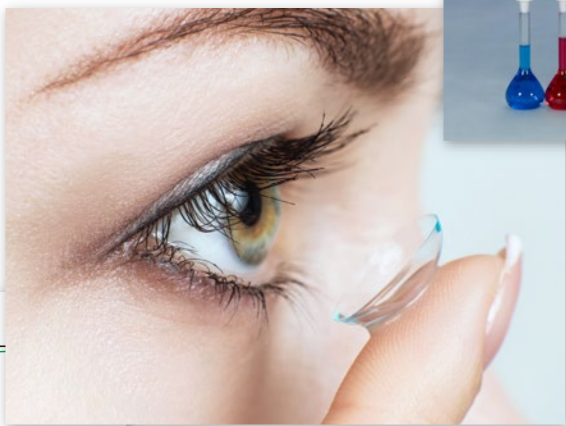
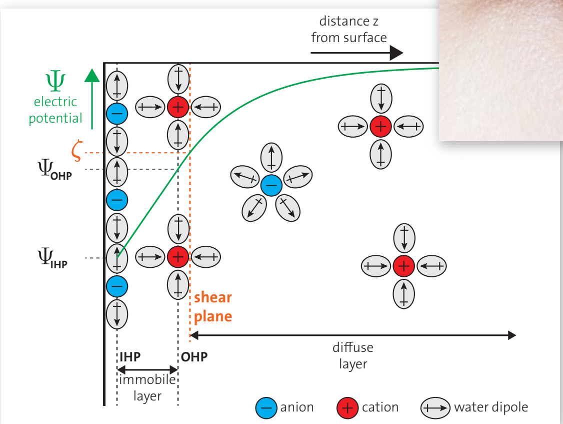
# ZPA 20

Zeta Potential Analyzer



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# Electrical double layer and zeta potential

Ions inside a polar liquid are surrounded by polarised solvent molecules that are loosely bound to the ion. In the case of water this assembly is called a hydrated ion.

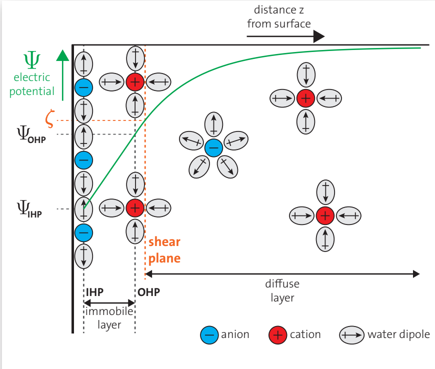
Most surfaces develop a **surface charge** when they come into contact with liquids. The surface charge can be caused by different processes like ion adsorption as well as protonation or dissociation of functional surface groups. The surface charge generates an electric field, which attracts counterions in the liquid towards the surface.

In front of the surface the so called **electrical double layer** forms which consists of an immobile and a diffuse layer. The immobile layer can be further divided into the inner Helmholtz plane (IHP) and the outer Helmholtz plane (OHP). The inner Helmholtz plane is defined by specifically adsorbed ions that are tightly bound to the surface at a short distance. These ions are partly dehydrated. Following this plane of specifically adsorbed ions are counterions which are non-specifically adsorbed and are fully hydrated. This defines the outer Helmholtz plane.

Following the immobile layer is the **mobile diffuse layer** which contains hydrated coions and counterions. The number density of the ions is influenced by the surface charge and hence the density decreases with distance to the surface. In addition to the electrostatic potential of the immobile layer the ions in the diffuse layer experience thermal Brownian motion. Since the ions in the diffuse layer are not bound to the surface they can be sheared off by a liquid flow that is for example caused by a pressure difference.

The electrical potential across the electric double layer can also be divided into two parts. Across the immobile layer the absolute value of the potential is assumed to decrease linearly. Inside the diffuse layer the electrical potential is defined by a Boltzmann distribution.

The potential inside the immobile layer is experimentally inaccessible but is also not relevant for practical applications. The potential at the transition between immobile and diffuse layer on the other hand can be measured.




electrical potential in front of a surface

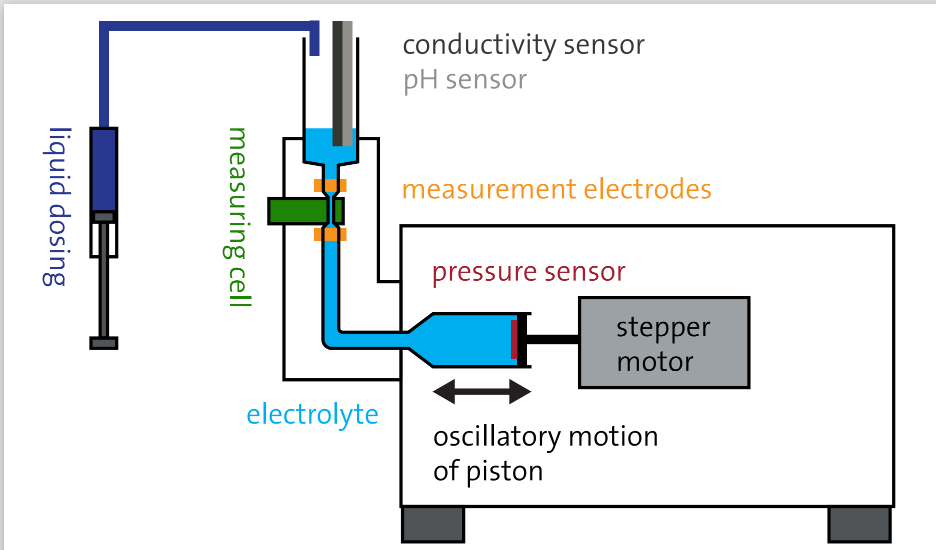
By moving the liquid and the surface relative to each other the ions inside the diffuse layer can be sheared of. The electrical potential at this **shear plane** is called **zeta potential** (ζ potential).

The ζ potential directly influences the stability of colloidal suspensions and gives indications on the adhesion between solids. Furthermore the ζ potential can be used to monitor the adsorption and chemical reaction of ions/molecules, surfactants, polymers etc. with the solid surface.

## Worlds first bidirectional oscillating streaming potential analysis

DataPhysics Instruments patented a measuring technique that uses an oscillatory flow of electrolyte solution through or along the sample. The streaming potential and the currently applied pressure are measured simultaneously together with the temperature, conductivity and pH value of the electrolyte solution. Through the wide range of applicable flow frequencies and amplitudes a fast and precise measurement is possible. The method has the following advantages:

- Oscillation with frequencies of up to 0.5 Hz allows 60 pressure ramps to be recorded in 60 s, leading to a higher statistical quality
- Oscillation flow of the electrolyte solution avoids polarisation effect at the measurement electrodes
- Total surface in contact with the electrolyte is small (no tubing, extra vessels) ensuring an easy and complete cleaning to avoid cross-contaminations
- Open architecture enables fast mixing and data acquisition with time resolved ζ potential measurements for studying of adsorption and surface modification kinetics
- Open architecture allows customisation through attachments such as spectrometers for simultaneous detection of concentration changes and streaming potential.
- Measuring cells can be loaded and prepared outside the system to allow for parallel measurement and sample preparation
- Controlling the packing densities of fibre and powder samples using a torque wrench allows for unrivalled reproducibility in sample preparation
- Transparent measuring cell allows to easily detect sources of errors such as air bubbles.
- Highly sensitive measurements due to large electrode surfaces to detect even the slightest changes of surface properties




schematic measuring setup

## ZPA 20

The **Zeta Potential Analyzer ZPA 20** is a compact measuring instruments that utilises the patented bidirectional oscillating streaming potential method. It is designed to measure the **zeta potential** of various **macroscopic solid samples** with highest accuracy and within shortest time.

The ZPA 20 uses removable measuring cells for various types of materials. Hence, **plate shaped samples** as well as **fibres** and **powders** can be easily prepared and placed into the system. A consistent packing density of powders and fibres can be ensured using a torque wrench.

The ZPA 20 features high precision measuring probes for voltage, current, conductivity, pH value, pressure and temperature.

With its powerful stepping motor the ZPA 20 can create an **oscillating flow** of the electrolyte with frequencies of **up to 0.5 Hz** and hence, the zeta potential can be measured in **under a minute** with a high statistical quality and across a multitude of applied pressures.

Concentration dependent measurements can be done using the optional **liquid dosing unit LDU 25**. For example, the **isoelectric point** can be determined automatically by adding basic or acidic solutions to the electrolyte and hence, changing the pH value.

Zeta Potential Analyzer ZPA 20

## Software for an efficient workflow

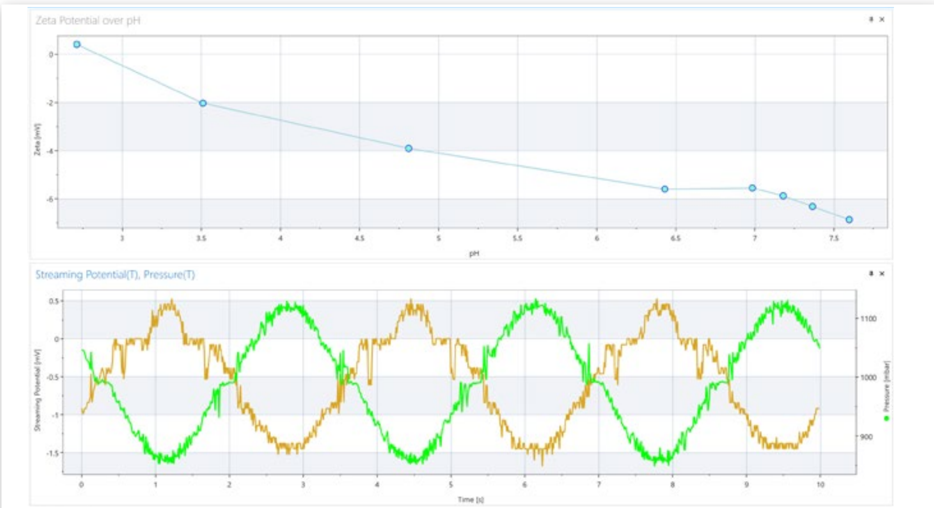
The Zeta Potential Analyzer ZPA 20 is operated using the dedicated ZPA**Software**, which is an application designed for Microsoft Windows®.

Its modern user interface is multilingual (English, German, Chinese, Japanese, Russian, French) and operable either traditionally, using mouse and keyboard, or on multi-touch notebooks/ pads by finger or pen. Thanks to a comprehensive integrated help function the user is smoothly guided through the set-up of both standard single measurements and more complex titration projects.

During the execution of the experiment live plots of all measured quantities, i.e. in particular the streaming potential and the pressure difference, but also conductivity, the pH value and temperature, are displayed. Moreover, the zeta potential is directly calculated and shown.

For projects with changing pH the software automatically calculates the required titration volumes and controls the optional liquid dosing unit. Hence, the entire process of dosing, mixing and measuring can be fully automated and directly yields the characteristic isoelectric point of the studied material.


liquid dosing unit LDU 25


ζ potential over pH and streaming potential with pressure for one measurement cycle using ZPAS

## Technical data

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|---|---|
| **Measuring principle**<br>streaming potential<br>streaming current | bidirectional oscillating streaming potential / current<br>± 2500 mV ±(0.2% + 76 µV)<br>± 2.5 mA ±(0.2% + 76 nA) |
| **Pressure measurement** | 3000 mbar ±(0.5% + 92 µbar) |
| **pH measurement and change**<br>pH range | automatically changeable with optional liquid dosing unit LDU 25<br>pH 2 ... pH 12 |
| **Conductivity** | 0.01 ... 1000 mS/cm |
| **Measuring cells**<br>MC-ZPA/PF<br>MC-ZPA/S | <br>for fibres, powders and granulate materials<br>for plate shaped solid materials; max. sample dimensions: 19 mm x 17 mm x 2 mm |
| **Typical measuring duration for zeta potential** | < 1 min |
| **Dimensions** (L [mm] x W [mm] x H [mm]) | 322 x 617 x 580 |
| **Weight** | 23 kg |
| **Power supply** | 90 ... 264 VAC; 50 ... 60 Hz; 4 A |

**For more information please contact us. We will find a tailor-made solution to your surface chemistry requirements and will be pleased to provide a quotation, obligation-free, for your instrument system.**

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