The Malvern Zetasizer Nanoseries, Nano-ZS90 For Dynamic Light Scattering And Zeta Potential Determination

Presented by

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And

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Dynamic light scattering (DLS)

Introduction

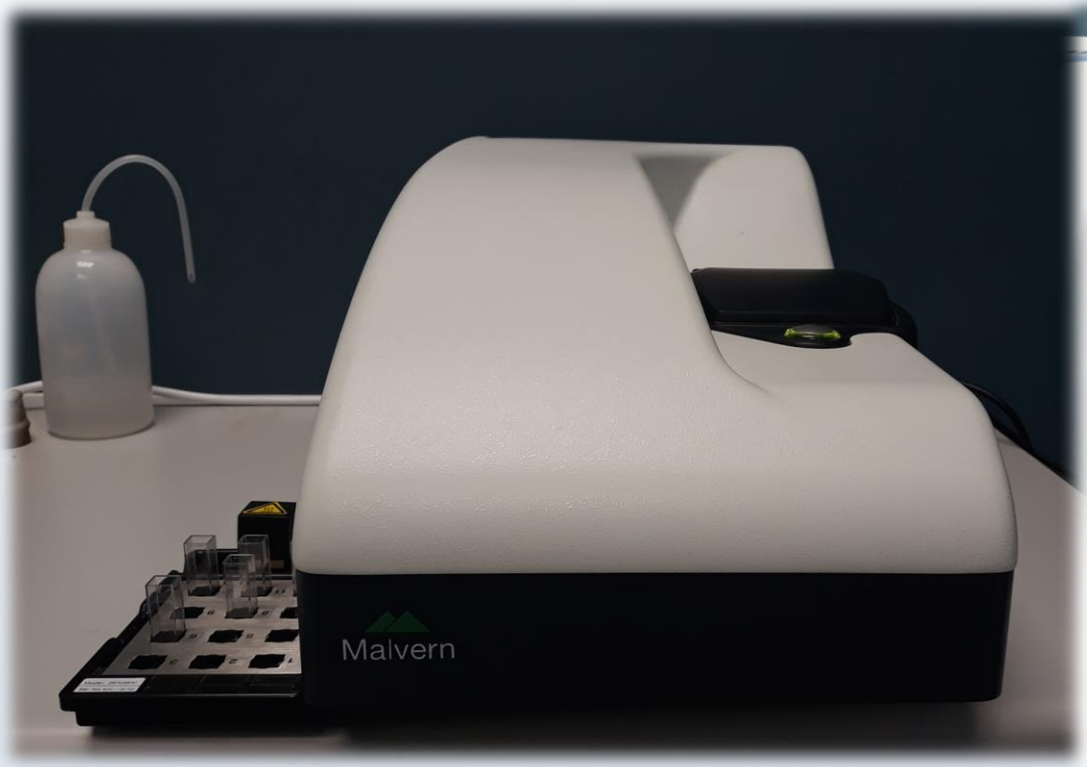
- Dynamic light scattering/ photon correlation spectroscopy/ quasi-electric light scattering
- Based on Brownian motion

  - $\mathbf{d} = \frac{KT}{3\pi\eta D}$

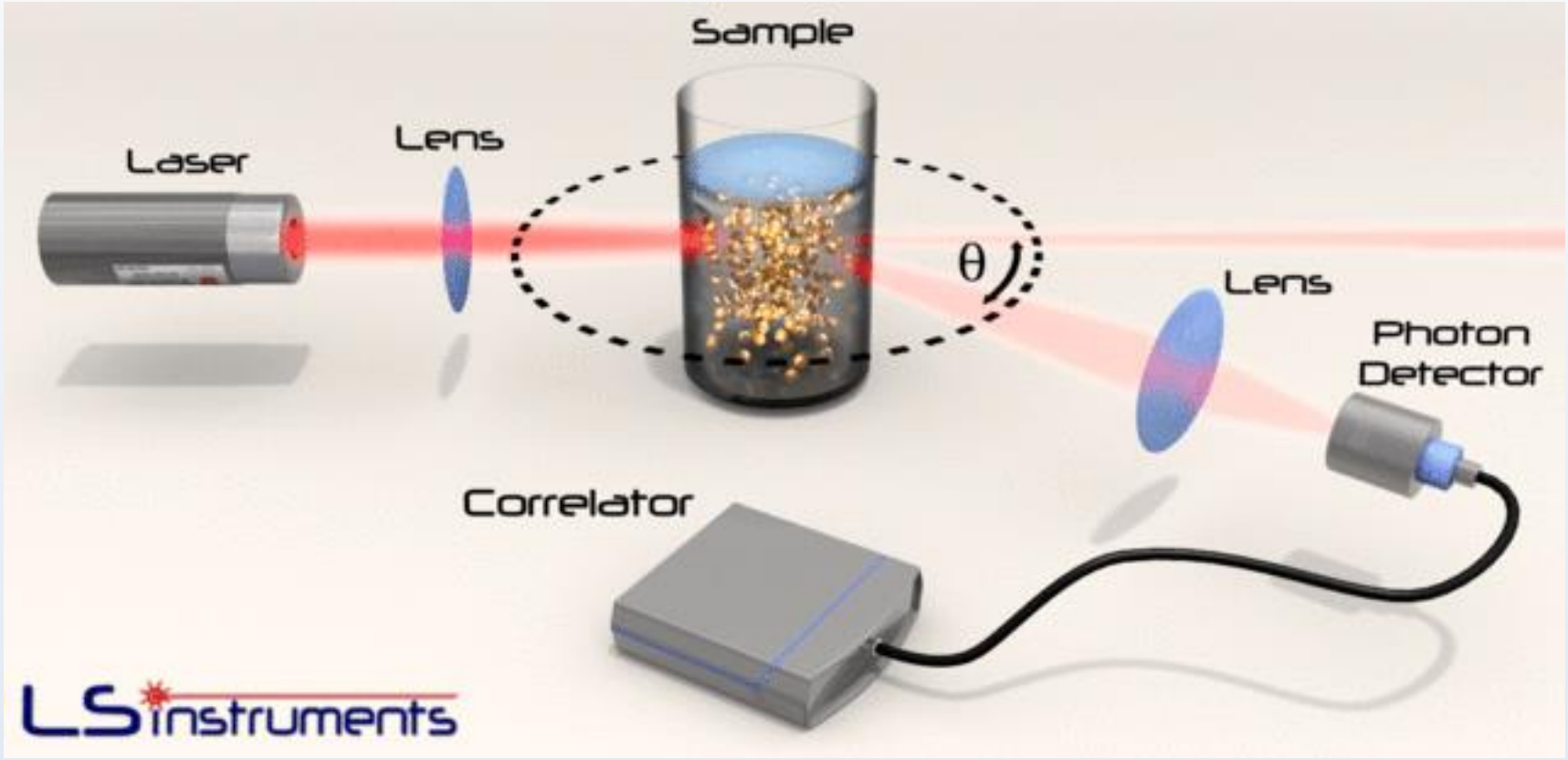
  Where d is the hydrodynamic diameter, K, the Boltzmann constant, T the Temperature, η the viscosity and D, the diffusion coefficient

- Particle size
- Molecular weight
- Zeta potential

DLS equipment



The principle behind DLS



Gif sourced from: https://giphy.com/gifs/biology-methods-structural-axBzDrJ6Txk1a

Types of samples and preparation

- Emulsions, micelles, polymers, proteins, nanoparticles or colloids
- Size range 1-10000 nm
- Concentrations
  - Depends on sample
- Solvents
  - Viscosity
- Cuvettes: plastic, quartz or glass

Analysing the results

Zetasizer - [Nadine.dts]

File Edit View Measure Tools Security Window Help

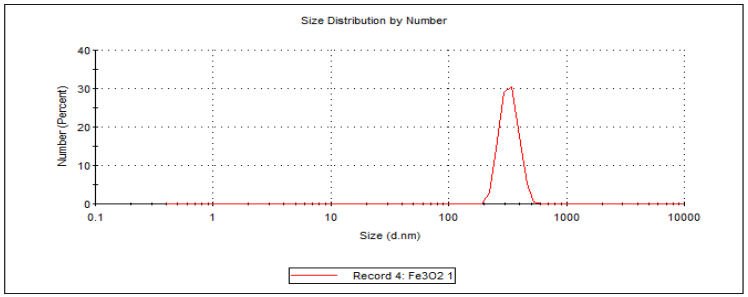
Size

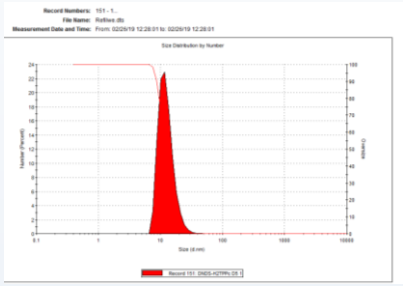
Records View | Distribution Overplot (M) | **Number PSD (M)** | Size Results Export (M) | Size diagnostics report (M) | Z Avg Trend (M) | Z-Ave trend (M)

Sample Name:	Fe3O2 1		
SOP Name:	mansettings.nano		
File Name:	Nadine.dts	**Dispersant Name:**	ethanol
Record Number:	4	**Dispersant RI:**	1.361
Material RI:	1.59	**Viscosity (cP):**	1.2000
Material Absorbtion:	0.010	**Measurement Date and Time:**	09 July 2019 03:13:50 PM
Temperature (°C):	20.0	**Duration Used (s):**	50
Count Rate (kcps):	350.1	**Measurement Position (mm):**	4.65
Cell Description:	Glass cuvette with round aperture	**Attenuator:**	8

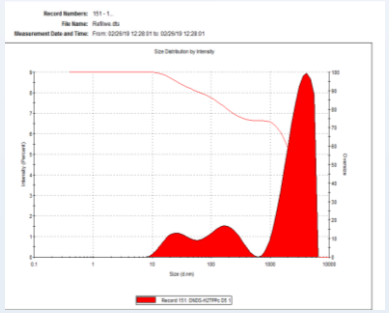
		Size (d.nm):	**% Number:**	**St Dev (d.nm):**
Z-Average (d.nm):	586.1	**Peak 1:**	329.5	100.0	58.33
PdI:	0.529	**Peak 2:**	0.000	0.0	0.000
Intercept:	0.928	**Peak 3:**	0.000	0.0	0.000

Result quality : Refer to quality report

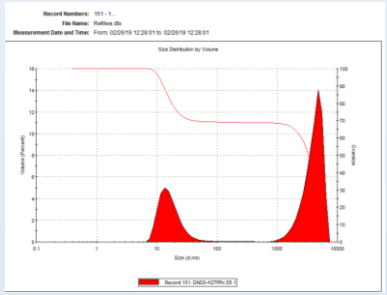




Number



Intensity



Volume

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Pros and cons

Advantages

- Quick and easy to operate
- Sample recoverable
- User friendly

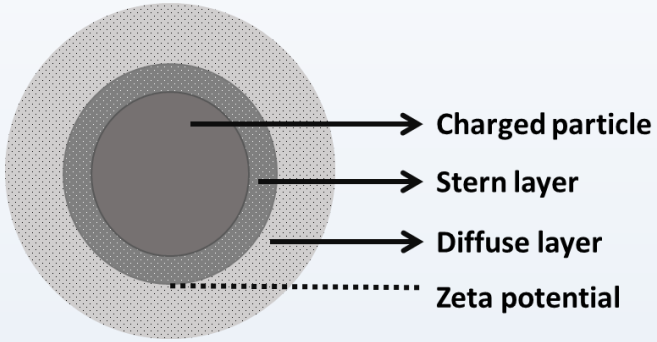
Challenges

- Hydrodynamic diameter is spherical
- Concentration (Filter larger particles out)
- Sensitive to dust

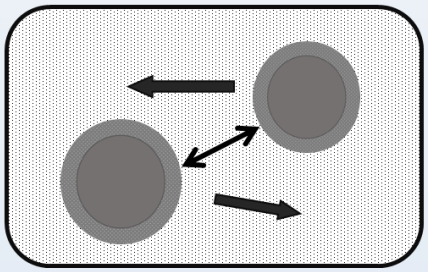
Zeta potential

Definitions

- Zeta potential (ζ-potential) - potential difference across phase boundaries between solids and liquids



- Potential difference - amount of work energy required to move an electric charge from one point to another



ζ-potential theories

- Smoluchowski approximation
  - Theory is valid for any concentration or shape of dispersed particles.
  - Fails to consider surface conductivity

- Hückel approximation
  - Ability to automate complex measurements (e.g. pH or concentration dependences)

Measuring Zeta Potential

- A folded capillary cell.
- Applied electric field.
- Zeta potential indirectly measured by monitoring particle speed.

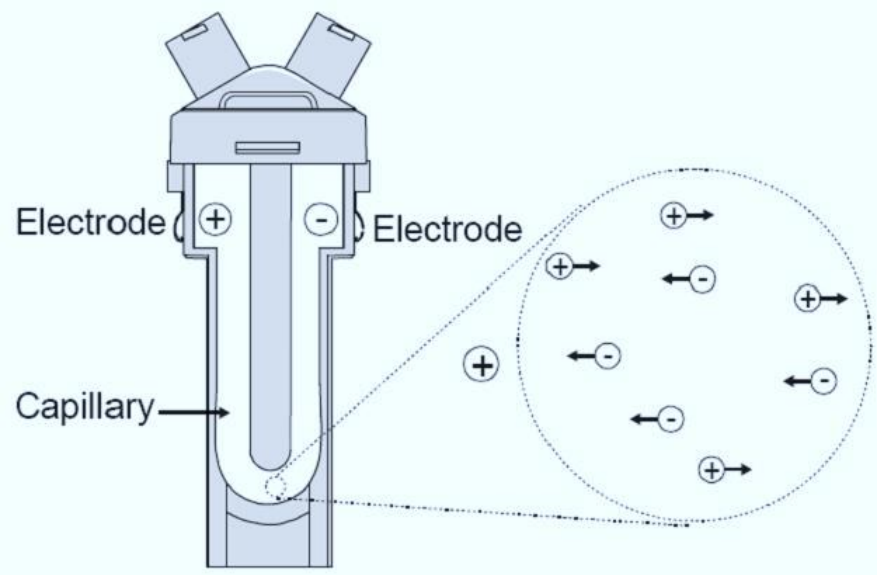
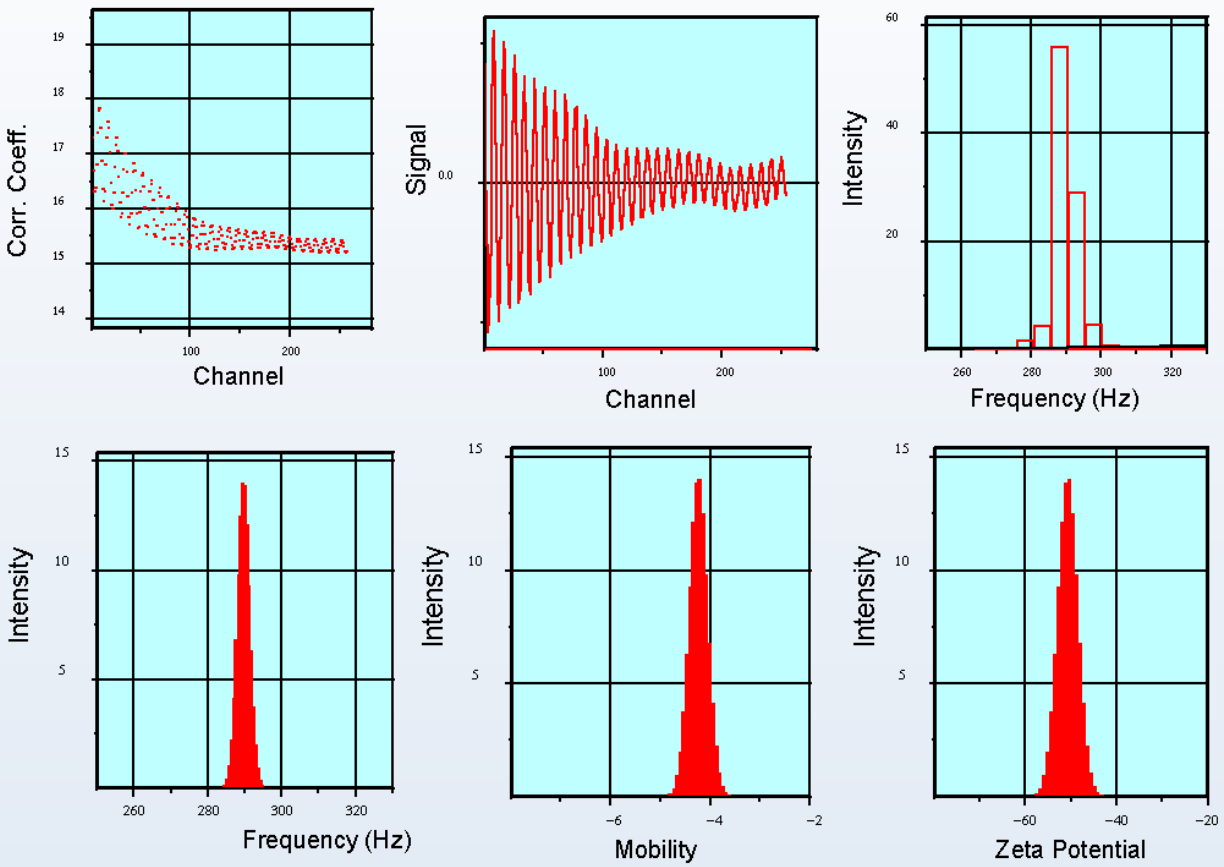


Image sourced from: http://departments.agri.huji.ac.il/zabam/zetasizer.html

Signal processing and data evaluation



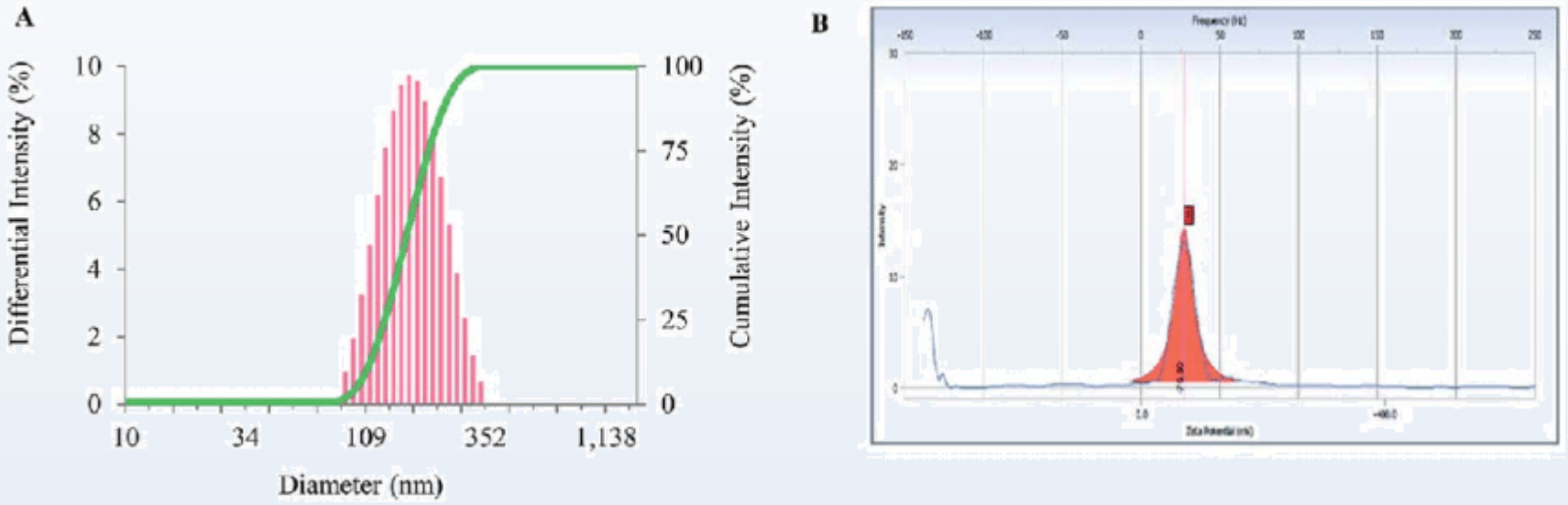
Stages of signal processing from the correlation function to a Fourier Transform analysis (FFT) to frequency, mobility and zeta potential spectrum.

Image sourced from: http://www.silver-colloids.com/Tutorials/Intro/zetaintro.html

Applications of Zeta Potential

- Prepare colloidal dispersions for cosmetics, inks, dyes, foams, and other chemicals.
- Reduce cost of additives by calculating the minimum amount needed to achieve the desired effect.
- Microelectrophoresis to characterize blood, bacteria, and other biological surfaces.

Applications of Zeta Potential



Characterization of BSA–CK NPs by particle size analysis, showing the size-dependent distribution of the nanoparticles (A); zeta potential analysis showing the surface charge of À70.80 mV for the BSA–CK NPs.

P. Singh, H. Singh, V. Castro-Aceituno, S. Ahn, Y. Ju Kim and D. C. Yang, RSC Adv.,2017,7,15397.

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