NANO
FLOWSIZER

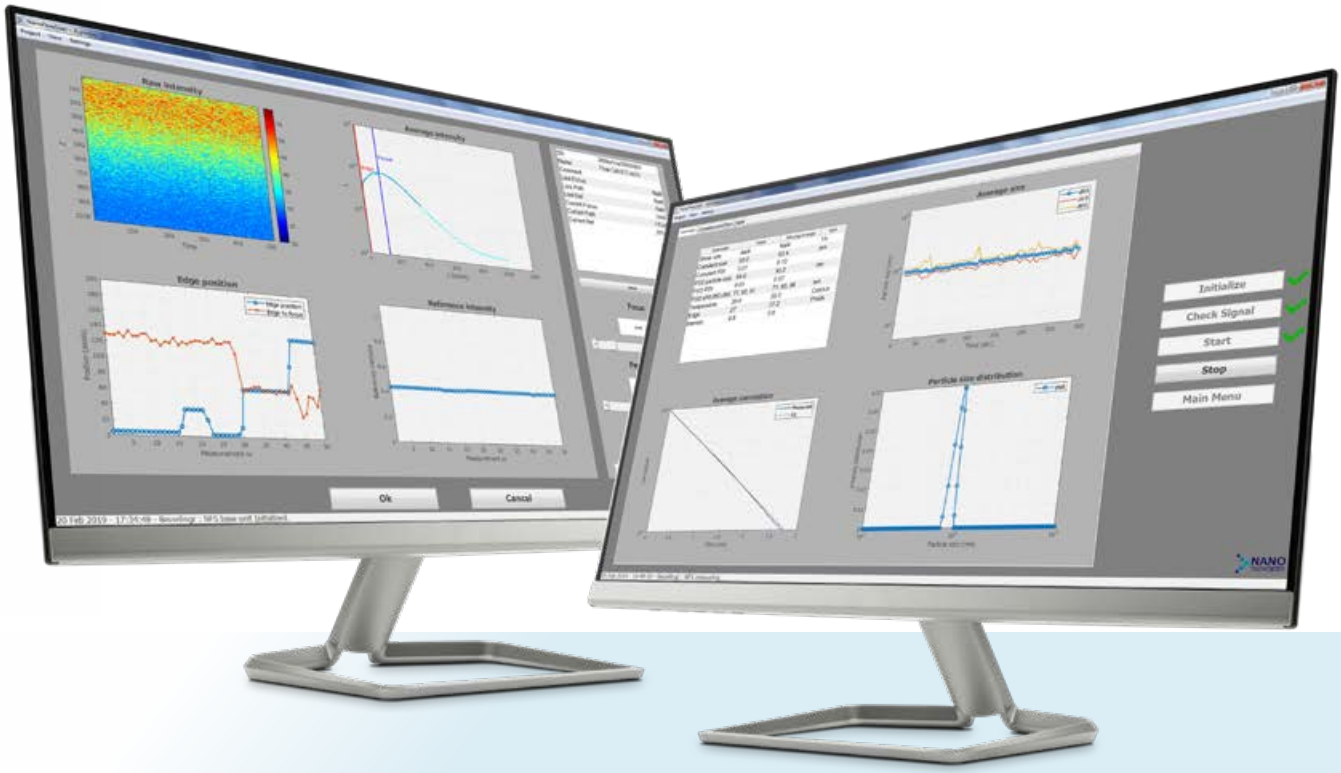
A New Innovative Technology for Continuous Real-time In-process Nanoparticle Size Characterization

INPROCESS | LSP
Advanced Analytics for Products and Processes

NanoFlowSizer

A non-invasive Process Analytical Tool for monitoring nanoparticle size characteristics

The NanoFlowSizer is a new innovative system for continuous, real-time nanoparticle size characterization of colloidal systems, nanosuspensions, nanoemulsions and other dispersed nanoproducts directly in manufacturing processes (inline) or in a laboratory setting (offline). As inline instrument, the NanoFlowSizer is a powerful non-invasive Process Analytical Tool allowing close monitoring of particle size characteristics in your process in either development laboratories, pilot plants or commercial operations, without the need of sampling. The NanoFlowSizer can be integrated easily in your process by using flow-through cells allowing high speed measurements of even highly turbid nanomaterial using new Spatially Resolved Dynamic Light Scattering (SR-DLS) technology and smart XsperGo software. The NanoFlowSizer provides unique opportunities for studying particle size dynamics supporting your product and process development. The NanoFlowSizer can also be operated in offline mode for manual measurements under static and flow conditions using cuvettes or other glassware.



Average particle size and size distributions typically provided every 10 seconds

- Continuous size characterization of nanoparticles during processing
- Inline Process Analytical Tool
- Non-invasive measurement
- Real-time process feedback
- Measurement of highly turbid materials
- High speed measurement
- Inline, online and offline operation
- For very small (<<mL) to large sample volumes

The NanoFlowSizer further explained

Spatially Resolved Dynamic Light Scattering (SR-DLS)

Dynamic light scattering (DLS) is an accepted technology for measuring particle size and size distribution of nanoparticles in liquids. It is based on measurement of fluctuations in light scattering caused by Brownian motion of suspended particles. For Brownian diffusion, the frequency of scattered intensity fluctuations depends on the particle size; smaller particles diffuse more rapidly and thus produce higher frequencies. Therefore, the temporal fluctuations in light scattering hold information on the particle size.

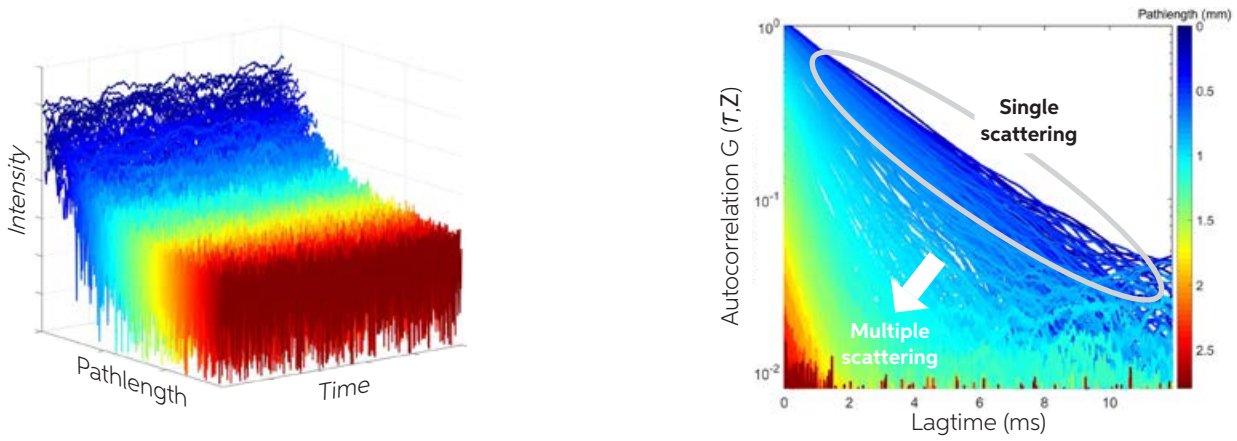
Standard DLS measurements need to be performed under static conditions ensuring that particle movement is solely caused by Brownian motion and not influenced by other factors like liquid flow. Additionally, standard DLS cannot be applied to the turbid suspension which are often encountered in industrial or process environments. This limits the use of standard DLS for inprocess applications.

These limitations can be overcome by the new concept of Spatially Resolved Dynamic Light Scattering (SR-DLS) which allows particle size characterization in process flows and for highly turbid suspensions. The NanoFlowSizer technology is based on low coherence interferometry providing light scattering information as function of optical pathlength in process flows. The depth resolved light scattering holds information on particle movement caused by both Brownian motion as well as flow rate. The contribution to scattered light fluctuations due to Brownian motion is used for calculation of the particle size characteristics.

Other key advantages of the NanoFlowSizer are the capability to distinguish single from multiple scattered light, and the high measurement speed. The XsperGo software automatically identifies and selects single scattered light allowing measurement of highly turbid suspensions in flow. Additionally, the high data-information content and high speed processing, provide characteristics such as mean particle size and distribution typically within 10 seconds. These clear advantages make the NanoFlowSizer the ideal solution for inline measurements, providing continuous real-time process feedback on nanoparticle size characteristics, a powerful Process Analytical Tool.

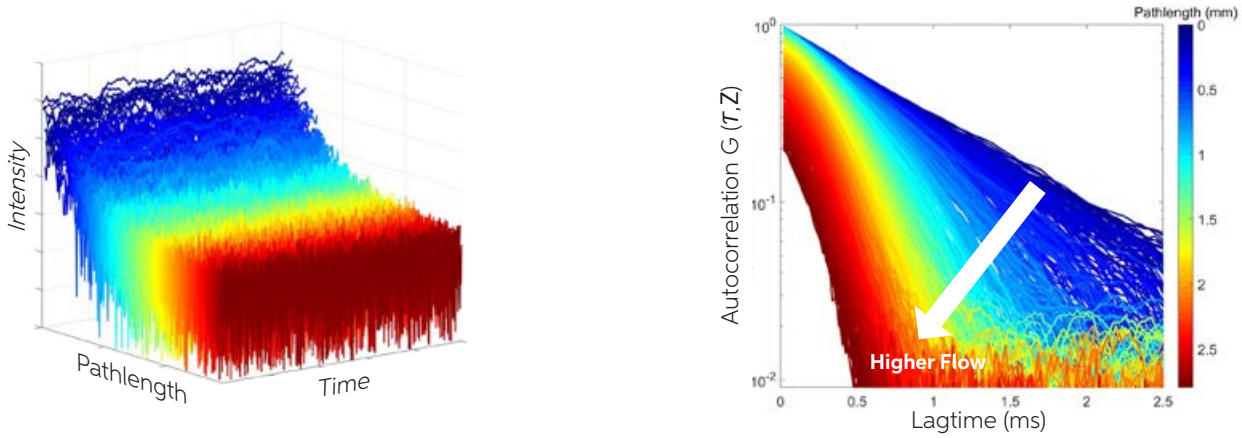
INCREASING TURBIDITY

SR-DLS without flow



SR-DLS without flow: (left) temporal depth resolved scattering data as basis for (right) auto correlation functions showing single and multiple scattering regimes. The single scattering regime is automatically identified and used for particle size characterization.

SR-DLS with flow



SR-DLS with flow: (left) temporal depth resolved scattering data as basis for (right) auto correlation functions showing flow related decorrelation for increasing depth in a flow cell. The flow contribution is determined and compensated for, allowing size characterization using only the diffusive contribution.

NanoFlowSizer measurements are performed through glass preventing any direct contact or interference with the sample, which makes the technology ideally suited for continuously monitoring (sterile) processes.

NFS SYSTEM CONFIGURATIONS	PROCESSING INLINE/ONLINE IN FLOW	LABORATORY R&D / QUALITY	
	In Flow	In Flow	Static
NanoFlowSizer Base System			
Base Unit	●	●	●
Probe Unit	●	●	●
Interchangeable Sample Modules			
Flow-through Cell Module (0.5 -2 '')	●	●	
Vial Module			●
Cuvette Module			●
Bottle & Vial Modules (customization optional)		●	●
Micro Flow Cell Module		●	●
Other			
XsperGo Software	●	●	●
Workstation	●	●	●
System Cable (base unit to probe unit)	1.5 - 5 meter		
Trolley	Optional		

MEASUREMENT SPECIFICATIONS	
Central wavelength	1300 nm
Axial scan rate	Up to 76 kHz
Maximum measuring depth / optical path length	3.5 mm
Maximum scattering volume	5 nL
Detection	Backscattering (180°)
Depth resolution	4 µm
Particle size range	10 - 1000 nm (at least)
Maximum process flow	6 L/min for polystyrene particles (100 nm, 5 mg/mL)
GENERAL	
Supply voltage for base unit	100 V – 240 V / AC
Maximum power consumption	150 W
Weight base unit	12 kg
Weight probe unit	5 kg
Storage/operating temperature base unit	10 °C to 35 °C
Operating range temperature sensor	-10 – 85 °C (± 0.5) 85 – 125 °C (± 2)
Dimensions of base unit (L x W x H)	420 mm x 320 mm x 149 mm
Dimensions probe unit (L x W x H)	310 x 91 x 210 mm
FEATURES XSPERGO	
Particle size information	Z-average, PDI (ISO 22412), PSD
Particle size distribution	Intensity based and volume based, d10 / d50 / d90
Miscellaneous	Flow profile, Scatter profile (concentration), Advanced time & depth resolved particle diagnostics

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