286/E1

Dynamic light scattering: Instrumentation and data processing

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Dynamic Light Scattering (DLS) also known as Photon Correlation Spectroscopy is one of the most popular methods used to determine the size of small particles. The advantage of using dynamic light scattering is the possibility to analyze samples containing broad distributions of species of widely differing molecular masses (e.g. a native protein and various sizes of aggregates). With this technique it is also possible to obtain absolute measurements of several parameters of interest like molecular weight, radius of gyration, translational diffusion constant and so on. The aim of this work was to develop an experimental set up for Dynamic Light Scattering, to develop a method for data processing and to check the reliability of the developed experimental set up and data processing method.

The experimental set up is illustrated above. It consists of He-Ne laser with wavelength λ=632.5nm, a Photomultiplier tube (PMT), Fiber optics probes, a high voltage supply, cell (sample holder) and personal computer with vernier labpro software. Scattered light is collected at PMT and amplified before sending to the computer. Since we have only numerical data set to be dealt, using an appropriate software intensity auto correlation coefficient is calculated. The intensity correlation of the scattered beam is fitted to the autocorrelation function $g_2(q,\tau) = 1 + \exp(-2Dq^2\tau)$. Here, D is the diffusion coefficient, q is the scattering vector, and is the lag time. q is calculated using $q=4\pi n\sin(\theta/2)/\lambda$. Knowing D, the particle size is calculated using the Stokes–Einstein equation $D=K_BT/6\pi\eta a$. Ferric Hydroxide colloid was used to measure the accuracy of this method. 750ml of boiling distilled water was poured into 12ml of a 32% Ferric Chloride solution. The hydrolysis of Ferric Chloride occurred instantly and a sol of Ferric Hydroxide was formed. The colloid was quite stable and the particles size usually lies in the range 0.1μm to 1 μm.The results of the particle size analysis of Ferric Hydroxide colloid using the method described above agree well with the particle size given in literature for the same system.

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