Electro-kinetic experiments with an improved integral super-heterodyne laser Doppler velocimetry

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Super-heterodyne Doppler velocimetry have been successfully employed in our group for a long period of time to characterise electro-kinetic phenomena. It provides an integral measurement of the particle velocity distribution and allows simultaneous detection and quantification of superimposing electro-phoretic and electro-osmotic phenomena [1, 2]. Measurements at fixed low angles collect only incoherently scattered light and thus measure single particle properties independent of the sample structure [3]. In this contribution, we present an improved version of this technique allowing a continuous variation of the scattering angle. This in addition allows to study the influence of structure via a coherent detection scheme. Moreover, we implemented a novel experimental cell with exchangeable side walls, which allows us to characterise different surface types. The talk will highlight practical points and illustrate the versatility of the improved instrument with example measurements for some applications.

Most importantly, we report a novel empirical corrections scheme for multiple scattering, implemented in the evaluation software. The new evaluation scheme for instance, extends the range of examinable particle concentrations and allows studies of the concentration dependence of the electro-kinetic properties over several orders of magnitude without interference by multiple scattering. Using this we can show that the previously measured, seemingly contradicting results on small and large colloidal spheres [4, 5, 6, 7] can be reconciled in a single curve. The electro-phoretic mobility of highly charged spheres under thoroughly deionized conditions starts with low mobilities in the single particle limit, increases up to a plateau under conditions of strong inter-particle interactions and formation of fluid order and finally decreases again with the onset of self-screening effects lowering the zeta-potential.

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