MICROTRAC
a VERDER company

NANOTRAC FLEX & STABINO ZETA

NANOPARTICLE SIZE & ZETA POTENTIAL

THE PERFECT DUO FOR EFFICIENT PARTICLE ANALYSIS

1974
MICROTRAC launches the first commercial laser diffraction analyzer, MICROTRAC **Model 7991.**

1987
Rollout of the high-precision gas adsorption instrument **BELSORP 28** by MicrotracBEL.

1998
Retsch Technology develops the **CAMSIZER** and its patented dual camera system.

2003
Premiere of the catalysis investigation system **BELCAT** by MicrotracBEL.

2007
Debut of MICROTRAC's **BLUEWAVE** laser diffractor that uses real blue lasers for highest resolution and sensitivity.

2011
Introduction of **CAMSIZER XT** with optional modules for wet and dry measurement.

2013
MicrotracBEL introduces the multi-sample **BET** surface area measurement system, **BELSORP MR6**.

2018
Launch of the MICROTRAC **SYNC**: laser diffraction and dynamic image analysis combined in one instrument.

2020
Merging of Retsch Technology, MICROTRAC & MicrotracBEL into MICROTRAC under the umbrella of Verder Scientific.

2023
Formulaction, a recognized innovator in the field of Stability & Dispersibility analysis, is integrated into MICROTRAC.

Three Centers of Excellence

MICROTRAC: A SINGLE-SOURCE SOLUTION PROVIDER FOR PARTICLE CHARACTERIZATION

PARTICLE SIZE & SHAPE FOR PARTICLE ANALYSIS

Size & Distribution | Shape

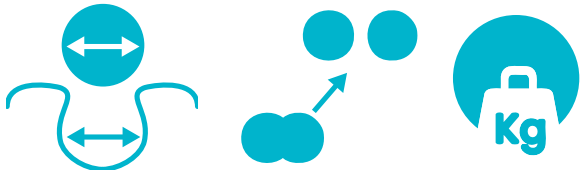
Our expertise in particle size distribution and shape analysis ensures optimal product quality control and supports advanced research efforts. At the core of our technology are **Dynamic Image Analysis (DIA) used on the Camsizer** and a combination of **Laser Diffraction (LD) and Dynamic Image Analysis used on the SYNC** systems. These two technologies cover all your needs for particle size analysis, ranging from 10 nm to 135 mm, whether for dry or wet samples. Our unique size & shape analysis technology utilizes advanced light scattering, state-of-the-art cameras, and sophisticated computational software to deliver outstanding accuracy and repeatability.

COLLOIDS AND FORMULATIONS CHARACTERIZATION

Particle size | Zeta potential | Stability & Shelf-Life

When working with colloids or formulations, the three main parameters to consider are **particle size, zeta potential and stability/shelf-life.** At MICROTRAC, we address all these needs with our comprehensive technology platforms: **NANOTRAC, STABINO, and TURBISCAN**. Our solutions analyze these critical factors to ensure rapid R&D and quality control for the highest product quality. Utilizing **Dynamic Light Scattering (DLS), Static Multiple Light Scattering (SMLS), and Zeta Potential (ZP),** our systems offer unique features such as non-dilution, high accuracy, and fast measurement-enabling you to make fast decisions based on reliable data.

GAS ADSORPTION FOR MATERIALS CHARACTERIZATION



Surface Area & Pore size | Catalysis | Density

We offer advanced solutions for measuring surface area, porosity, and catalytic properties of materials. The MICROTRAC analyzers, celebrated for their precision in **gas and vapor adsorption measurements,** determine BET surface area and pore size distribution for both porous and non-porous materials. These analyzers employ cutting-edge gas adsorption technology and are widely used in various sectors, including Research and Development, Quality Control, and Quality Assurance. These tools are trusted worldwide, reflecting the renowned craftsmanship and quality of Japanese engineering, with comprehensive support provided by our competence centers in Japan (Osaka), Germany (Haan), USA (Newtown, PA) and France (Toulouse). The **BELSORP** and **BELPORE** analyzers are essential for achieving accurate gas and vapor adsorption analysis.

NANOTRAC FLEX & STABINO ZETA

THE MOST VERSATILE AND POWERFUL TECHNOLOGIES ALONE AND IN COMBINATION

NANOTRAC FLEX

The **NANOTRAC FLEX** is the most versatile Dynamic Light Scattering (DLS) analyzer, featuring a unique external probe design. It enables in situ particle sizing and monitoring by turning any vessel into a sample cell without the need for consumables. The probe allows for easy “dip and measure” functionality and accommodates universal solvent compatibility. This compact system is ideal for various applications, offering high precision and ease of cleaning between samples.

STABINO ZETA

The **STABINO ZETA** system excels in fast and precise zeta potential measurements. It can measure zeta potential and streaming potential for particles ranging from 0.3 nm to 300 µm, at concentrations up to 40% by volume. The system’s unique technology allows it to determine multiple parameters simultaneously. The built-in titration function provides comprehensive charge analysis, making it highly efficient for applications such as pH titration, polyelectrolyte titration, and salt titration.

NANOTRAC FLEX AND STABINO ZETA

The **DUO** is a combination of, **NANOTRAC FLEX** and **STABINO ZETA** systems which offer a powerful solution for particle size and zeta potential analyses. This integration allows simultaneous measurement of size and zeta potential within the same sample, enhancing efficiency and providing comprehensive data. The combined use of both systems ensures accurate characterization of particulate systems, making them suitable for diverse research and industrial applications.

Particle Analysis in the Nanometer Range

PARTICLE ANALYSIS DOWN TO NANOMETERS

DYNAMIC LIGHT SCATTERING BY MICROTRAC

MICROTRAC's **NANOTRAC FLEX** consists of highly flexible **Dynamic Light Scattering (DLS)** analyzers that provide information on particle size, concentration and molecular weight. MICROTRAC is a pioneer of particle size analysis and has been developing **DLS systems** for over 30 years. The innovative design of the **NANOTRAC** series allows faster measurements with reliable technology, higher precision, and better accuracy. All of this combined into compact DLS analyzers with a revolutionary fixed optical probe.

The unique and flexible probe design allows the user to choose from a wide array of measurement cells to satisfy the needs of any application. This design also allows for measurement of samples over a wide concentration range, monomodal or multimodal samples, all without prior knowledge of the particle size distribution.

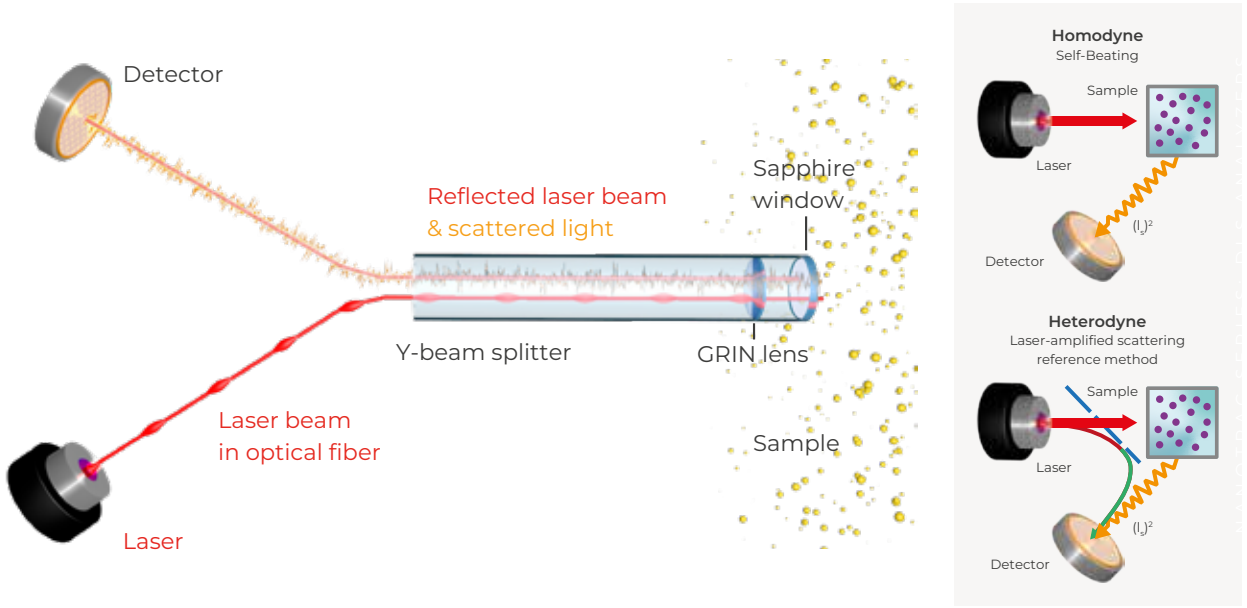
Advantages of MICROTRAC's

DYNAMIC LIGHT SCATTERING

- Measurement range from 0.3 nm to 10 µm
- Concentration up to 40% w/v
- Minimum volume of 2 µl
- Results after just 30 seconds
- *A priori* knowledge of the sample not required
- Easy detection of multimodal and broad distributions without any need to select or input additional information
- Repeatability better than 1% for 100 nm polystyrene
- Temperature range from 4°C to 90°C
- 180° backscatter DLS setup
- Fixed optical setup including external measurement probe
- Frequency Power Spectrum calculation model instead of PCS
- Controlled reference optical signal
- Concentration measurement
- ISO 22412:2017
- FDA 21 CFR Part 11 compliant

NANOTRAC FLEX

180° DYNAMIC LIGHT SCATTERING, THE MICROTRAC WAY



Nanoparticles suspended in a liquid undergo **Brownian motion**, caused by random collisions with molecules in the surrounding medium. The particles' **velocity distribution**, averaged over time, approaches a known functional from - their **size distribution. Dynamic Light Scattering (DLS)** is the technique used to calculate this distribution based on the measured velocity profile.

The optical bench of the NANOTRAC series analyzers is a **probe** containing an optical fiber coupler with a Y-splitter. Laser light is focused on a sample volume near the interface (approx. 50 µm) between the **sapphire probe** window and the dispersion. The high-reflectivity **sapphire window** reflects part of the laser beam back to a **photodiode detector**. Simultaneously, light scattered by particles in the **180° direction** is collected by the probe and directed to the same detector.

Since the **scattered light** has lower intensity than the reflected beam, both signals mix - adding the low-amplitude scattering signal to the high-amplitude laser beam. This **Laser Amplified Detection** method achieves up to 10^6 times better signal-to-noise ratio than traditional DLS techniques like Photon Correlation Spectroscopy (PCS) or Nanoparticle Tracking Analysis.

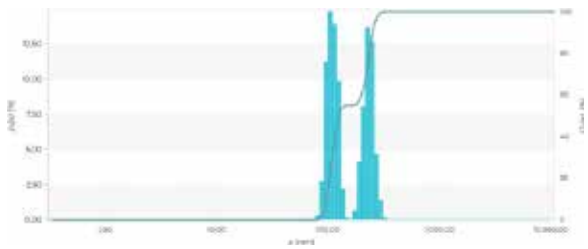
A Fast Fourier Transformation of the Laser Amplified Detection signal produces a linear **frequency power spectrum**, which is then transformed into logarithmic space and deconvoluted to yield the particle size distribution. This method robustly calculates **narrow, broad, mono- or multimodal distributions** without requiring prior assumptions for algorithm fitting, unlike PCS.

Moreover, Laser Amplified Detection is **unaffected by signal aberrations** from sample contaminants. In contrast, classical PCS instruments often require filtration or complex measurement protocols to mitigate such effects.

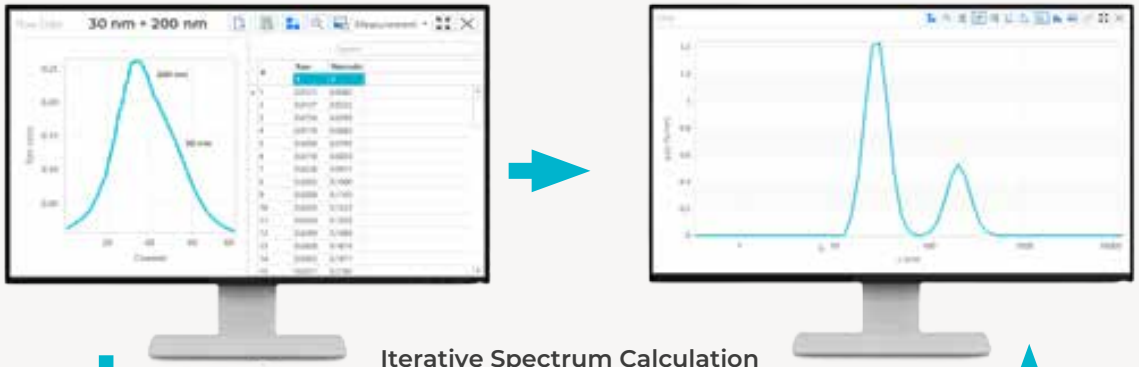
Features

- Complete optical bench in a compact fiber probe
- Laser Amplified Detection technology
- Highest signal-to-noise ratio in the industry
- One calculation for all sample types independent of concentration or distribution shape
- One measurement at one angle, 180°
- Measures particle size, zeta potential, molecular weight, and concentration

The graph displays the distinct advantage of MICROTRAC's **DLS** approach - enabling the simultaneous detection of both 100 nm and 200 nm particles within a single measurement. This dual-particle analysis capability streamlines particle characterization, reducing analysis time while delivering sharper, more comprehensive insights for even the most complex, multi-modal samples.



Iterative Particle Size Calculation from Power Spectrum



Iterative Spectrum Calculation

1. Estimate size distribution
2. Calculate estimated particle size
3. Calculate error in particle size
4. Correct estimated distribution
5. Repeat 1-4 until error is minimized
6. Distribution with minimum error is best fit particle size distribution

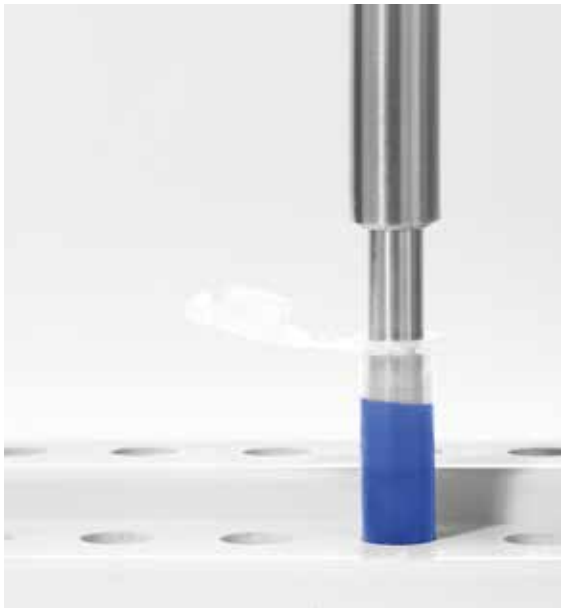
NANOTRAC FLEX

FLEXIBLE *IN SITU* MEASUREMENTS

- Most flexible **DLS** ever
- Unique external probe design
- *In situ* particle sizing and monitoring
- Turn any vessel into a sample cell
  – no consumables required
- External probe allows dip and measure
- Universal solvent compatibility
- Small footprint

The unique probe design of the **NANOTRAC FLEX** allows the measurement of only one droplet as shown in the top left figure. In this case only a minimum sample volume is needed. The probe also fits easily into a 1.5 mL Eppendorf Tube® (top right figure). With the **NANOTRAC FLEX**, every vessel can be used as a sample cell, and there is no need for cuvettes of any kind. This allows the use of the probe either at line or in line to monitor the particles growing during a reaction. During a reaction, the dispersion is either flowing or stirring. The dispersion motion will obscure the Brownian motion, and a **DLS** measurement is normally not possible. To measure in stirring or moving liquids, the **FLOWGUARD** (right bottom figure) can be used. The **FLOWGUARD** creates an enclosure around the probe, which shields the measurement surface from turbulent flow. An orifice ensures the constant exchange of the sample, while slowing down the stirring movement at the probe interface. This design ensures an accurate particle size distribution that is representative of the suspension outside the enclosure. The **NANOTRAC FLEX** probe is also very easy and quick to clean between sample measurements of any kind.

Measurement of a droplet on the tip of the probe



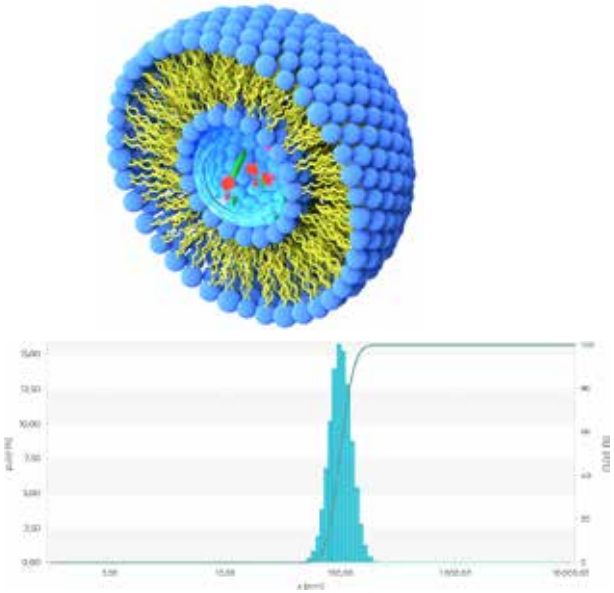
Dip-in measurement with an Eppendorf tube®

Measurement in a beaker or any other vessel

Measurement using the **FLOWGUARD** in a vessel

PARTICLE SIZE OF CAPSULES FOR DRUG DELIVERY SYSTEMS (DDS)
– A CARRIER FOR ANTI-CANCER AGENTS

Drug Delivery Systems (DDS) allow drugs to be delivered efficiently to the affected site while suppressing their adverse effects for the rest of the human body. If the size of the particles constituting the DDS is controlled, it is possible to allow the needed amount of a given drug to be absorbed via a specific site in a living body. Often liposomes will be used as Drug Delivery Systems. Liposomes can be phospholipid capsules possessing an isolated inner aqueous layer in a double-structure lipid membrane, identical to the membranes found in a living body. They are highly effective in suppressing adverse effects and are thus able to be developed, among others, as a carrier for anti-cancer agents. Also, in the field of cosmetics, this kind of capsule has recently begun to be used in various products as it enables the functional ingredients of cosmetics to penetrate efficiently into the keratinous skin layer.

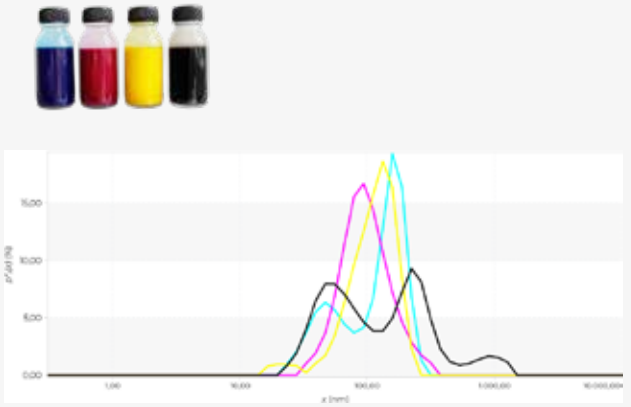


PARTICLE SIZE OF INKS
– IN ORIGINAL CONCENTRATION WITHOUT DILUTION

Modern printing inks contain many components, each having a specific purpose in maintaining color, intensity, dispersion, viscosity, as well as acting as a milling aid. The resulting light scattering affects light fastness, shade, and intensity of color.

The figure shows a typical printout for different colored inks. Note the presence of the bimodal distribution. The samples were measured using the original concentration. The second mode may be indicative of agglomerated particles or individual coarse particles. It may also be characteristic of the ink.

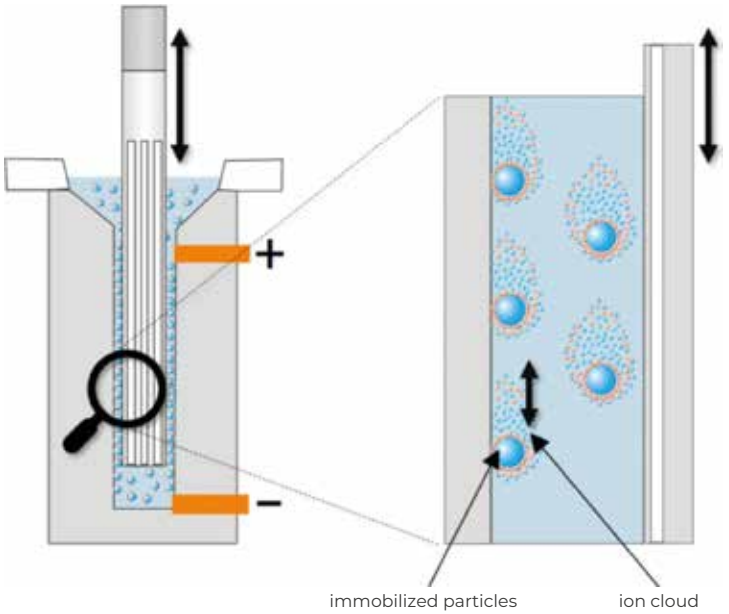
The **NANOTRAC DLS** analyzer family has the capability to measure inks of all colors including black, magenta, yellow and cyan. The measurement can be conducted using high concentrations and can reveal special distribution features such as bimodal distributions and changes in particle size.



Particle size distribution of non-diluted inks
(intensity distribution)

STABINO ZETA

ZETA POTENTIAL AND TITRATION FOR COMPLETE STABILITY



Features

- 5 measurement parameters at the same time
- “Mix and Measure” – an enormous advantage
- Adjusted titration speed
- Fast measurement time
- Extension: In-situ size distribution
- Simple operation

At the heart of the **STABINO ZETA** is a cylindrical PTFE cup with an oscillating piston. Charged particles in a polar liquid are surrounded by an ion cloud that balances the charge between the particle surface and the liquid. When the solvent moves, this ion cloud is deformed, resulting in charge separation.

The **STABINO ZETA** generates this effect through liquid flow caused by the piston’s oscillation. While the particles remain immobilized on the container walls, the moving liquid induces charge separation. This zeta or streaming potential is measured via two electrodes and serves as an indicator of particle stability against agglomeration. After calibration, the signal is output as flow potential or zeta potential.

Titration solutions are added automatically via integrated pumps from two storage containers. The liquid movement ensures rapid homogenization during titration, enabling fast and reliable measurements. In addition to zeta potential and titrant volume - used to calculate charge density - the system also measures temperature, pH, and conductivity.

STABINO ZETA

FAST ZETA POTENTIAL MEASUREMENT & TITRATION

- Zeta and streaming potential in one measurement
- Up to 5 measurement parameters simultaneously
- Charge analysis of particles from 0.3 nm up to 300 µm
- High concentration range from 0.01 to 40 vol%
- Zeta potential at high conductivity
- No optical parameter needed
- “Mix & Measure” technique
- Zeta potential mapping tool for formulation
- Can be combined with **NANOTRAC FLEX** for particle size analyses
- Easy to use software
- Integrated titrator by default

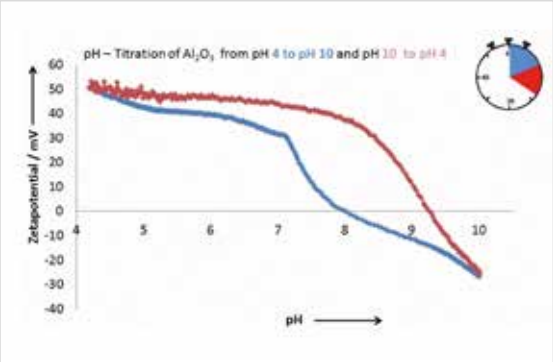
The **STABINO ZETA** provides very fast, precise, and reproducible zeta potential measurements due to its high resolution and data point density, respectively. The **STABINO ZETA** can measure the zeta potential of particles in a range of 0.3 nm to 300 µm, with a concentration range of up to 40% by volume.

Thanks to the unique measurement technology, the **STABINO ZETA** can determine five parameters simultaneously within a few seconds. In combination with **MICROTRAC's DLS analyzer, NANOTRAC FLEX,** the size can be measured at the same time, in the same sample.

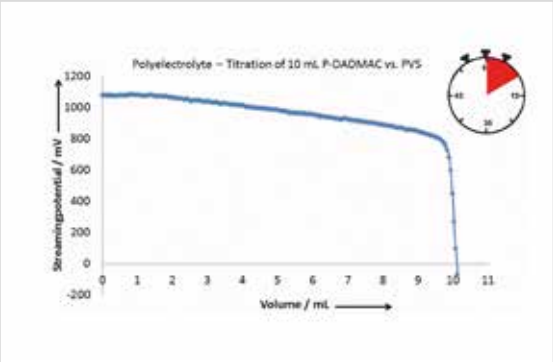
In addition, the **STABINO ZETA** has a built-in titration function where all the parameters are analyzed simultaneously at every dosage step. The determination of the isoelectric point is one of the possibilities of titration and is completed within a few minutes.

The titration applications are:

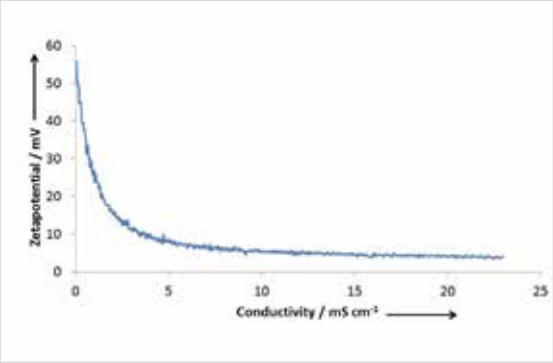
- pH titration
- Polyelectrolyte titration
- Titration with salts



pH forth and back titration of Al_2O_3 from pH 4 to 10 and from pH 10 to 4 with a hysteresis effect



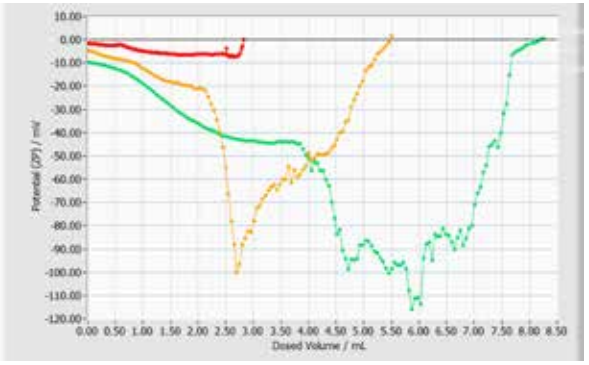
Polyelectrolyte titration of 10 mL P-DADMAC against PVS shown here in streaming potential



Salt titration of Al_2O_3 with 1 mol/l KCl to see the influence of the change of conductivity on zeta potential

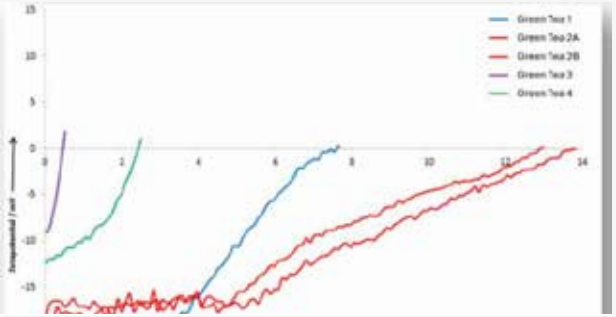
STABINO ZETA
SUNSCREEN STUDIES
WITH NON DILUTION AND FAST ZETA POTENTIAL

Controlling zeta potential is essential for sunscreen sprays, as it affects particle stability and dispersibility. Maintaining optimal zeta potential prevents aggregation, ensuring even skin coverage, improved stability, and effective sun protection, which enhances product quality and consumer safety. Additionally, polyelectrolyte (PE) titration is important for determining the zero point of charge (zeta potential = 0 mV). This measurement helps identify charge density, total charge, number of active ingredients, and the type of charge in cosmetic samples, further optimizing product performance and safety.



Sample	Titrant P-DADMAC Con.	Zeta Potential (0 mL)	V (0 mV)	Chrarge Conc.
red	0.0025 N	-1.6 mV	2.824 mL	0.681
yellow	0.0025 N	-4.6 mV	5.473 mL	1.320
green	0.0025 N	-9.5 mV	8.209 mL	1.980

STABINO ZETA
STABILITY ANALYSIS OF GREEN TEA



Sample name	Starting potential P (0 ml) / mV	Consumption V (0 mV) / ml
Sample 1	-22,0	7,604
Sample 2A	-18,6	13,826
Sample 2B	-19,0	12,945
Sample 3	-9,2	0,464
Sample 4	-12,6	2,429

To predict the long-term stability of green tea, a polyelectrolyte titration to the zero point of charge was performed on four different samples.

10 ml of the original green tea samples were transferred to the **STABINO ZETA** measuring cylinder and then titrated with cationic 0.0025N P-DADMAC polymer solution until the zeta potential reached 0 mV (zero point of charge). To verify the measurement result, a double determination was conducted on sample 2.

In conclusion, **STABINO ZETA** is suitable for rapid stability prediction within a few minutes. Furthermore, a much more precise prediction is given than with classic ‘visual’ test of retained samples. An additional advantage of the **STABINO ZETA** method is that it allows the manufacturing process to be monitored immediately and, if necessary, appropriate counter-measures to be taken.


MICROTRAC
STABIN
ZE
1
2
0,4

DUO

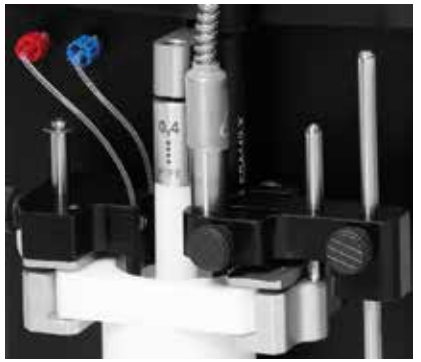
MULTIPARAMETER READING FOR SIZE & ZETA

Features

- Comprehensive Particle Analysis
- Enhanced Understanding of Stability
- Real-Time Titration Capability
- Efficient Workflow
- Versatility
- Improved Data Correlation

The combination of the **NANOTRAC FLEX** and **STABINO ZETA** offers a highly effective solution for colloidal characterization. By integrating these two advanced techniques - dynamic light scattering (DLS) for particle size analysis and zeta potential measurement - this versatile DUO enables comprehensive and detailed analysis of nanoparticle suspensions. This approach facilitates improved process control, formulation optimization, and enhanced product quality.

Additionally, the DUO offer exceptional flexibility, as each instrument can be operated independently or seamlessly together as a single integrated solution.



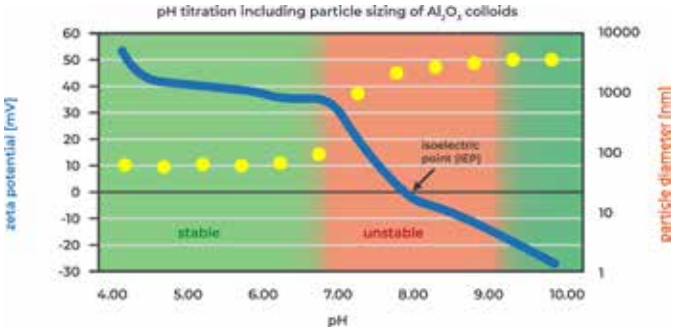
STABINO ZETA

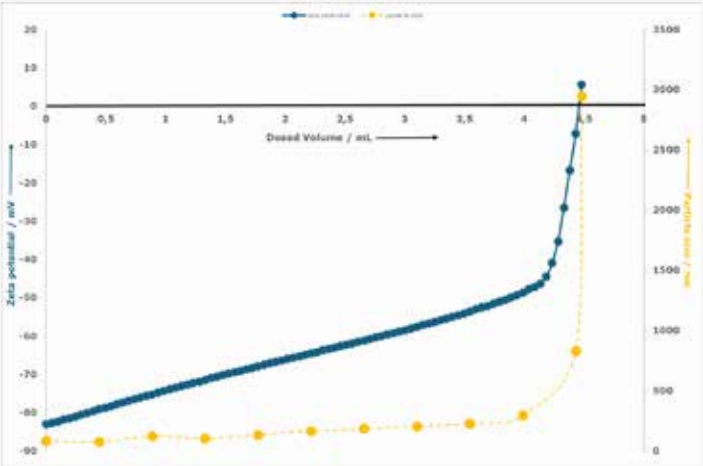
CRITICAL COAGULATION AND STABLE PH RANGES OF AL_2O_3

At the isoelectric point (IEP) during a pH titration, the zeta potential of the particles is 0 mV. At the IEP, an electrostatically stabilized dispersion reaches its maximum instability. However, by this stage, the most significant changes have already occurred. When monitoring pH titration alongside particle size measurements, it becomes evident that coagulation can begin well before the IEP is reached.

It is important to identify this critical coagulation point.

As an example, consider an Al_2O_3 suspension. At pH 4, the particle size is 165 nm and the suspension remains stable. During titration with NaOH, coagulation starts as early as pH 7, even though the IEP is at pH 8.4. Throughout the titration, the zeta potential is monitored as an indicator of the stability of electrostatically stabilized dispersions.





STABINO ZETA

OBSERVATION OF THE AGGLOMERATION OF PIGMENTS DURING A POLYELECTROLYTE TITRATION

One of the key factors in optimizing particle coatings is controlling particle charge and precisely dosing additives, as both directly impact stability and particle size. These considerations are crucial for the daily production of high-quality colloidal dispersions.

The influence of particle charge on dispersion performance can be vividly illustrated by simultaneously measuring particle size and the consumption of ionic additives such as polyelectrolytes (PE).

For example, during the PE titration of a pigment to its zero point of charge (ZPC), a clear increase in particle size is observed as the surface charge decreases. Unlike the isoelectric point (IEP), the coagulation point occurs only at the ZPC, ensuring enhanced stability until this threshold is reached.

MICROTRAC

APPLICATIONS

Dynamic light scattering (DLS) analysis dominates with unmatched versatility, making it a go-to in both research and industry. The MICROTRAC N**ANOTRAC FLEX, STABINO ZETA** or the **DUO** are built for heavy-duty use, easy to run, practically zero maintenance, and ready for non-stop 24/7 action. Crank out high sample throughput and tackle a giant particle size range from 0.3 nm to 10 µm (size) and 300µm (zeta). This technology is not only popular, but also an indispensable part of every professional laboratory.

TYPICAL FIELDS OF APPLICATION

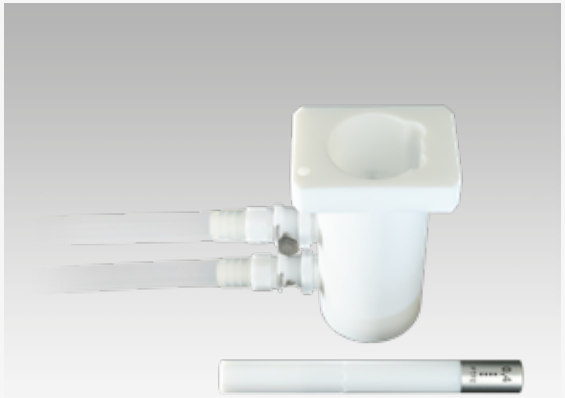
- PHARMACEUTICALS
- INKS / PIGMENTS
- LIFE SCIENCES
- CERAMICS
- BEVERAGES & FOOD
- COLLOIDS
- POLYMERS
- MICROEMULSIONS
- COSMETICS
- CHEMICALS
- ENVIRONMENTAL
- GLUES
- METALS
- INDUSTRIAL MINERALS

ADDITIONAL SOLUTIONS

ACCESSORIES & TECHNICAL SPECIFICATIONS

PISTON SET (100, 200, 400 and 1000 µm)

MEASURING CELL (500 µL, 1mL, 3mL, including piston)

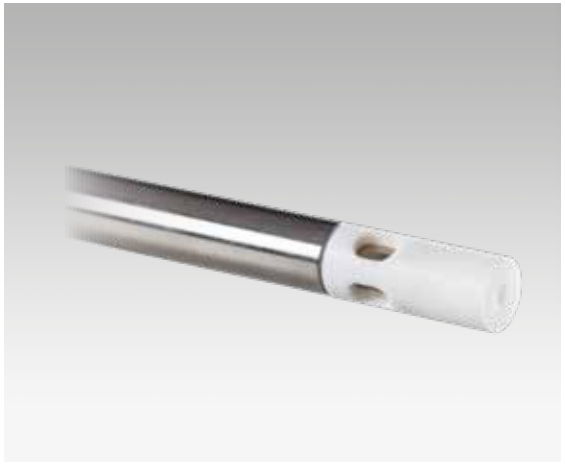


TEMPERED MEASURING CELL (0°C to 90°C)

MEASURING CELL (black, 10 ml)

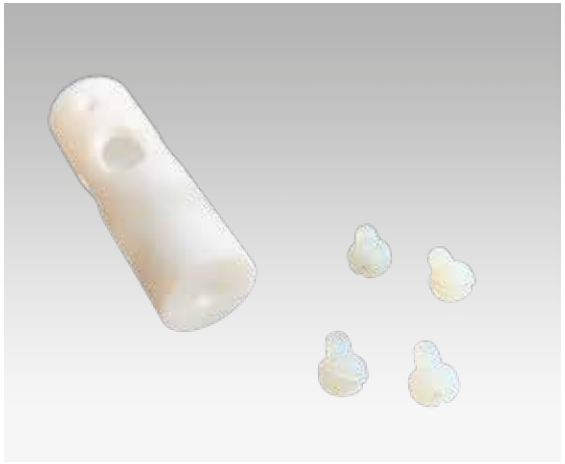
TRANSPORT BAG

- A robust and padded transport bag for safe and comfortable transportation of **NANOTRAC FLEX** or **STABINO ZETA**. The bag is tailor-made for these two devices and ensures a secure fit. The compact design enables easy handling and reliable protection during transportation



NANOTRAC FLOWGUARD Long At-line Probe

- The NANOTRAC FLOWGUARD facilitates in situ **DLS** measurements in a process environment, such as reaction vessels or pipes.



NANOTRAC FLOWGUARD Short Probe

- The NANOTRAC FLOWGUARD turns all **NANOTRAC FLEX** probes in monitoring device for particle growing in a small Reaktion control. (not suitable for at-line use)

System	NANOTRAC FLEX	STABINO ZETA
Method	Backscattered laser-amplified scattering reference method	Zeta streaming potential
Calculation model	FFT power spectrum	-
Measurement angle	180°	-
Measurement size range	0.3 nm – 10 µm	-
Zeta potential measurement	-	✓
Zeta measurement range (potential)	-	-3000 mV – +3000 mV
Zeta measurement range (size)	-	0.3 nm – 300 µm
Electrophoretic mobility	-	max. 200 (µm/s) / (V/cm)
Conductivity measurement	-	✓
Conductivity range	-	up to 350 mS / cm
Molecular weight measurement	✓	-
Molecular weight range	< 300 Da -> 20 x 10^6 Da	-
Temperature range	+4°C – +90°C	0°C – +90°C *
Temperature accuracy	± 0.1°C	
Temperature control	-	✓
Temperature control range	-	0°C – +90°C
Titration	-	✓
Titration type	-	pH, polyelectrolyte, salt
Titration endpoints	-	pH, zeta potential, conductivity, volume and time
At line / in line measurement	✓	-
Reproducibility (size)	≤ 1	
Reproducibility (zeta)	-	± 3%
Sample volume size measurement	2 µl – ∞	-
Sample volume zeta measurement	-	950 µl – 10 ml
Concentration measurement	✓	-
Sample concentration	Up to 40 % (sample dependent)	
Carrier fluids	water, polar and non-polar organic solvents, acids and bases	
Laser	780 nm, 3 mW	-
Humidity	90 % non-condensing	
Dimensions (W x H x D)	180 x 300 x 260 mm	180 x 300 x 260 mm

*No need for dry gas purge

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