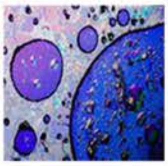
Providing the resolution you need for complex distributions

NICOMP

Dynamic Light Scattering
Particle Size Analyzer

PSS



When there is more to your results than just a Gaussian...

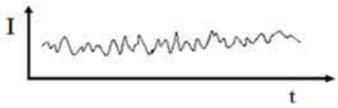
The Nicomp 380 was specifically designed to measure nano-sized particles as well as other colloidal systems. From approximately 0.5 nm to 6 microns the 380 has been the instrument of choice for researchers and top notch scientists for years. Its unique features such as base-line adjust for automatic aggregate compensation and a proprietary high resolution multi-modal algorithm has historically proven its ability to separate close bimodals and native populations from aggregate tails.

Highlights

Wide Dynamic Range	0.5 nanometers to 6 microns
Absolute meaurement	does not require calibration
Large representative sample	is measured quickly
High sensitivity	relatively high sensitivity to aggregate populations (D^6)
Analytical function	assumed for particle size analysis
Complex algorithms	Gaussian or Nicomp
Principle of meaurement	makes it easy to add Zeta Potential analysis capability

Dynamic Light Scattering

Small

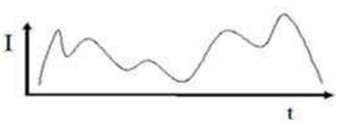


The Nicomp 380 Submicron Particle Size Analyzer uses the principle of Dynamic Light Scattering (DLS) to obtain the partcile size distribution of colloidal systems whose sizes range from 0.5 nanomters to 6 microns. DLS works by illuminating a group of particles in suspension with a focused laser beam which gives rise to many scattered light waves. These waves interfere with each other and produce a net scattered intensity that fluctuates as a function of time at some distant detector. Diffusion, or Brownian motion, of the particles causes random variations in the phases of the individual waves, resulting in a fluctuating light intensity. The particle size distribution can be obtained by analyzing the time behavior of these fluctuations using an autocorrelator. The autocorrelation function for a single uniform size distribution is a decaying exponential function where particle diffusivity is easily obtained from the decay time. Finally the particle radius can easily be calculated using the Stokes-Einstein relationship.

Medium

In general most samples are not uniform instead they are quite often polydisperse, having a range of particle sizes. The autocorrelation function then consists of a combination of decaying exponential functions, each having a different decay time and the analysis of the autocorrelation function is no longer quite simple. The instrument using varying deconvolution algorithms must invert the raw data in order to arrive at the best estimate of the true particle size distribution. The Nicomp excels at characterizing these difficult particle size distributions by utilizing a group of unique deconvolution algorithms ranging from a simple Gaussian approximation to a proprietary high resolution multi-modal deconvolution analyses called the “Nicomp Distribution”.

Large



Some of the unique features found on Gaussian analysis mode is a baseline adjust parameter which provides aggregate compensation that excedes the sensitivity found on most other instruments which employ a dust or dirt factor. The Gaussian analysis mode also allows for the user to specify a solid or vesicle weighting mode for analysing thin walled colloidal systems like liposomes. The Nicomp Analysis Mode is a proprietary high-resolution deconvolution algorithm that was first introduced over 25 years ago. It has historically proven its ability to accurately analyze even the most difficult closely spaced bimodals (e.g. 2:1 apart) and even certain trimodal distributions. This is extremely useful in finding the native peak of the aggregate distribution.

Dynamic Light Scattering

The standard Nicomp 380 is equipped with a 12 mW laser diode and PMT detector with an optical fiber set to 90°. Sample is introduced with drop-in cells.

The 380 is the only Dynamic Light Scattering Instrument designed using a modular approach. Its capabilities may be enhanced by adding one or more modules:

Autodilution

This patented module eliminates the need for manual dilution of concentrated sample. Autodilution makes particle size analysis quick and easy, with no training required. Results are highly reproducible.

380/HPLD High Power Laser Diodes

PSS offers an array of high power laser diodes to meet the needs of our most demanding applications. Higher power lasers are needed to extend the lower limit of our instrument by providing adequate scattering from small particles. They are also useful when measuring large particles such as dextrans, which yield insufficient scattering intensity because of index of refraction properties. The result is a more versatile instrument, ideal for sizing microemulsions, surfactant micelles, proteins and other macromolecules. It can even estimate the extent of aggregration of biopolymers after reconstitution, without chromatographic separation.

Avalanche Photo Diode (APD) Detector

The Nicomp 380 can be equipped with various high-powered lasers as well as a high-gain Avalanche Photo Diode Detector (APD which provides approximately seven times the gain of a conventional photomultiplier tube. The APD is used to increase signal-to-noise and sensitivity in systems that do not scatter light well. Proteins, micelles, other macro-molecular-based systems, and nanoparticles are often dilute (1 mg/ml or less) and are made of atoms that do not scatter light well. The Avalanche Photo Diode coupled with a nominally higher powered laser diode module offers a low cost solution for accurately analyzing nanoparticles in a short period of time.

380/MA Multi-angle Goniometer

Particles larger than 100 nm do not scatter light isotropically in all directions. It is possible to make DLS measurements more sensitive to certain sized particles by changing the angle of detection. The Nicomp 380 can be equipped with a mini-goniometer that moves the optical fiber between 12° and 175° by 0.9° increments.

Zeta Potential

The Nicomp 380/ZLS is designed to measure the electrophoretic mobility and zeta potential of charged particles in liquid suspension. The main reason to measure zeta potential is to predict colloidal stability. The interactions between particles play an important role in colloidal stability. The use of zeta potential measurements to predict stability is an attempt to quantify these interactions. The zeta potential is a measure of the repulsive forces between particles. Since most aqueous colloidal systems are stabilized by electrostatic repulsion, the larger the repulsive forces between particles, the less likely they will be to come close together and form aggregates. Thus the more stable a colloid will be. The Nicomp 380/ZLS combines the techniques of Dynamic Light Scattering (DLS) and Electrophoretic Light Scattering (ELS) to measure both sub-micron particle size distributions and zeta potentials in one compact instrument.

The Nicomp 380/ZLS uses the method of Electrophoretic Light Scattering (ELS) to measure Zeta potential. To make a measurement, a small aliquot of sample is typically placed in a disposable plastic cuvette. Then the palladium electrodes are inserted. The entire cell is placed into the Nicomp 380. Because of the unique cell design, there is no need to align the cell to the stationary plane. After the cell is in place, a simple click of the mouse starts the measurement. Since ELS requires the use of heterodyned light, the scattered light must be properly mixed with a reference beam (split off from the incident light beam) prior to entering the detector. The software will begin a measurement by automatically adjusting the incident light intensity to optimize the mixing between the scattered light and the reference beam. Once this is completed, a reference power spectrum is measured while the electric field is off. Then the electric field is applied and another power spectrum is measured. The change in the frequency of the peak in this power spectrum when compared to the reference spectrum is the Doppler shift. The Doppler shift is used to calculate the average mobility. Using the Smoluchowski equation, the zeta potential is determined.

Autotitrator

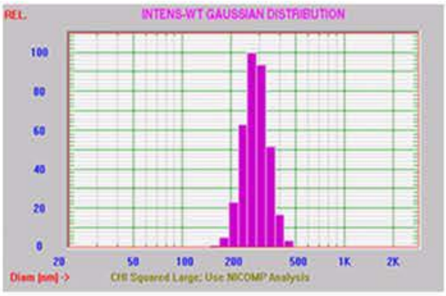
The Autoitrator module gives the Nicomp 380/ZLS the ability to automatically make multiple measurements on the same sample over a series of different pH's or ionic concentrations. This allows iso-electric points to be determined.

Phase Analysis Light Scattering (PALS)

The use of Phase Analysis (instead of the standard amplitude analysis) allows for the more accurate and precise measurement of small Doppler shifts. This means that zeta potential measurements can be made in high ionic strength or high dielectric environments (like alcohols and organic solvents).

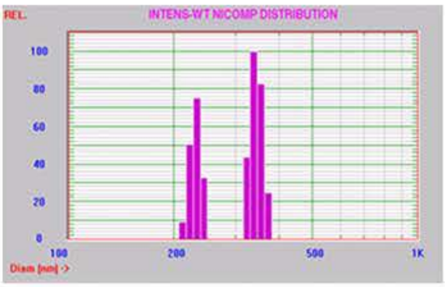
Proven performance for a wide range of analytical approaches

The backbone of the Nicomp 380 is a high-resolution multi-modal deconvolution algorithm that resolves close bi-modal distributions and can even separate a nanomaterials's native peak from its aggregate tail. This is essential for developing and classifying nanoparticles and determining colloidal stability, as seen in the following situations:



Problem

In this bi-modal (consisting of a 70%-30% mixture of a 220 and 340 nm latex standard), the Gaussian approximation falsely reports a peak at 288 nm.



Solution

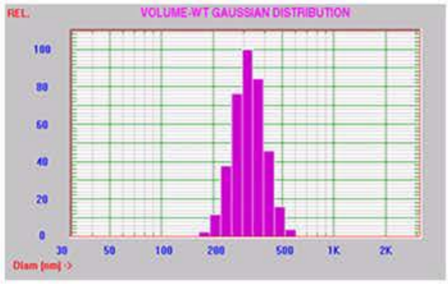
The Nicomp 380 DLS correctly detects a bi-modal with peaks located at approximately 230 and 345 nm, and with volume weighted relative distributions of 38% and 62%, respectively. Note that the 380 also indicates a high Chi Square value, which confirms that a Gaussian analysis is not a good fit.

Problem

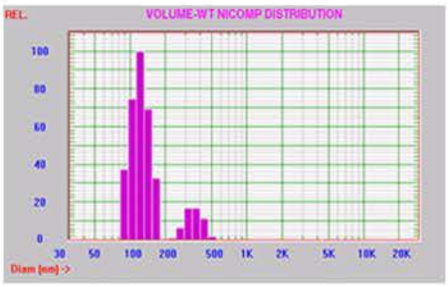
Changes in temperature and other variables can directly impact the outcome of your particle size analysis. Unfortunately, most instruments lack the resolution to detect and track these changes, and can only report a broad uni-modal distribution.

Solution

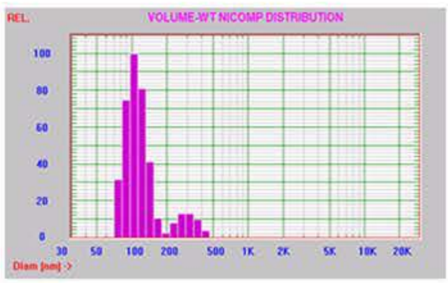
With its proprietary deconvolution algorithm, the Nicomp 380 can track small changes in particle size distribution over time, so distribution shifts and gains can be detected providing valuable insight to the stability and characterisitics of the sample.



Starting conditions: The gel is filled with water at room temperaure (26ºC). When the temperature is raised to 40ºC, the polymer gel will collapse upon itself, and the size will drop to approximately 100nm.



Here, a Peltier block inside the instrument was used to raise the gel temperature to 40ºC for 12 minutes. As expected, the peaks shifted to smaller sizes (Note that the second peak is still positioned at approximately 329 nm - almost exactly where the original materials was found.)



In this case, the peaks shifted to even smaller sizes when the gel temperature was raised to 40ºC for 15 minutes. The second peak's center of mass began shifting to smaller sizes as well.

Nicomp Specifications

Particle Size Range	0.5 nm - 6 microns
Analysis Types	Gaussian or Nicomp high resolution multi-modal
Correlator Channels	1024 + (Logarithmically extended baseline)
Software Options	21 CFR Part 11 compliant software; standard Windows based software
Validation Documentation	Available for standard and 21 CFR Part 11 software
Laser Options	5 mW HeNe, 15 mW, 35 mW, 50 mW, 100 mW laser diodes (red) 20 mW, 50 mW, 100 mW laser diodes (blue/green)
Detector Options	PMT (photomultiplier), CMP (channel photo multiplier 4x gain) & APD (Avalanche Photo Diode 7x gain)
Angular Range	Multi-angle Goniometer (10°-175°)
High-concentration Back Scattering	175° Back Scatter
Solvents	Aqueous, most organics, all wettable parts Teflon, Kel-F and glass
Dimensions	17" wide x 24" deep x 10" high
Weight	Approximately 62 lbs. (depending on options selected)
Sample Cells (Sizing and Zeta)	Standard 4 mL (1 cm x 1cm) cuvet (quartz or plastic), 1 mL glass tubes (disposable), index matched low volume cells as low as 10 uL(can easily be centrifuged to remove dirt and dust)
Flow through Sample Cells (Sizing and Zeta)	Quartz flow cell (all wettable surfaces Teflon, Kel-F, quartz glass)
Modular Options	Zeta Potential (frequency and phase analysis PALS), high-concentration back scattering, autodilution, auto-sampler, multi-angle, high power lasers, high gain detectors, 21 CFR Part 11 compliant software, on-line
Power	100 - 120 VAC, 60 Hz or 220 - 240 VAC, 50 Hz
Diluent	Clean diluent supply and waste reservoir for autodilution and autosampler
Computer	Windows operating system XP, Pentium microprocessor; 40-gigabyte hard drive; 1 gigabyte RAM; CD drive; USB port; serial port or adapter

World Wide Solutions

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