What are typical values for the refractive index increment dn/dc ?

Chapter: Static Light Scattering
Key Words: refractive index increment, dn/dc

The refractive index increment is quite dependent on the properties of the sample system, that is it depends not only on the material of the "particle" but also on the dispersant or "solvent". For the Zetasizer Nano static light scattering measurements can be performed via the Debye plot technique with sequential dilutions, based on the (isotropic, small scattering object) assumption of the Rayleigh equation:

$$\frac{Kc}{R_\theta} \approx \frac{1}{M_W} + 2A_2c$$

where R_θ is the Rayleigh ratio related to the scattering intensity, and c the sample concentration. By plotting Kc/R_θ versus sample concentration the molecular weight M_W the molecular weight, and the second virial coefficient A_2 may be obtained from fitting a line to the data. The parameter K is related to the scattering efficiency and is given by:

$$K = \frac{2\pi^2}{\lambda^4 N_A}\left(n_o \frac{dn}{dc}\right)^2$$

composed of the laser wavelength λ, Avogadro's constant N_A, the refractive index n_0 of the solvent and the refractive index increment *dn/dc.* The refractive index increment is an indication of the contrast, it describes how much the refractive index changes when the concentration is changed.

Knowledge of the specific refractive index increment is therefore required and important since the scattering intensity is dependent on the square of *dn/dc*.

Values are wavelength dependent and vary with the solvent and the temperature of the system under investigation.

The refractive index increment for a few typical sample systems is given in the table below. These values are valid for λ = 632.8nm, and temperature T = 25ºC.

Table 1: Average dn/dc values for a selection of typical light scattering samples

Solid Phase	Liquid Phase	dn/dc [mL/g]
Biomolecules	Aqueous buffer	average 0.185
Proteins	Aqueous buffer	0.16-0.20, average 0.185
DNA	Aqueous buffer	0.17
RNA	Aqueous buffer	0.17-0.19
Polysaccharides	Aqueous buffer	average 0.15
Chitosan	Aqueous buffer	0.16-0.18
Dextrane	Aqueous buffer	0.14-0.15
Hyaluronic acid	Aqueous buffer	0.16-0.18
Pullulan	Aqueous buffer	0.14-0.16
Starch	Aqueous buffer	0.15
Liposomes		
phospholipid	Water	0.16
Polymers		
PST	THF	0.18-0.19
PST	Toluene	0.08-0.11
PST	Cyclohexane	0.16-0.17
PST	Decaline	0.12
PST	MEK	0.21
PMMA	THF	0.09
PMMA	Toluene	0.01-0.02
PVC	Cyclohexanone	0.08
PVC	DMF	0.08
PVC	THF	0.10

A detailed collection of many more values for specific sample systems may be found in:
Refractive Increment Data-Book for Polymer and Biomolecular Scientists
A. Theisen, C. Johann, M.P. Deacon, S.E. Harding
Paperback 64 pages (2000)
Publisher: Nottingham University Press
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