13. Photon Correlation Spectroscopy and Applications

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13.1 Structure and Dynamics of Colloidal Solutions Studied by Small Angle Neutron Scattering and Photon Correlation Spectroscopy

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Small angle neutron scattering technique has been used to study systematically the structure of ionic and zwiterionic micelles formed from ionic and polar surfactants in aqueous solutions. A recently developed theory of ionic liquids has been shown to apply to dense micellar solutions where the charge density on the micellar surface is sufficiently high. Combination of the structural studies and the theoretical evaluation of the inter-micellar interactions allow an unambiguous analysis of the neutron scattering data to obtain:

1. micellar aggregation number;

2. effective surface charge, and

3. micellar shape and size;

as functions of the surfactant and salt concentrations. Thus the micellar growth and polydispersity can be simultaneously studied.

A high-resolution spectroscopic technique based on analyses of scattered light intensity fluctuations has been in use for some time. Our method is based on the digital time-domain pulse correlation technique using a 256-channel clipped correlator developed in the laboratory. The correlator-multichannel memory system is controlled by a PDP 11/MINC computer system which is capable of high-speed data acquisition and analysis necessary for the study of time-varying phenomena.

We have applied this photon correlation technique to study the Brownian dynamics of strongly interacting colloidal systems. Interesting results on the variation of mutual diffusion coefficient of

the micellar solutions with addition of salts and alcohol have been observed.

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