A Compact Photon-Correlation Spectrometer for Research and Education

I.K. Yudin, G.L. Nikolaenko, and V.I. Kosov
Oil & Gas Research Institute of the Russian Academy of Sciences
Leninsky Prospect 63
Moscow 117917, Russia

V.A. Agayan, M.A. Anisimov, and J.V. Sengers
Institute for Physical Science and Technology and Department of Chemical Engineering
University of Maryland
College Park, MD 20742 USA

We have developed a compact photon-correlation spectrometer for measuring static and dynamic light scattering in liquid systems including those characterized by strong light absorption (opaque systems). A simple and flexible design together with high resolution make the experimental setup to be a suitable tool in basic and applied studies in physics, chemistry, biology, medicine, engineering, and environmental research. With the setup it is possible to perform both homodyning and heterodyning measurements of the correlation function of scattered light. An ordinary low-intensity *He-Ne* laser can be used. The technique enables one to measure the size and diffusion coefficient of submicron particles suspended in liquids, as well as the mutual diffusion coefficient in binary mixtures, viscosities of liquids, and molecular weights of polymers in solutions. The quantity of the sample to be measured can be very small, starting from 0.01 cm^3. The measurements are fast, lasting usually from seconds to several minutes, which enables one to monitor and study kinetics of processes. We have also developed a special optical scheme to measure light scattering in opaque systems. The installation includes an original single-board digital correlator, to be plugged in a personal computer, and a set of programs to control and execute experimental processes and to perform data analyses. The accuracy of the results obtained has been verified by measuring submicron particle sizes in a variety of systems, such as latex suspensions, aniline dye dissolved in water, and dilute solutions of polystyrene in toluene.