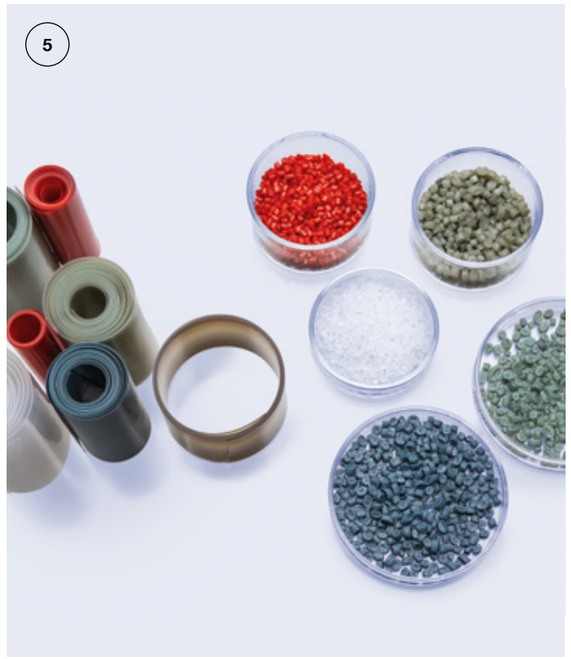
→ Monitor cleaning effectiveness by measuring surface charge before and after cleaning.

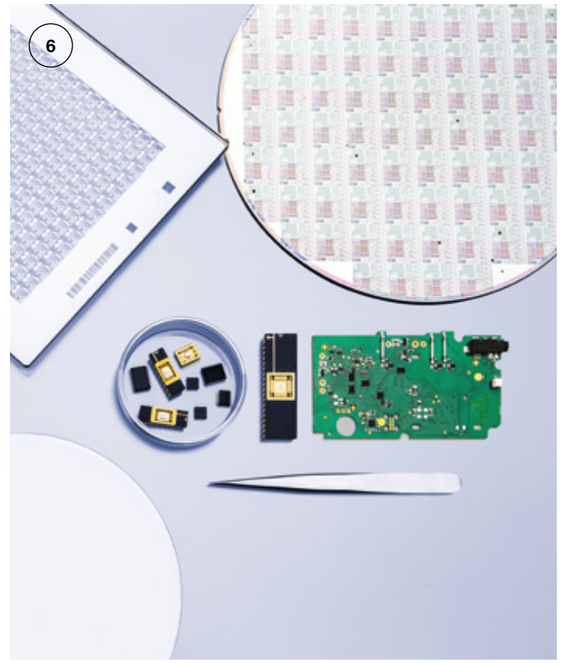
→ Ensure high-purity surfaces critical for microelectronics manufacturing.

→ Help reduce defects and increase yield.

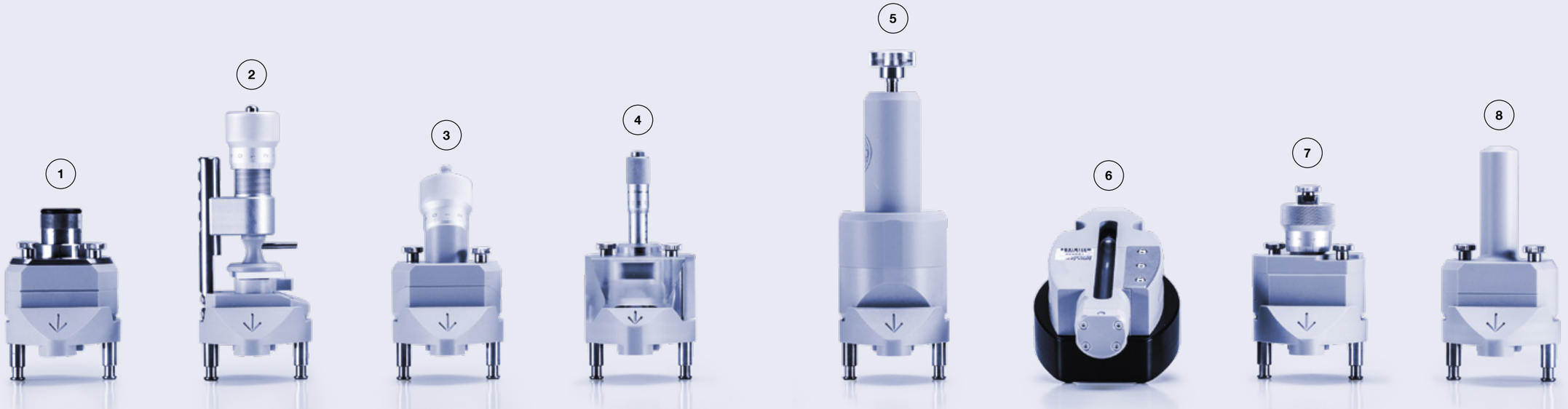
→ Support stringent quality control in advanced technology industries.







The Right Cell for Every Surface



1. Adjustable gap cell	2. Clamping cell	3. Cylindrical cell	4. Measuring cell for flexible tubing
Typical samples			
- Planar samples, polymer films, flat membranes, silicon wafers - Disks, QCM sensors, biological substrates	- Planar samples (rigid/flexible), glass, ceramics, wafers - 2R/4R vials - Cylindrical geological or technical cores (measuring cell for core samples)	Fibers, fabrics, nonwovens, powders, and granular media	Non-porous polymer hoses, hollow fiber membranes
Sample dimensions			
- 20 mm × 10 mm (max. 2 mm thick) - Disks of 12 mm, 14 mm, or 15 mm diameter (max. 2 mm thick)	- Standard: ≥35 mm × 15 mm (max. 40 mm thick); - Small: ≥17 mm diameter - Core samples: diameter: 1 inch to 1.5 inch; length: max. 4 inch	- Min. 100 mg; - Min. 25 µm, max. 1 mm (granular) or 100 µm (powder)	Length: 10 cm to 13 cm; OD: 1 mm to 6 mm (hoses), 0.7 mm to 3 mm (hollow fiber membranes)
Key use cases			
- Flat sheet membranes, films, and small planar samples - Quartz disks, well plate substrates, biosensors	- Large or thick planar samples, glass slides, tiles, semiconductor wafers - Inner surface of 2R/4R vials - Radial/axial zeta potential of core samples	Zeta potential of permeable plugs: textiles, hair, technical fibers, powders	Inner surface of tubing, water treatment membranes

5. Measuring cell for ceramic membranes	6. Measuring cell for hollow fiber membranes	7. Measuring cell for soft contact lenses	8. Measuring cell for syringes
Typical samples			
Single/multichannel ceramic membranes (microfiltration)	Hollow fiber membranes (hemodialysis), coarse particles	Soft contact lenses	Pre-filled glass/polymer syringes
Sample dimensions			
- Length: ~100 mm - OD: 10 mm or 13 mm (single-channel), 25 mm or 30 mm (multichannel)	- Length: 166 mm to 171 mm; - Diameter: 11.8 mm to 12.2 mm (fibers); - 50 µm to 2 mm (particles)	1 lens per measurement	Barrel (1 mL, long version according to ISO 11040-4) - OD: ~8.1 mm; ID: 6.3 mm (glass) to 6.5 mm (polymer); length: 64 mm - Needle length: 12.7 mm; diameter: 0.40 mm
Key use cases			
Tubular ceramic membranes, filtration modules	Hemodialysis fibers, large particles	Surface charge of contact lenses, biocompatibility, and cleaning studies	Inner surface charge of pharmaceutical syringes

Intuitive Software

SurPASS 3 software puts advanced surface analysis at your fingertips – fast, reliable, effortless.

Seamless operation for reliable results
The SurPASS 3 software automates the entire workflow from cell recognition to data export. Start fully automated zeta potential analysis with one click – no expert knowledge needed. It automatically detects the measuring cell and optimizes parameters for your sample.

Automated pH scans and isoelectric point detection
Perform unattended pH titrations and isoelectric point determinations with automatic selection of acidic or alkaline titration – delivering precise results in under an hour.

Real-time adsorption kinetics
Track adsorption and desorption processes on your actual samples with high time resolution (up to 160 ms), thanks to the patented dynamic streaming potential mode. This enables direct observation of rapid surface interactions under steady-state flow conditions – ideal for process optimization and research.

Comprehensive data management
View and save all key parameters – zeta potential, pH, conductivity, temperature, and pressure – in real time, with Excel-compatible export for easy reporting.

Key benefits:

→ One-click measurement start and guided setup

→ Automatic cell recognition and parameter optimization

→ No instrument calibration required – only pH/conductivity probes

→ Fast, reliable results in less than two minutes

→ Exportable data to meet research needs

Background Knowledge and Support

With SurPASS 3, you benefit from Anton Paar's comprehensive global support and a wealth of scientific resources. Our renowned ZETA Guide and detailed application notes provide step-by-step guidance for both new and advanced users. Access a regularly updated library of application reports, technical articles, and the Anton Paar Wiki for in-depth knowledge on surface charge analysis and related topics.

Stay ahead with live and on-demand webinars, video tutorials, and online seminars – covering everything from basic principles to advanced troubleshooting. Our network of over 30 subsidiaries and partners worldwide ensures that an expert is always nearby to assist you in your language, whether you need advice on sample preparation, method development, or data interpretation.

Your benefits:

→ The ZETA Guide for in-depth learning

→ Application notes and reports for practical solutions

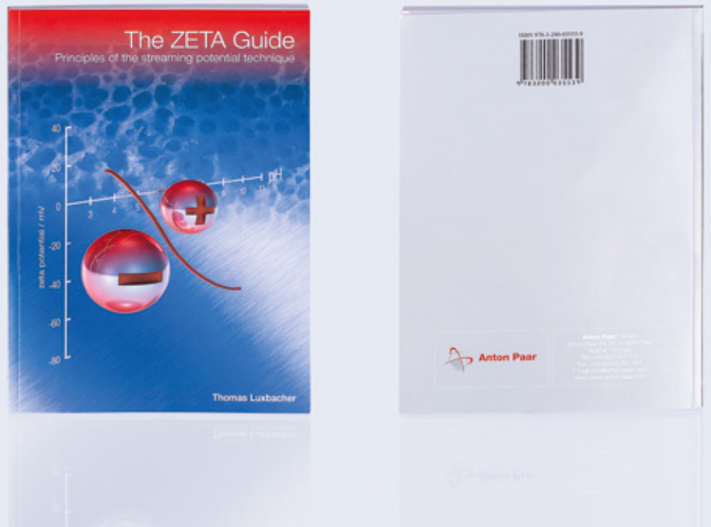
→ Live and recorded webinars, video tutorials, and seminars

→ Anton Paar Wiki and technical articles for instant answers

→ Direct access to application specialists and technical support

→ Local support in your region, in your language

Find out more



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