Diagram referenced as "Light scattering. Schematic apparatus (Tanford). Bio-physics lectures"

Contributors

Gratzer, W. B. (Walter Bruno), 1932-

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becomes

$$\frac{i_\theta}{I_0} = \frac{2\pi^2\tilde{n}^2(\partial\tilde{n}/\partial c)^2(1 + \cos^2\theta)c}{\mathcal{N}\lambda^4 r^2(1/M + 2Bc + 3Cc^2 + \cdots)} \qquad (17\text{–}26)$$

For dilute solutions the difference between $\tilde{n}$ and the refractive index, $\tilde{n}_0$, of the solvent becomes negligible, so that $\tilde{n}^2$ may generally be replaced by ${\tilde{n}_0}^2$. At the limit, $c = 0$, equation 17–26 thus reduces to the ideal equation, equation 17–13, derived earlier.

Equation 17–26 is the fundamental equation for the scattering of unpolarized light by dissolved particles much smaller than the wavelength of light. The equivalent equation for polarized incident light would differ only in containing the factor $2\sin^2\theta$ in place of $1 + \cos^2\theta$. In either case we see that the molecular weight and the virial coefficients (of the equation for the chemical potential) may be determined.

Equation 17–26 may be obtained by means of an exact molecular theory,[38] as well as by the method given here.

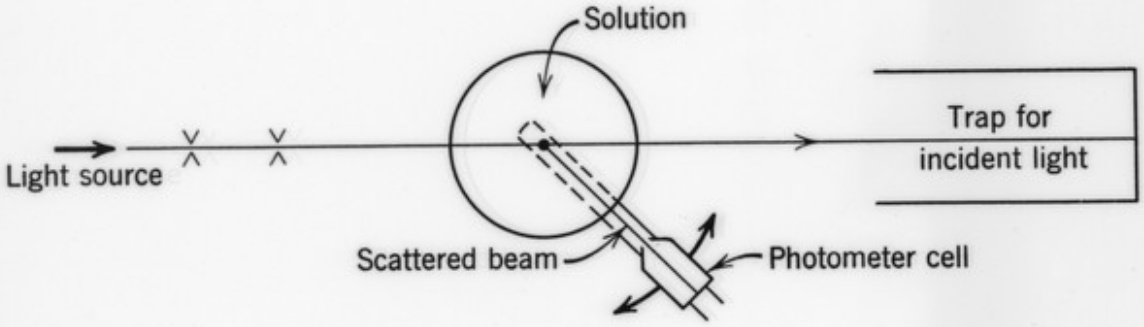

Fig. 17–3. Schematic diagram of the apparatus for light scattering measurements. The photometer cell may be rotated about an axis directly below the center of the vessel containing the solution. The photometer output is amplified and recorded on a galvanometer or recorder.

17d. Experimental determination of light scattering. Detailed descriptions of apparatus for making light scattering measurements are given by Debye,[14] by Zimm,[15] and by Brice, Halwer, and Speiser.[16] These papers, and papers by Carr and Zimm[17] and by Brice, Nutting, and Halwer,[18] discuss also the determination of constants of the instrument and correction for fluorescence and other factors which may interfere with the measurements. Figure 17–3 shows a diagrammatic sketch of a typical apparatus. The light source is usually a mercury arc, from which, by use of filters, we may obtain monochromatic radiation of wavelength 4358 or 5461 Å (these being the ones most commonly employed). The detecting device is a photomultiplier tube