

LM10-HS: Ultra-high Sensitivity Counting, Sizing and Visualising Nanoparticles

Introduction

NanoSight have developed a unique instrument which can image the light scattered from nanoparticles in liquid suspension. Particles in liquid suspension move under Brownian Motion, the speed of which can be used to calculate particle size through the application of the Stokes Einstein equation. Particle size is calculated on a particle-by-particle basis which overcomes some of the inherent weakness in standard light scatter techniques which produce an average particle size weighted towards any larger or contaminant particles within a sample.

Improving Sensitivity

The high sensitive system complements and extends the range of instruments supplied by NanoSight for imaging and sizing nanoparticles in liquid suspension. The system utilises EMCCD camera technology (Electron Multiplication Charge Coupled Device) which has improved the sensitivity of the standard NanoSight system by a factor of x100. Practically, this means that the lower limit of detection for a particular particle type has been improved by a factor of 2 when compared to the standard instrument.

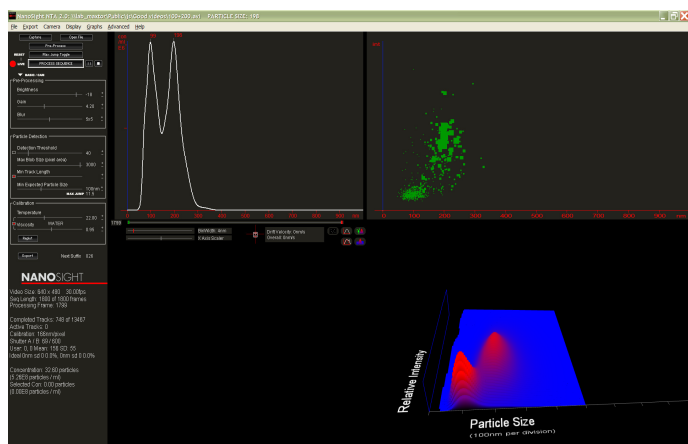


Figure 1. Number particle size distribution showing peaks at 100 nm and 200 nm which are fully resolved. Image is of NanoSight's NTA software.

Key Features

- Size range: 10 - 2000 nm
- Any particle type
- Sample volume 350 μ l
- Any solvent
- Small instrument footprint
- 1 minute analysis time
- Refractive index is not required

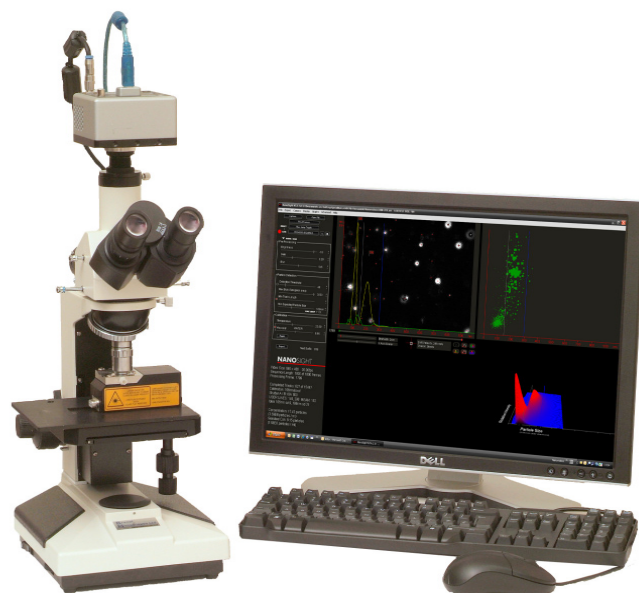


Figure 2. The NanoSight LM10-HS System.

Experimentation

NTA does not use the intensity of light scattered as a measurand and hence there is no requirement for knowledge of the solvent refractive index of the solvent in the calculation. The software does however log and display relative particle intensities despite the absolute intensity not being used in the size calculation.

As more refractile particles scatter more light, Dynamic Light Scattering (DLS) particle size distributions are weighted towards distributions are weighted towards the more brightly scattering particles (whether they be larger or more refractile particles).



Figures 4 and 5 show 3D plots of size vs. intensity vs. Concentration, generated by NanoSight's NTA software. Notice in Figure 3, the 50 nm gold scatter light more effectively than the 100 nm latex despite the fact they are smaller. This is characterised by a negative slope on the size vs. intensity graph. Figure 5 shows a more normal graph in which 100 nm latex are resolved from the 200 nm latex nanoparticles. The positive slope demonstrates that the larger particles scatter light more effectively than the 100 nm particles.

Figure 6 shows a number size distribution from a monodisperse sample of gold colloid.

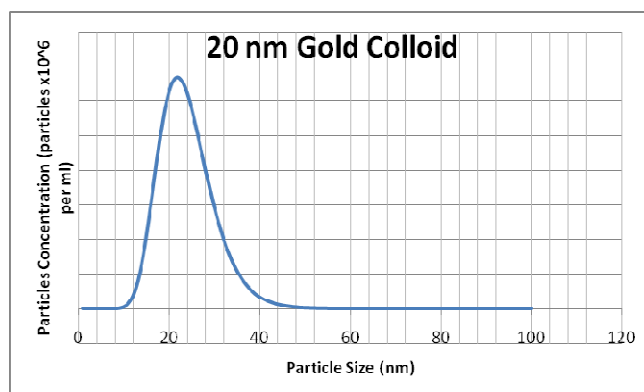


Figure 6.

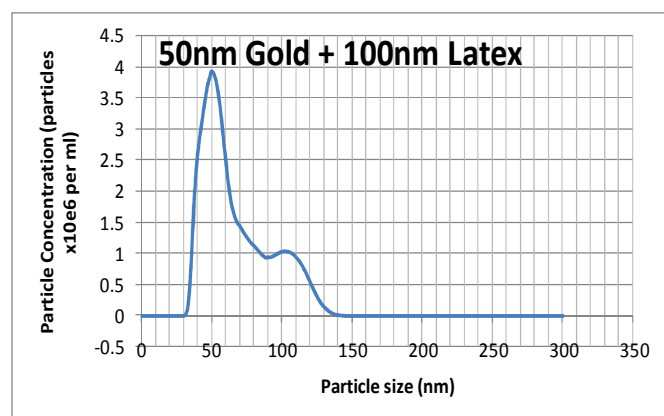


Figure 3.

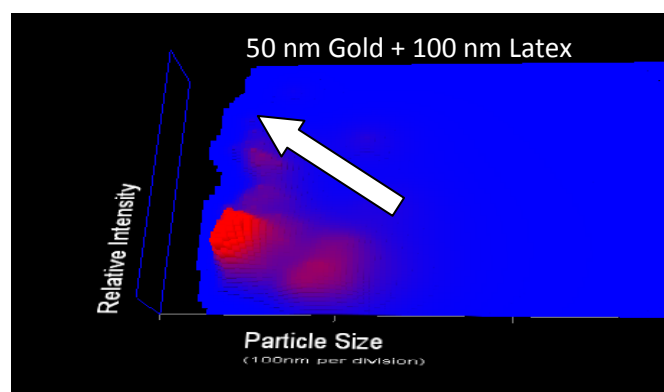


Figure 4.

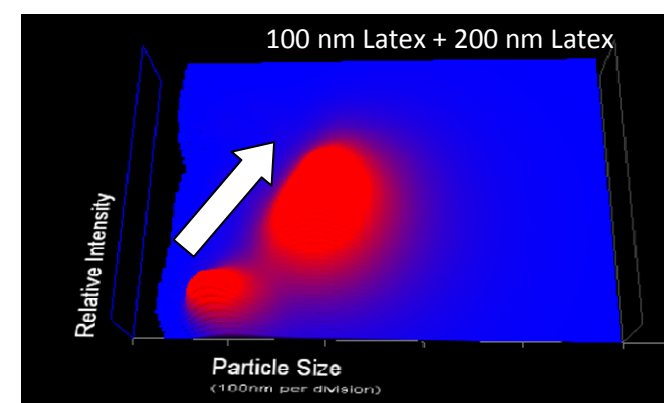


Figure 5.

Sample Preparation

- Sample pre-treatment is minimal requiring only dilution to 10^6 - 10^9 per ml.
- Accurate and reproducible analyses can be obtained from video of only a few seconds duration and the results allow particle size vs. number to be recovered.
- Given the real-time nature of the technique, changes in particle size distribution through aggregation or dissolution can be followed.
- The minimum detectable size measurable depends on the particle refractive index.
- The technique is absolute, requiring no calibration.
- The technique uniquely allows the user to a direct qualitative view of the sample under analysis (perhaps to validate data obtained from other techniques such as DLS) and from which an independent quantitative estimation of sample size, size distribution and concentration can be immediately obtained.

Applications

The ability to image and size increasingly small particles is of paramount importance to an increasingly large number of applications:

- **Virus Counting:** Size and count viruses is of paramount importance to those working in vaccine development, phage therapeutics, virus purification/ultrafast sample characterisation and gene therapy
- **Characterisation of wear debris from orthopaedic implants.** The size and concentration of wear debris can be related to the biological response to the implant as well as the mechanical deterioration of the implant.



- **Drug delivery:** Liposomes and nanoparticles for drug delivery. Size and concentration is related to the amount of drug delivered and the particle size influences the bio-distribution of particles/liposomes.
- **Protein aggregation:** The real-time information provided by the NanoSight technique is of great importance when studying aggregation phenomena and optimising manufacturing process yield of biologics and biotherapeutic products such as antibodies, etc. Protein aggregation is of importance in the study of diseases such as Alzheimer's disease where protein aggregation has been linked with progression of the disease.
- **Nanoparticle toxicology studies:** Considerable research is currently underway to understand the potential biological effects of nanoparticles on biological systems. The study of nanoparticle interactions with the human body and environment is of increasing importance. The ever decreasing size of engineered nanoparticles make the new high sensitive system ideal in such research.

The instrument can be applied in many different applications. Hence, if your area of research is not covered in this brief summary then please contact NanoSight for further information.

Contact

For further information, contact NanoSight or your local distributor, listed at www.nanosight.com.

Specification	LM10	LM20	LM10-HS
Lower Limit of Detection	20 nm	20 nm	10 nm
Upper Limit of Detection	2000 nm	2000 nm	2000 nm
Software	NTA 2.0	NTA 2.0	NTA 2.0
Space Requirements	400 mm x 400 mm	130 mm x 380 mm	400 mm x 400 mm
Sample Volume	500 µl	500 µl	500 µl
Temperature Control Available	NO	YES	NO
Fixed Alignment	NO	YES	NO
X10 Objective for Low Concentration Applications	YES	NO	YES
Oculars of Qualitative View of Particles	YES	NO	YES
Solvent	Any Non-Corrosive Solvent or Water	Any Non-Corrosive Solvent or Water	Any Non-Corrosive Solvent or Water
Laser Output	40 mW at 638 nm (Class 1 Laser Product)	41 mW at 638 nm (Class 1 Laser Product)	42 mW at 638 nm (Class 1 Laser Product)

Table 1. Specifications of NanoSight's LM instruments including the higher sensitivity LM10-HS.

