The Turbiscan Stability Analyzer

Formulation Stability And Shelf Life Analysis For Emulsions and Suspensions

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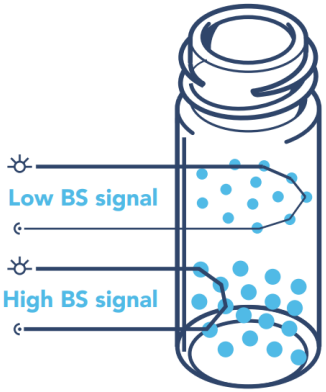
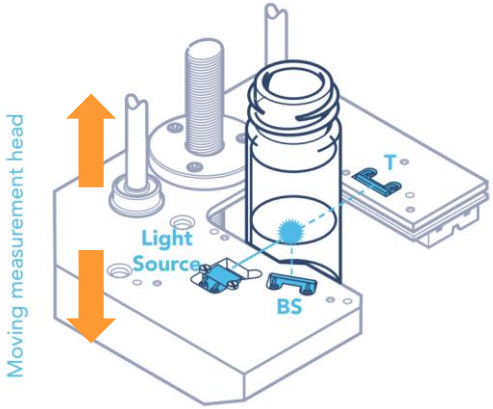
STABILITY & SIZE
MICRORHEOLOGY
RHEOLOGY ON CHIP

Static Multiple Light Scattering
Technology and Theory

Static Multiple Light Scattering can be used to monitor particle concentration and size changes inside of concentrated formulations.





Backscattering (BS) is a function of:

d : <u>particle size</u>

Φ : <u>particle concentration</u>

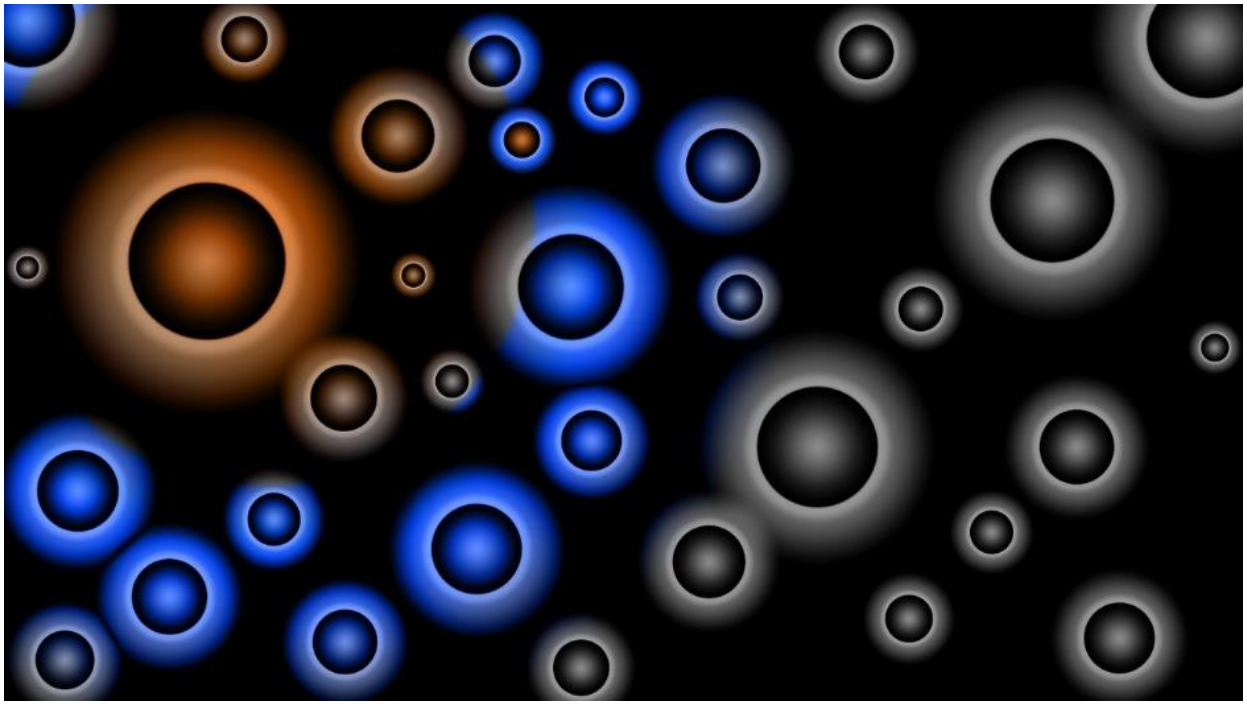
Repetition of the measurement provides:

Δd : <u>change in particle size</u>

Δ Φ : <u>change in particle concentration</u>

Changes in the signal = changes in the sample = monitoring of destabilization

Particle Sizing

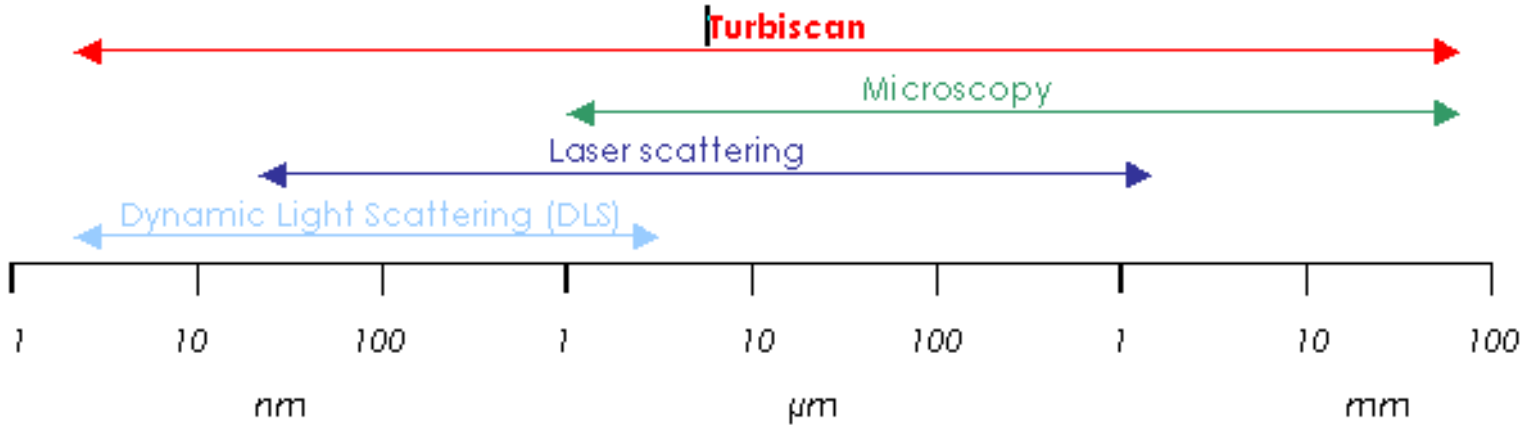


Turbiscan: Instrument

Technology and Theory

Mean Particle Size Measurement

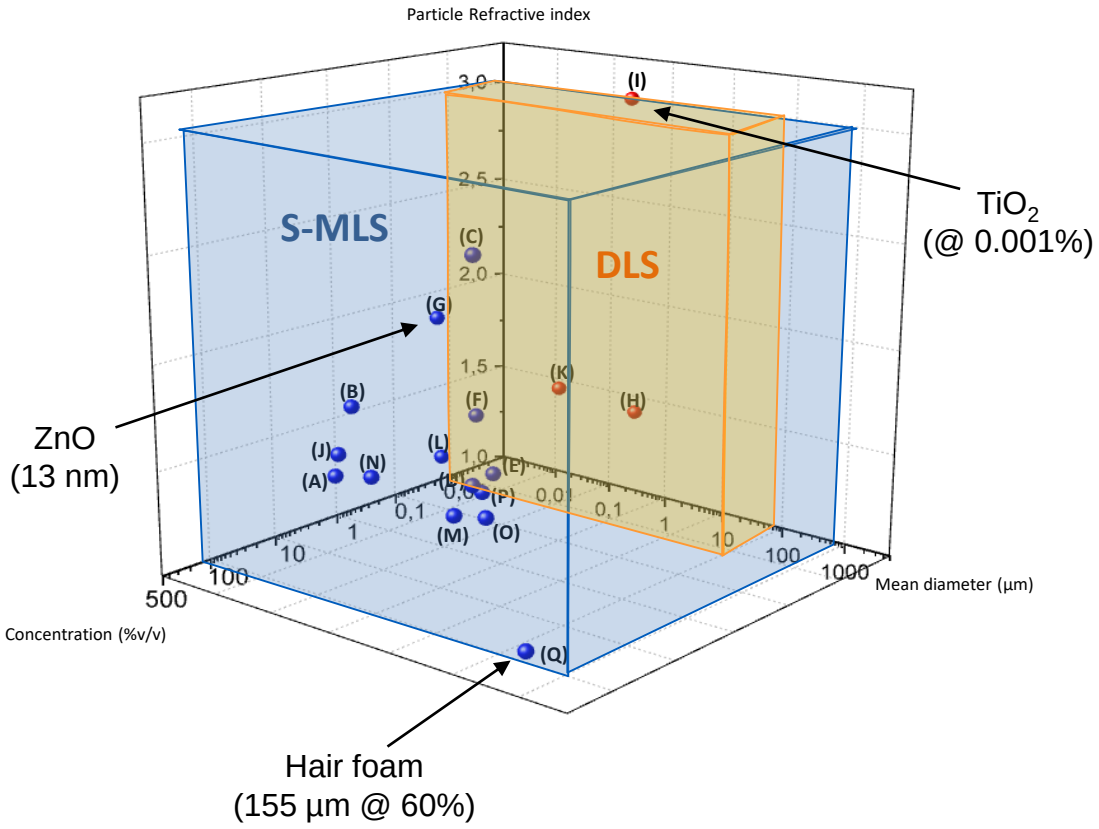
↳Size range: from 10 nm to >1mm



- **Using backscattered or transmitted light, <u>mean particle diameter can be calculated without sample dilution</u>**
- **Nanoparticles as small as 10 nm have been measured using this technique.**

Turbiscan: Data

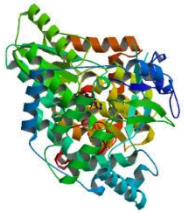
Mean Particle Size Calculations



Type of sample		Particle
Suspension	I	TiO_2
	H	SiO_2
	K	Polystyrene
	G	ZnO
	F	$CaCO_3$
	E	SiO_2
	D	Talc
	C	TiO_2
	B	Al_2O_3
	A	Ludox (colloidal silica)
	J	Polystyrene
Protein	L	Bovine Serum Albumin
Emulsions	P	Emulsion with sunflower oil (surfactant tween 20)
	N	Emulsion
	O	Emulsion with sunflower oil (surfactant sodium caseinate)
	M	Healthcare emulsion
Foam	Q	Hair foam

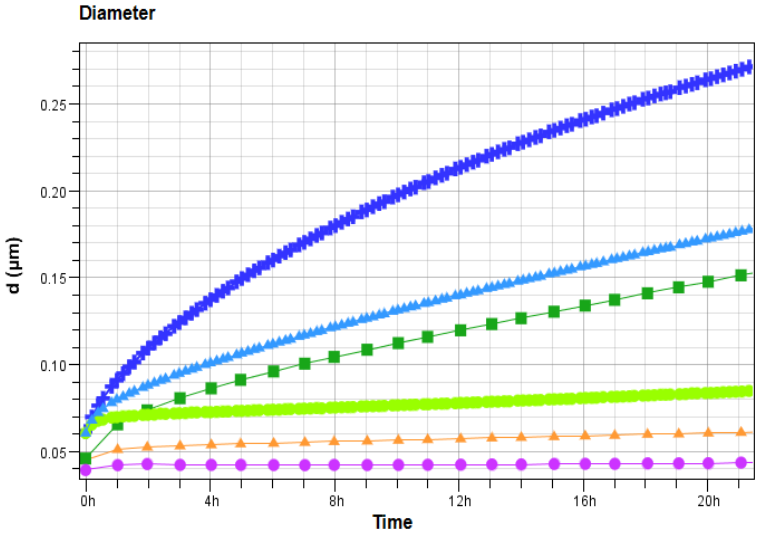
⇒ SMLS covers a wider concentration area than DLS (17% of samples)

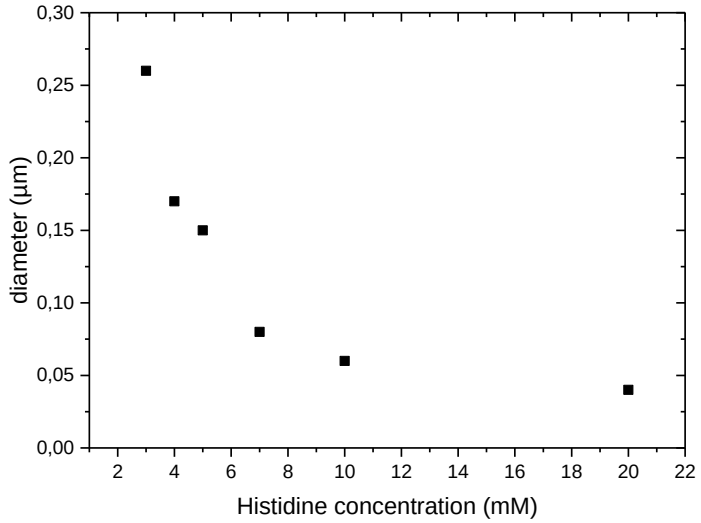
Turbiscan Applications
BSA Protein Denaturing



The Histidine effect

- **Problematic**: Temperature increase leads to proteins denaturation which consists in modifying interactions and going from transparent to opaque samples linked to size increase
- **Solution**: Histidine, an amino-acid, is currently used to protect therapeutic protein against denaturation.
- **System**: 8 samples of BSA (10% wt) with different amount of histidine (mM) were analyzed at 60° C





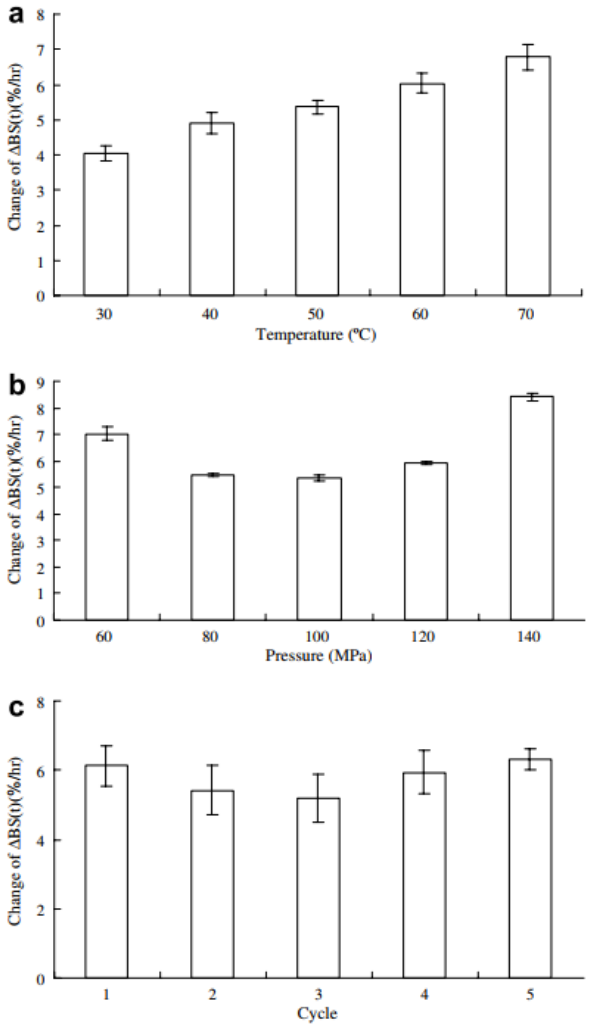
Increasing histidine concentration will keep diameters closer to their native state (here, below 50 nm).

Turbiscan Applications
Beta-Carotene Nanoemulsions

O/W emulsions consisting of β-carotene-containing oil and varying amounts of emulsifiers in water were prepared. Differing methods of temperature (a), pressure (b), and number of cycles (c) were analyzed.

(a) Increasing temperature causes increasing BS signal = flocculation.
(b) Pressure will reach an optimum kinetic around 100 MPa, lower or higher pressures increase this flocculation kinetic.
(c) Number of homogenization cycles is optimized at three.

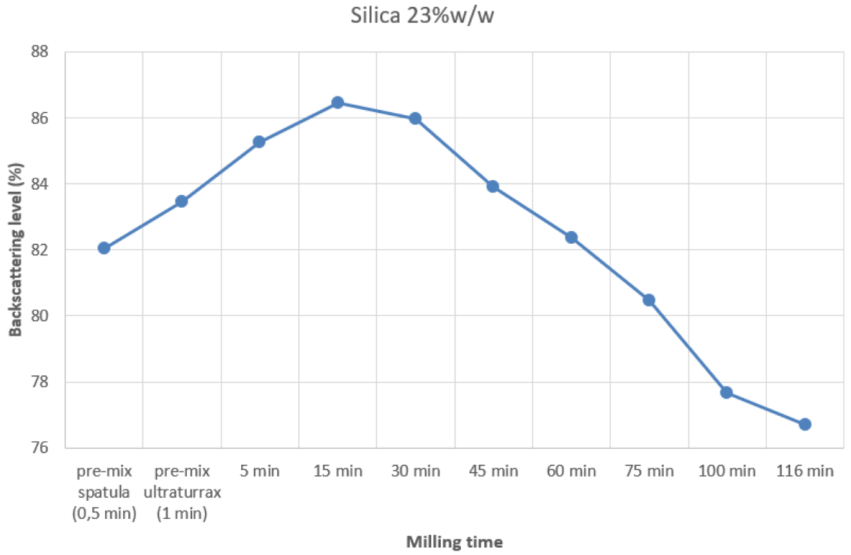
Initial particle sizes ranged from 114-184 nm



Y. Yuan et al. Food Research International 41 (2008) 61–68

Nanoparticle Milling Effect

- The milling process and time can be used to monitor the mean particle size of concentrated silica suspensions.
- Analysis time is 25 seconds and occurs on the native sample with no dilution and in a non-destructive manner.



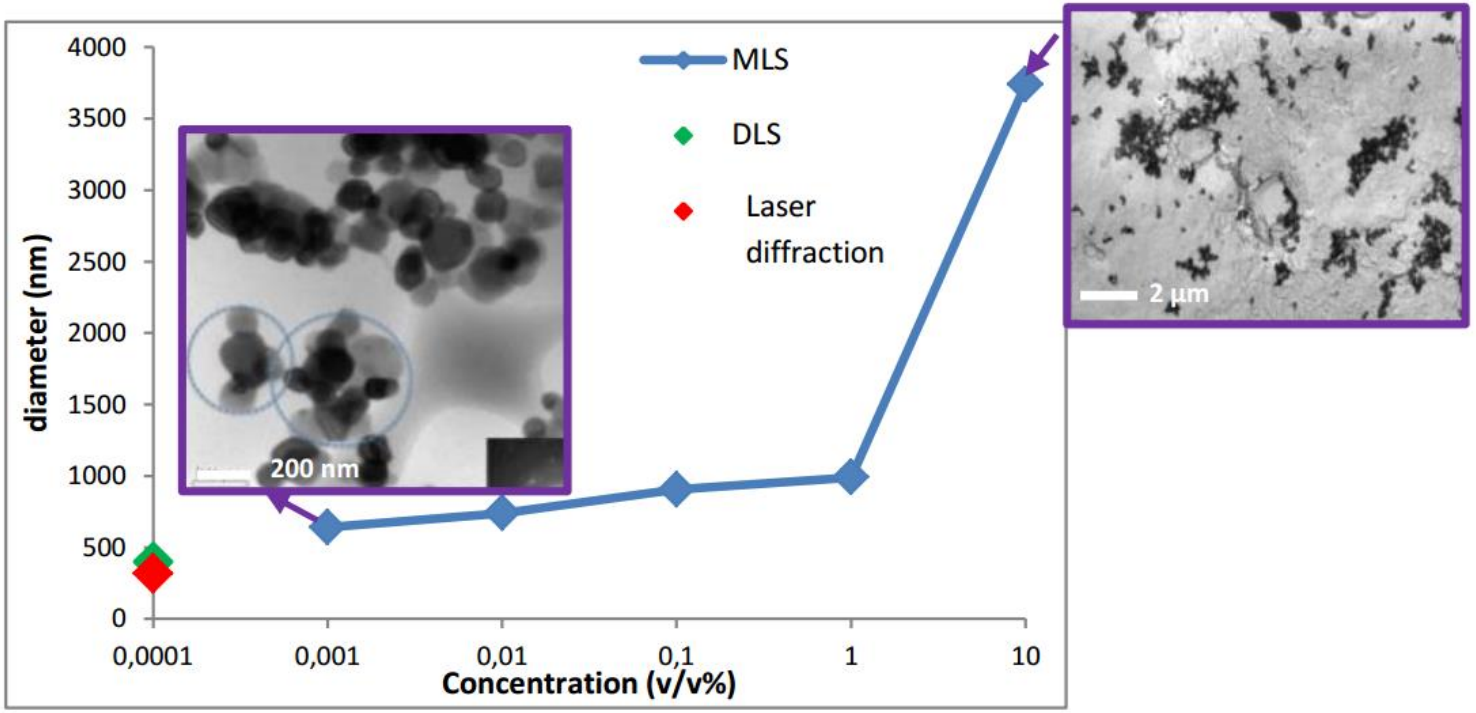
13%	d_{mean} (nm)	23%	d_{mean} (nm)
pre-mix spatula (0,5 min)	1860	pre-mix spatula (0,5 min)	1840
pre-mix ultraturrax (1 min)	1210	pre-mix ultraturrax (1 min)	1690
5 min	1150	5 min	1520
10 min	1080	15 min	1420
15 min	330	30 min	240
20 min	310	45 min	230
25 min	310	60 min	220
32 min	290	75 min	210
45 min	250	100 min	200
60 min	230	116 min	190

Pigment Applications

Particle Sizing: Mean Particle Sizing

Analysis of TiO_2 particles

- The Turbiscan, along with cryo-microscopy, both confirm that the mean particle size of TiO_2 suspensions increase with increasing concentration.
- Due to concentration limitations, other methods (DLS, laser diffraction) cannot monitor such an effect.



THE REFERENCE FOR STABILITY MEASUREMENTS

TURBISCAN
STABILITY & SIZE

Turbiscan summary:

- Rapid shelf life studies
- Objective, reproducible results
- Multiple applications, multiple projects
- Identification and quantification of instabilities
- Mean particle size calculations in concentrated media

Other applications:

- Food + Beverage
- Metalworking fluids
- Oil + Gas
- Foam and defoamer analysis
- Paint and coating suspensions

FULL CHARACTERIZATION OF DISPERSIONS

Thank you!

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