Small Angle Static Light Scattering

The flat cell light scattering instrument consists of a GLG5360 Helium-Neon Laser (NEC Corporation, Tokyo, Japan, P=10mW, $\lambda=632.8$nm) and an array consisting of 160 photodiodes for simultaneously detecting scattering curves from 1° to 60° (Scattering vector in water $2.3 \times 10^{-4} - 1.3 \times 10^{-2}$ nm$^{-1}$). The sample cell has a variable thickness of 15 $\mu$m up to 5 mm. This allows to measure turbid samples with particle sizes between a few hundred nanometers up to about 10 $\mu$m.
Information for users, on the requirements for measuring their samples.

DLS

By evaluation of the measured correlation function hydrodynamic radii from a few nanometers up to a few micrometers can be obtained. A minimum of 500 µl of clear and dust free sample with sufficient concentration (typically several per mills, for micellar solutions higher than the cmc) is necessary. Biosamples (Proteins etc.) can be measured in a square cell at 90°C with only 30µl solution (typically per mill). Sample may be exposed to air during the measurement. Viscosity of the solvent should be known. Sample should not absorb light at 532 nm or 632.8 nm.

Examples:

DLS can be used for the determination of hydrodynamic radii of proteins and lipoproteins [1] [2], vesicles [3] surfactant micelles [4], emulsion droplets [5] inorganic particles [6][7], etc.

Example: Determination of the size distribution of micells by DLS. Figure taken from [4]

Example: Determination of the size of Hemoglobin vesicles by DLS. Figure taken form [3]
Multispeckle DLS:

Dynamics of ergodic non-ergodic systems can be measured. Correlation times up to $10^4$ seconds can be achieved. A minimum of 20 µl of sample is necessary. Flat cells are airtight but long-term stability against air cannot be guaranteed. Sample should not absorb light at 632.8 nm.

Multispeckle DLS can be used for the measurement of slow dynamics in highly concentrated emulsions, gels, etc.

Small angle static light scattering:

Particles sizes from hundreds of nanometers up to 10 µm can be measured. A minimum of 20 µl of sample with sufficient concentration is necessary. Turbid samples e.g. milk can also be measured. Multiple scattering can be reduced by decreasing the cell thickness (15µm up to 5mm). At Transmission be > 0.9 the effect of multiple scattering is negligible. Sample may be exposed to air during the measurement. Refractive indices of continuous and dispersed phase of the sample should be known.

Examples:

By means of small angle static light scattering the size and size distribution of emulsion droplets [8][9], inorganic particles [10], etc. can be determined.
Example: Small angle static light scattering of silica particles and resulting size distribution. Figure taken from [10]

![Graph 1](image1.png)

**Figure 1.** Results from static light scattering on dense (50 vol %) emulsions with various surfactant concentrations. Left: scattering patterns of oil-in-water emulsions with different amounts of added surfactant. The highest concentration of surfactant was ~0.5 wt % (dash-dotted), followed by ~0.3 wt % (dashed), ~0.1 wt % (dotted), and finally ~0.075 wt % (solid). Right: scattering pattern of an emulsion with 50 vol % oil and a surfactant concentration of 0.075 wt % (open circles), in comparison with its GIFT-fit function (solid line). The GIFT evaluation of the scattering data was based on a hard sphere structure factor model resulting in the correct volume fraction of 49.8%.

Example: Small angle static light scattering of concentrated emulsions. Figure taken from [8]

![Graph 2](image2.png)

**Figure 2.** Measured scattering curves. (a) 
- method (50 vol% untreated silica, 5.9 wt% sucrose, 0.65 ml/1 mm, 160 min/mil tested). (b) DLS method (50 vol% coated silica, 40 wt% sucrose, 0.67 ml/1 mm, 0.8 min/mil tested). The curve of the stable suspensions were measured separately.

References


