

Intensity and Time Correlation Functions of Multiple Scattering in Turbid Liquids: Simulation and Experiments

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In highly turbid samples the scattering intensity contains contributions of single and multiple scattering. New techniques have improved the selectivity of the scattering angle and enable separating the single scattering from the multiple scattering. Vice versa multiple scattering contributions can be analyzed, which is of interest in its own right and requires assessment of such contributions by theory and simulation. We report on the simulation of the scattering intensity and of the time correlation functions of Latex solutions and of mixtures in the vicinity of the critical solution point. Simulation results for the scattering intensity and the time correlation functions of the multiple scattering contributions are compared with experimental results, corrected for nonideal properties of the detection optic [1]. Because the experiments allow only the determination of the single and total multiple scattering, a method is proposed that allows estimation of the various multiple scattering contributions. It turns out that, even in highly turbid samples, the majority of multiple scattering contributions reaching the detector involves essentially particles within the scattering volume, which is defined by the scattering geometry. Coherent backscattering is found in highly turbid samples as the maximum of the scattered intensity is shifted to such positions within the scattering volume, where the light-path is short [2]. At small times the time dependence of the multiple scattering correlation functions is determined by contributions of all allowed scattering vectors. The scattering cross section of the particles and the turbidity of the sample both lead to a preference of small scattering angles on the light path. At longer times the decay is almost exclusively determined by the intermediate scattering angles that yield the shortest light path. In the Gaussian approximation the exponents of the form factor and of the time-correlation function of the single scattering form a universal parameter determining the intensities and the correlation functions of the various multi-scattering contributions.

[1] J.Köser, F.Kuhnen, D. Saracsan, and W.Schröer, Progress in Colloid and Polymer Science 133 173-180 2006.

[2] W. Schroer, J. Köser, F. Kuhnen, Journal of Molecular Liquids 134 40-48 2007