Malvern Panalytical

ZETASIZER PRO AND ZETASIZER ULTRA

ADVANCE WITH CONFIDENCE



LIGHT SCATTERING ANALYSIS **FOR YOU**

Light scattering is a fundamental analytical technique for the characterization of particulate materials, and is most commonly applied to colloidal systems, nanoparticles and macromolecules in solution or dispersion, to determine particle size, molecular weight, or electrophoretic mobility. Different methods of light scattering analysis provide a range of useful information about your samples:

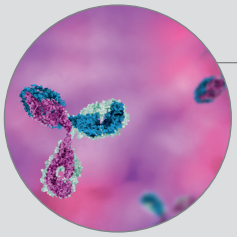
- Dynamic Light Scattering (DLS) measures the size and size distribution of molecules and particles
- Electrophoretic Light Scattering (ELS) measures the electrophoretic mobility of particles or molecules in dispersion or solution – this is often converted to a 'zeta potential'

This data is often critical for establishing and optimizing sample integrity and stability, including the detection of aggregates or agglomerates. Routine use of light scattering analysis helps speed formulation development, gives greater insight into stability assessments, and helps elucidate and solve product and process challenges.



"Our Zetasizer has been imperative in allowing me to analyze my drug-loaded polymeric nanoparticle formulation batches with consistent results. The instrument is easy to use and allows for numerous analytical combinations."

Jessica Castaneda-Gill
University of North Texas
Health Science Center, USA



BIOSCIENCE AND BIOPHARMACEUTICALS

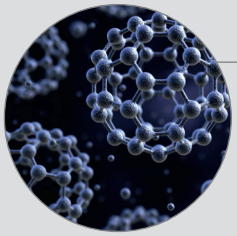
Temperature or pH changes, agitation, shear, and time all impact the stability of biological molecules, causing denaturation and aggregation, loss of function, and possibly undesirable immune response, in the case of biopharmaceuticals.

The Zetasizer® range provides rapid purity and stability screening, and assists with formulation development so that processes and products can be optimized and de-risked



PAINTS, INKS AND COATINGS

Paint, ink and coating formulations must be stable to keep them in an optimum state over time without change or aggregation. Particle size and zeta potential, measured by the Zetasizer instruments, play important roles in determining a product's properties, such as dispersibility, color, strength, finish, durability and shelf life



NANOMATERIALS

Zetasizer measurements of nanoparticle size distribution, dispersion properties, stability and propensity to aggregate are crucial to the design of new nanomaterials. The very large surface area of such materials may result in novel physical and chemical properties, such as increased catalytic activity, improved solubility or unexpected optical or toxicological behavior



FOODS AND DRINKS

Zetasizer systems are used to analyze particle size and zeta potential to improve the appearance and taste of foods, drinks and flavorings, and optimize dispersion and emulsion stability in order to extend product shelf life and improve product performance



PHARMACEUTICALS AND DRUG DELIVERY

The correct particle size and zeta potential can help ensure the production of effective therapeutics, delivered safely. Zetasizer systems are used to characterize the stability and quality of dispersions, emulsions and creams, reducing formulation time and speeding new products to market



ACADEMIA

The Zetasizer is an essential analytical tool for many academic laboratories worldwide, finding use in all applications where particle or molecular size and zeta potential analysis is required. The breadth of applications covered by Zetasizer systems, coupled with tens of thousands of scientific citations, have earned these instruments a central space in many scientific faculties.



CONSUMER PRODUCTS

Improving many consumer goods requires understanding and control of the colloidal parameters guiding interparticle interactions and influencing product stability and performance. An example is the impact of micelle and emulsion particle size and charge on cosmetic and detergent performance. Zetasizer instruments characterize micellar size, charge, and the critical micelle concentration of surfactants, and measure the size and stability of emulsions

WHY USE LIGHT SCATTERING?

There are various types of light scattering, each designed to provide useful and actionable physicochemical information on the sample being analyzed.

The Zetasizer Pro and Zetasizer Ultra both offer two types of light scattering technology as standard: dynamic light scattering (DLS) and electrophoretic light scattering (ELS).

The frequency and intensity of the scattered light can be measured to determine the size and charge of materials. This information is commonly used to shorten development time for, and improve the stability of, colloidal (including protein) and emulsion formulations, and to assess the levels of aggregation in a system.

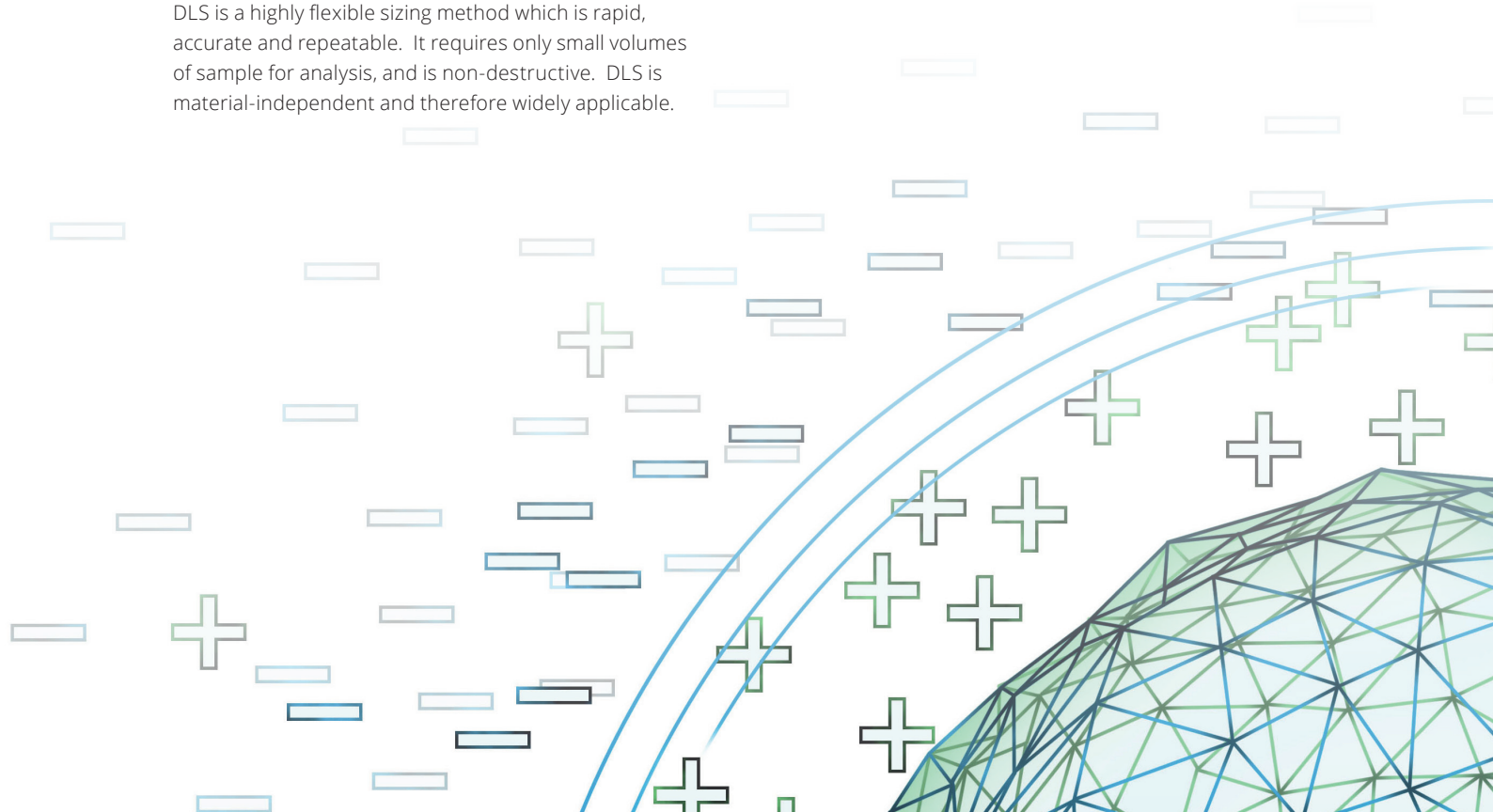
Dynamic Light Scattering (DLS)

Dynamic light scattering is a well-established technique for measuring the size and size distribution, typically in the submicron range, of molecules and particles which are dispersed or dissolved in a liquid. The Brownian motion of these particles or molecules causes the intensity of the light they scatter to fluctuate rapidly. Analysis of these short-term intensity fluctuations yields the speed of the Brownian motion and hence the particle size, using the Stokes-Einstein relationship.

DLS is a highly flexible sizing method which is rapid, accurate and repeatable. It requires only small volumes of sample for analysis, and is non-destructive. DLS is material-independent and therefore widely applicable.

Non-Invasive Back-Scatter (NIBS)

Zetasizer systems include NIBS™ technology, which combines back-scatter detection with variable measurement positioning and high efficiency fiber optic technology. This significantly increases the range of sample concentrations and sizes that can be measured, compared to conventional DLS.





"The Zetasizer is such an easy system to use for the analysis of low volumes of nanoparticles in various dispersants for size and zeta potential measurements. The various cells are easy to use and cover all applications. The auto-titration unit is also very efficient at producing pH, isoelectric and titration results. Malvern Panalytical customer support is just an email away when help or service is needed. This is one of the most used and valued particle analyzers in our lab!"

Corine Goodrich
Pace Analytical Services Inc.,
Minneapolis, USA

Electrophoretic Light Scattering (ELS)

Electrophoretic Light Scattering measures the electrophoretic mobility of particles in dispersion or molecules in solution. This mobility is often converted to zeta potential to enable the comparison of materials under different experimental conditions.

ELS combines light scattering with electrophoresis. A dispersion is introduced into a cell containing two electrodes. An electrical field is applied across the electrodes, and any charged particle or molecule will migrate towards its oppositely-charged electrode with a velocity which is dependent upon its charge. The measured electrophoretic mobility is normally converted into zeta potential using established theories.

The use of ELS commonly relates to stability and formulation applications. Particles or molecules with no net charge may bind together, which may be a challenge in systems such as protein formulations which are prone to aggregation. Particles or molecules which have either a net positive or net negative charge will better maintain a distance from one another, creating a stable system. The formulation containing these particles or molecules is very influential on their charge state, and changes to formulation attributes such as pH , additive concentration and ionic strength can impact product stability and shelf life.



DESIGN **MATTERS**

The Zetasizer Ultra and Zetasizer Pro have recently been awarded a prestigious Red Dot Design Award, emerging as winners from a wide variety of products in 48 different categories from designers and manufacturers across the globe. This international distinction is one of the most sought-after seals of quality for good product design.

The Zetasizer Ultra and Zetasizer Pro reflect and contemporize the values and heritage of Malvern Panalytical's flagship Zetasizer Nano range, upon which the technology of these enhanced next generation instruments is based. The instruments' new form, incorporating the highest quality materials and refined interface, conveys an assured expertise consistent with their unique enhanced capabilities, helping the user focus on the specifics of the sample measurement in order to deliver more accurate results.

reddot award 2018
winner



A FOUNDATION OF **EXCELLENCE**

Pioneer technologists at the heart of Malvern Panalytical were pivotal to the commercial development of light scattering methods for particle size analysis. Scientists at the Royal Signals and Radar Establishment (RSRE, Malvern, UK), applied digital correlation techniques to analyze the scattering from particles undergoing Brownian motion. This led to the development in late 1971 of the world's first commercial correlator, and to Malvern Instruments and RSRE being jointly awarded the prestigious MacRobert engineering award for Outstanding Technical Innovation on the 20th December 1977.

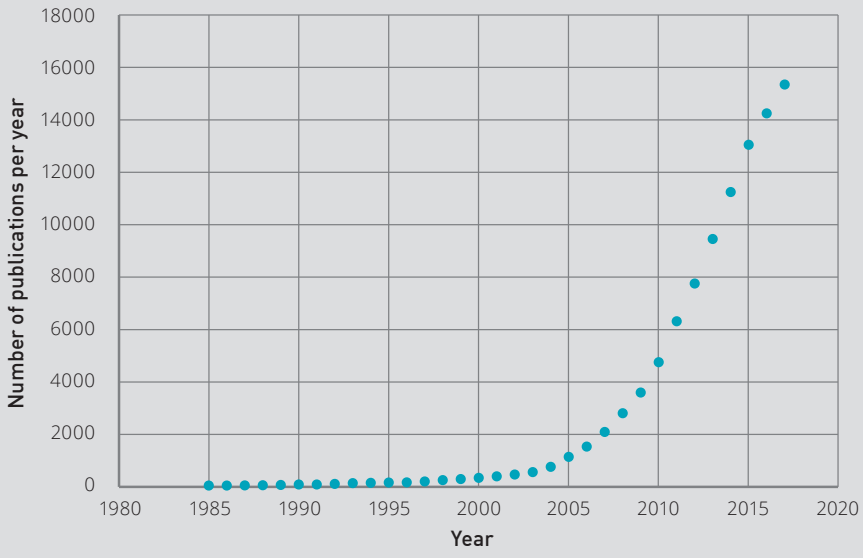
This instrument had applications in aeronautics, marine engineering, fuel performance, and life sciences. Its key application was measuring the size distribution of particles in suspension or macromolecules in solution, by measuring the diffusion coefficient of the scattering entities. Quoting the MacRobert Award Evaluation Committee, responsible for choosing the recipients of the award, "The Malvern Correlator provides an outstanding example of the way in which advanced scientific principles can be allied to the latest technological developments to provide equipment of practical and commercial value."

The technique of Photon Correlation Spectroscopy (PCS), more commonly known as Dynamic Light Scattering (DLS), continued to evolve, with Malvern Instruments' first integrated measurement system, the Autosizer, appearing on the market by the late 1970s. The subsequent development of Electrophoretic Light Scattering (ELS) by Malvern Instruments in the early 1980s resulted in the world's first integrated particle size and zeta potential measurement system, the Zetasizer 2.

In 2003, the Zetasizer Nano family, incorporating patented non-invasive backscatter (NIBS) technology, was launched. NIBS is one of the key features that makes Zetasizer instruments the best-in-class, enabling the ultimate in instrument flexibility by maximizing the dynamic range without compromise, providing the highest sensitivity whilst handling the most concentrated samples, and measuring the very smallest particles as well as the very largest. It is the accessibility, versatility and ease of use of this range of instruments that has made light scattering an analytical mainstay for applications ranging from ink manufacture to drug delivery.

Publications referencing Zetasizer

Today, the design award-winning Zetasizer Pro and Zetasizer Ultra continue the legacy of Malvern Panalytical's pioneering scientists from the 1960s and '70s, building on this strong foundation and incorporating the very latest advances in hardware, software, technology and intelligence. With more than 80,000 scientific citations to date, it is clear that Zetasizer systems bring value across a broad spectrum of industrial and academic sectors, where they are widely used to speed and optimize both processes and products.



Data from Google Scholar, accessed 24th April 2018

ZETASIZER PRO



Fast

The Zetasizer Pro is a robust and versatile solution for routine laboratory measurements of molecular size, particle size, electrophoretic mobility and zeta potential. Size measurements can now be performed more than twice as quickly, compared to previous models, accelerating sample throughput and freeing up operator and system time for other tasks.

Simple

ZS Xplorer software is designed to simplify and automate even complex analysis, allowing challenging measurements to be completed without expert knowledge. Its unique sample-centric workflow delivers the ultimate in usability and flexibility, meaning it's faster and easier than ever to get from sample input to result output.

Intelligent

A common challenge with light scattering is dust contamination – this can now be intelligently identified and filtered from the data. It's also immediately apparent if results aren't quite as expected and need a little more attention. Integrated deep-learning empowered data quality guidance offers instant feedback, flagging any queries and providing actionable advice on how to improve lower quality data.



Optical filters

Both the Zetasizer Pro and the Zetasizer Ultra incorporate an optical filter wheel allowing NIBS size measurements to be made with either a fluorescence filter or horizontal and vertical polarizers in the detector path, if desired. The fluorescence filter allows users to measure previously challenging fluorescent samples by blocking emissions from fluorescence to improve signal-to-noise. The polarizers allow users to explore the effect of polarization on their samples and make depolarized DLS measurements.



ZETASIZER PRO **KEY FEATURES AND BENEFITS**

- Dynamic Light Scattering (DLS) measures particle and molecule size, from below 1 nm to 10 µm
- Electrophoretic Light Scattering (ELS) measures the zeta potential of particles and molecules, indicating sample stability and/or propensity to aggregate
- Sample-centric ZS Xplorer software enables flexible, guided use, and provides assistance as required
- The deep-learning empowered Data Quality System assists users in understanding which of their size data might be poor, and why. This intelligent neural network system also suggests how to improve results, helping less-experienced users generate excellent quality data
- Optical filter wheel offers a fluorescence filter and both vertical and horizontal polarizers for analytical flexibility
- Adaptive Correlation enables the software to determine optimum measurement duration, and identifies data associated with transient artefacts. Reliable and repeatable data is produced over twice as quickly, providing a truly representative view of the sample
- NIBS (Non-Invasive Back-Scatter) technology maximizes the dynamic range, providing the highest sensitivity for even the most concentrated samples
- M3-PALS with Constant Current Mode measures electrophoretic mobility and zeta potential in high conductivity media – reducing errors that can be associated with electrode polarization at higher ion concentrations

ZETASIZER ULTRA



Advanced

The Zetasizer Ultra is the ultimate companion for fast yet accurate particle and molecule sizing, particle charge and particle concentration measurements, and represents the most intelligent and flexible instrument in the Zetasizer range.

This powerful system has the unique capacity to perform calibration-free particle concentration measurements with ease, even deep into the nano size range.

Assured

Alongside Malvern Panalytical's NIBS (Non-Invasive Back-Scatter) technology, the Zetasizer Ultra offers Multi-Angle Dynamic Light Scattering (MADLS®).

This ground-breaking technique provides high resolution angle-independent size measurements, meaning no more worry about missing particles in your sample. With MADLS, you can be sure that all angles are simultaneously covered.

Expert

Pushing the upper analytical size range higher than ever before, the Zetasizer Ultra is designed to provide data you can trust to help you make those important decisions to improve your products and processes. Despite its unique capabilities, the Zetasizer Ultra's speed and ease-of-use are uncompromised, making it by far the most advanced and powerful light scattering system available.



"The Zetasizer is an excellent instrument for the study of particle size and charge. It is quick and easy to use and reliable in terms of the repeatability of results. I cannot imagine trying to complete my nanoemulsion project without it."

Kunal Kadiya
University of Saskatchewan Canada



ZETASIZER ULTRA **KEY FEATURES AND BENEFITS**

- Multi-Angle Dynamic Light Scattering (MADLS) for high resolution angle-independent size measurements offers greater insight into the size distribution of your sample
- Disposable capillary sizing cell provides the ultimate in non-destructive, low volume (down to 3 µL) analysis, with an upper size range that extends to 10 µm
- Simple, calibration-free measurement of particle concentration in homogeneous sample types, covering a wide range of materials
- Electrophoretic Light Scattering (ELS) measures the zeta potential of particles and molecules, indicating sample stability and/or propensity to aggregate
- Sample-centric ZS Xplorer software enables flexible, guided use, and the capability to build complex methods with ease
- Optical filter wheel offers a fluorescence filter and both vertical and horizontal polarizers for analytical flexibility
- NIBS (Non-Invasive Back-Scatter) technology maximizes the dynamic range, providing the highest sensitivity for even the most concentrated samples
- The deep-learning empowered Data Quality System assists users in understanding which of their size data might be poor, and why. This intelligent neural network system also suggests how to improve results, helping even less-experienced users generate excellent quality data
- Adaptive Correlation produces reliable and repeatable data over twice as quickly, providing a truly representative view of the sample
- M3-PALS with Constant Current Mode measures electrophoretic mobility and zeta potential in high conductivity media

ZS XPLORER SOFTWARE – RESULTS YOU CAN SIMPLY **TRUST**



Even the most advanced instruments need user-friendly, intelligent software to produce the best results. We've rethought and redesigned the new Zetasizer software to create a user interface that shows our world-leading light scattering technology at its finest. This new Zetasizer software package is named ZS Xplorer.

ZS Xplorer is sample-centric. Information on the sample, its conditions, and the variables to be tested are entered at the beginning of a run, and ZS Xplorer uses this information intelligently to optimize the method for that sample. It's as simple as adding a sample name, choosing a cell type and a measurement type, and pressing 'play'.

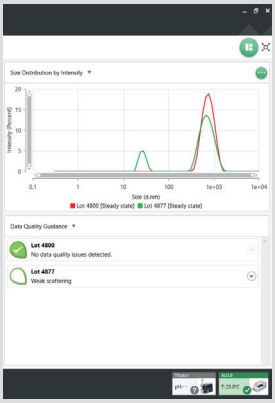
The method can be duplicated for the next sample in the run, after entering a new sample name. For more experienced users, there's full accessibility to all the method and data parameters .

We've made it easier to set up methods in advance and to combine methods for different measurement types. The live measurement display appears alongside the method builder, enabling the user to set up the next sample during a measurement run. In addition, ZS Xplorer will detect potential problems with an experiment, such as cuvette incompatibility, and will provide a warning before the analysis begins.

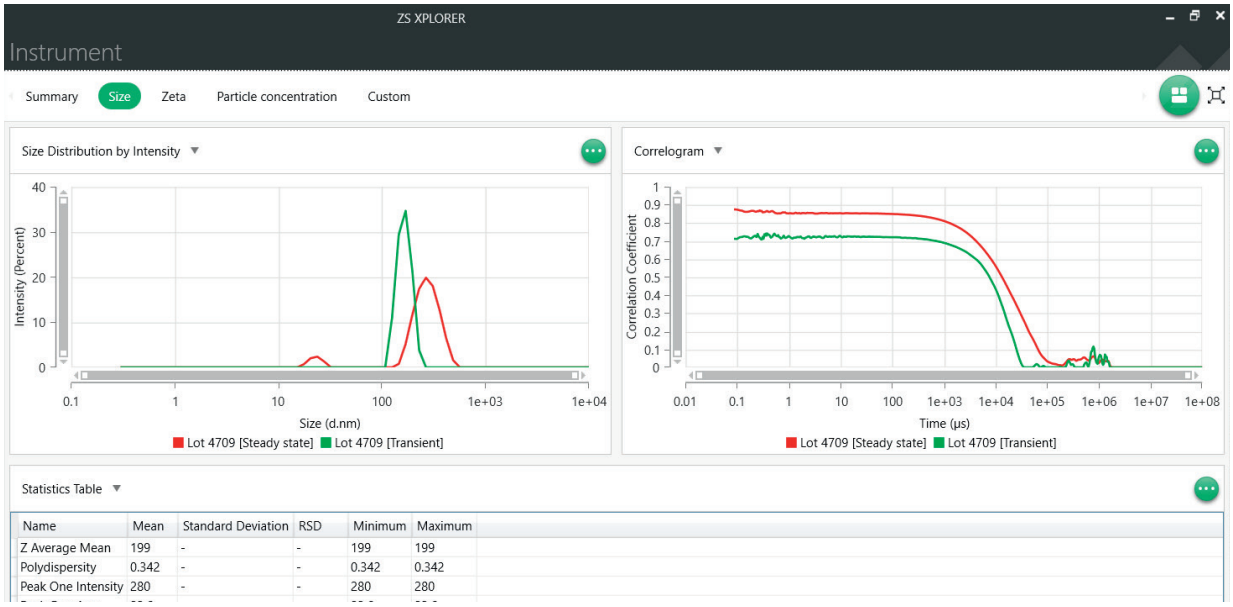
EXPERT GUIDANCE FOR TRUE DATA QUALITY

DLS can be affected by the presence of large aggregates or by multiple scattering at high concentrations, complicating data interpretation. The quality guidance system in ZS Xplorer intelligently applies its integrated expert knowledge to rapidly indicate the quality of data. When the guidance system detects poorer quality data, the interface will provide information about why this may have happened, and actionable advice on how to improve the measurement or the sample.

This feature is particularly useful for less-experienced users and for those analyzing new sample types, providing confidence that the data delivered can be depended upon.



MORE **INTELLIGENT** DATA, DELIVERED FASTER



ZS Xplorer features a new algorithm called Adaptive Correlation that uses information from the sample to determine how long it should be measured for, collecting data until the final answer has become consistent. This feature also applies intelligent logic to separate erroneous data associated with transient artefacts such as dust or aggregates, which may previously have required diagnosis by an experienced user followed by additional sample preparation.

Adaptive Correlation intelligently identifies rogue large particles and filters these from the presented data, but retains populations which are consistently present. This reduces the technique's sensitivity to occasional events and provides a more representative view of the sample.

Adaptive Correlation delivers reliable and repeatable data over twice as fast as ever before.

CUSTOMER STORY

Aqdot® is a Cambridge (UK)-based performance chemistry company with expertise in developing, licensing and selling novel proprietary products. One of their current projects is focused on the development and optimization of polymeric nanoparticles for pharmaceutical delivery applications. Particle size and zeta potential are key attributes measured by the Zetasizer Ultra which help determine this product's stability and efficacy.

Aqdot's scientists found the new ZS Xplorer software to be user-friendly, saving them a significant amount of analysis time. They reported finding the platform intuitive and simple, particularly when it came to building and modifying complex methods. The scientists especially valued the ability to obtain time-resolved data describing the properties of nanoparticles over timescales of a few seconds to several days, with the short-time measurements benefiting from the new shorter acquisition time capability and Adaptive Correlation feature. They appreciated the ability to analyze results and create methods whilst the instrument was collecting new data. In addition, during data analysis, the ability to select multiple records and overlay results made data comparison easy, speeding interpretation.

MADLS – ULTIMATE CONFIDENCE IN YOUR SIZE MEASUREMENTS

MADLS, or Multi-Angle Dynamic Light Scattering, is a revolutionary technology developed by Malvern Panalytical specifically for the Zetasizer Ultra. Within as little as three minutes, MADLS automatically performs a full analysis of your sample at multiple light scattering angles, so that each particle is analyzed robustly with no particle size bias. All data collected is auto-compiled into a single integrated measurement, providing a thorough and dependable picture of your sample , independent of measurement angle.

MADLS helps resolve size populations that may previously have been obscured by larger particles, reducing the need for further characterization by complementary techniques. This groundbreaking technology quickly and simply automates the entire process of performing a multiple-angle size measurement, eliminating confusing manual data interpretation. MADLS provides the ultimate in particle size resolution throughout your sample, and gives you confidence in every measurement you make.

"I found the new ZS Xplorer software intuitive and easy to use. It is very simple to set up a project folder, and the search and navigation tools within the file system are excellent.

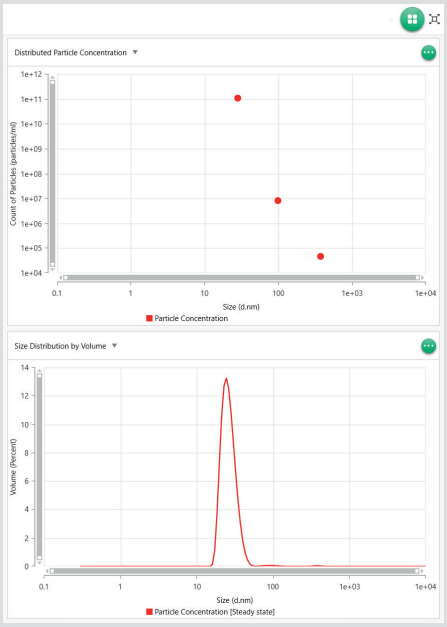
All that's needed to run an analysis is a sample name, cell type, and some basic measurement parameters."

Stuart Reynolds
Domino Printing Sciences
Cambridge, UK

Pushing the limits of particle concentration measurement

Another unique capability of the Zetasizer Ultra enabled by MADLS technology is the calibration-free measurement of particle concentration. This provides a truly representative picture of the sample, unaffected by angular sensitivity, with an increased capability to resolve individual populations. In a sample volume as low as 20 µL, nanoparticles, protein molecules and other particles as small as 1 nm can now be measured in terms of their concentration, allowing you to understand whether these populations are significant.

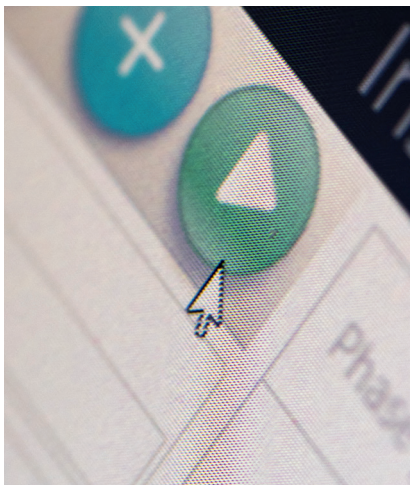
Particle concentration can be measured with little or no sample dilution, minimizing the risk of introducing dilution effects and errors. The technique is equally applicable to monodisperse and polydisperse samples, and is able to resolve the individual concentrations of different size populations.



WHAT DOES THIS MEAN FOR **YOU?**

Simple, sample-centric ZS Xplorer software ensures that the Zetasizer Pro and Zetasizer Ultra can be used by people at all levels of experience. There is no longer any need for users to be light scattering experts, and everyone can perform quick and easy, yet highly accurate experiments.

Sample preparation now requires less stringency, and DLS size measurements can be performed in less than half the time they previously took. The quality of data is increased due to intelligent algorithms that recognize sample artefacts. Together, this means that confidence in reporting the correct result, even for complex, multi-measurement methods, is improved whilst keeping measurement durations to a minimum.



The impact of these developments is wide-reaching:

- The ease and speed of analysis increases laboratory throughput, freeing time on the instrument for other projects
- Generation of excellent quality data, even by inexperienced users, frees more senior scientists for more complex work
- Actionable advice means studies are completed more quickly, with less data interpretation and troubleshooting required
- Consistency of results means less repetition of analysis, saving both sample material and costs, and increasing study impact and integrity
- Confident and quick evidence-based decisions can be made on the next steps to improve products and processes

CUSTOMER STORY

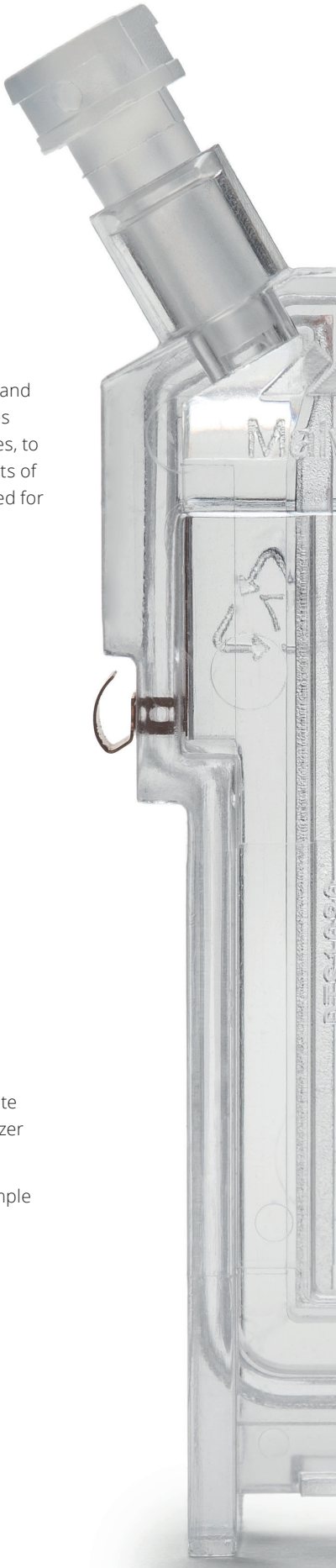
Particle Works, a Blacktrace Holdings Ltd. brand based in Royston, UK, develops and manufactures high performance, cutting edge nanoparticles and microparticles for use in applications including bio-imaging, targeted drug delivery, and controlled drug release.

The brand is known for its high-performance, monodisperse particles, so precise analysis of size, shape and structure is key within both R&D and QC. Transmission electron microscopy (TEM) has traditionally been used by Particle Works for particle sizing and morphological analysis. However, TEM is an expensive, low-throughput and time-consuming technique, which relies on user expertise, and is not applicable for use with every material. In addition, TEM can only measure a small proportion of a sample during each analysis, which calls for an orthogonal technique to verify the whole sample state.

Using the Zetasizer Ultra, the Particle Works team found that using MADLS with Adaptive Correlation data filtering has:

- Dramatically increased sample throughput and sped up the R&D build-measure-learn cycle
- Accelerated the particle development cycle from 12 months to approximately one month
- Enabled the analysis of whole samples, determining true particle size distributions
- Increased the self-reliance of R&D and Production personnel
- Substantially decreased the cost of development, due to reduced reliance on TEM

ACCESSORIES



Disposable folded capillary cell

(Pro and Ultra)

A disposable capillary cell which enables contamination-free, high accuracy size, zeta potential and protein mobility measurements in as little as 20 µL of sample. The new capillary shape provides improved repeatability along with enhanced thermal performance for high conductivity samples, to reduce Joule heating. Although disposable, each cell can be used for hundreds of measurements of low conductivity samples if desired. This cell is not suitable for use with MADLS , but can be used for NIBS and forward scatter size measurements



Low volume disposable sizing cell

(Ultra)

A very low volume (minimum 3 µL) disposable sizing cuvette which extends the size measurement range for the Zetasizer without density-matching of the dispersant.

This cell enables repeatable analysis even at ultra-low sample volumes, delivering high quality data whilst reducing cost. This cuvette is not suitable for use with MADLS



ACCESSORIES

Universal ‘dip’ cell kit
(Pro and Ultra)

A solvent resistant cell for the measurement of zeta potential of samples in aqueous and non-aqueous dispersants, designed to be cleaned and reused. The ‘dip’ cell kit can be used with standard polystyrene or glass cuvettes



High concentration zeta potential cell kit
(Pro and Ultra)

This high concentration cell enables measurement of the zeta potential of samples with little or no dilution required



12 mm square glass cuvette
(Pro, Ultra)

This glass cuvette is compatible with both aqueous and non-aqueous solvents and dispersants, and is used for size measurements, including those performed with MADLS. It can also be used for particle concentration measurements.



Low-volume quartz cuvette
(Pro, Ultra)

This quartz cuvette holds between 12 µL and 45 µL of sample and is used for size measurements. It is compatible with both aqueous and non-aqueous solvents and dispersants, and can be used for MADLS and particle concentration measurements



12 mm glass cell
(Pro, Ultra)

A glass cuvette used for size and zeta potential measurements using the ‘dip’ cell. This cuvette is compatible with both aqueous and non-aqueous solvents and dispersants, and can be used for MADLS and particle concentration measurements



12 mm square polystyrene cuvette
(Pro, Ultra)

A disposable polystyrene cuvette for size measurements, and also for zeta potential measurements when used with the ‘dip’ cell. This cuvette is typically used for samples where cross-contamination might be an issue and can be used for MADLS and particle concentration measurements



Disposable micro-cuvette
(Pro and Ultra (NIBS only))

This disposable plastic micro-cuvette holds a maximum sample volume of 40 µL and is compatible with both aqueous and non-aqueous solvents and dispersants. It is used for size measurements using NIBS. It is not suitable for MADLS or particle concentration measurements.



ACCESSORIES



MPT-3 Autotitrator

(Pro and Ultra)

A cost-effective accessory designed to automate the measurement of size and zeta potential as a function of pH, with new algorithms to improve point spacing precision



SV-10 Viscometer

(Pro and Ultra)

The SV-10 is an extremely simple and rapid system which accurately measures viscosity for the conversion of diffusion speed to size, and electrophoretic mobility to zeta potential. This is a standalone accessory that is particularly useful for complex dispersants for which there are no available standard literature values for viscosity



PRODUCT **SPECIFICATIONS** AT A GLANCE

Parameter		Zetasizer Pro	Zetasizer Ultra
Size			
Measurement techniques		Dynamic light scattering (Non-Invasive Back-Scatter - NIBS) Dynamic light scattering (13°, 173°)	Dynamic light scattering (Non-Invasive Back-Scatter (NIBS) Dynamic light scattering (13°, 173°) Multi-Angle Dynamic Light Scattering (MADLS)
Measurement angles [1]		173°, 13°	173°, 13°, 90°
Range (diameter) [2]		0.3 nm - 10 µm	0.3 nm - 10 µm
Minimum sample volume		12 µL	3 µL
Minimum sample concentration[3]	NIBS (173°) Forward angle (13°) Side angle (90°) MADLS	0.1 mg/mL 10 mg/mL N/A N/A	0.1 mg/mL 5 mg/mL 1 mg/mL 1 mg/mL
Maximum sample concentration [4,5]		40% w/v	40% w/v
Zeta potential			
Measurement technique		Mixed-mode measurement, phase analysis light scattering (M3-PALS)	
Size range suitable for measurement (diameter)[2]		3.8 nm – 100 µm	
Zeta potential range		No effective limitations	
Mobility range		> +/- 20 µ.cm/V.s	
Minimum sample volume[6]		20 µL	
Minimum sample concentration[3]		10 mg/mL	1 mg/mL
Maximum sample concentration[4,5]		40% w/v	
Maximum sample conductivity		260 mS/cm	
Conductivity accuracy		± 10%	
Particle concentration			
Concentration range (30 nm gold)		N/A	1 x 10^8 - 1 x 10^{12} particles/mL
System			
Product compliance		Product laser class 1, EN 60825-1:2014 and CDRH, LVD, EMC, RoHS	
Laser attenuation		Automatic, transmission 100% to 0.0003%	
Laser information	Maximum power output Beam wavelength	4 mW 632.8 nm	10 mW 632.8 nm
Detector		Avalanche photodiode	
Condensation control		Purge facility using dry air/nitrogen	
Temperature control range [7]		0°C - 120°C	
Dimensions (W x D x H)		322 mm x 565 mm x 245 mm	
Weight		19 kg	
Power requirements		AC 100-240 V, 50-60 Hz, 4.0 A	
Power consumption		Max. 100 W, 45 W typical	
Ambient operating conditions		+10°C to +35°C (+50°F to +95°F) 35% - 80% RH (non-condensing)	
Computer interface		USB 2.0 or higher	
Recommended computer specification		Windows ® 7 or 10 64bit OS, 4th generation i7 Processor, 8GB physical memory and 1TB hard drive & DVD Drive	

Notes: 1. Water as sample dispersant; 2. Peak mode range (diameter) 0.6 nm - 10 µm; sample & sample preparation dependent ; 3. Measured using 14.3 kDa protein; 4. Sample-dependent; 5. Measured using bile acid; 6. Using diffusion barrier method; 7. Temperature accuracy 0.1°C at 25°C, 0.2°C at 0°C, 0.5°C at 90°C, 2.5°C at 120°C

Malvern Panalytical

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