Inverse micelles dynamics in Nonpolar Liquids: comparison between OLOA and AOT

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Surfactants are often added to nonpolar colloidal suspensions for the sterical stabilization and electrical charging of colloidal particles. Many properties of the mixture are a result of the (inverse) micelle size. For example, the electrophoretic mobility, the fraction of charged micelles and the generation and recombination dynamics of charged micelles depend on the micelle size. The surfactant OLOA 1200 in nonpolar organic solvent dodecane has been extensively studied [1,2]. From transient current measurements a lot of information about the origin and properties of charged micelles has been revealed. It is observed that at small time scales ($<$ 100 ms) drift and diffusion of the initially present charged micelles are the main contributions to the measured current, and at larger timescales ($>$ 1 s) a nonzero quasi steady-state current at high voltages (above 0.5 V) remains due to the generation of charged micelles [3]. The analysis of these measurements learns that the micelle size is approximately 7 nm. As a result of this quite large micelle size, the electrophoretic mobility of single charged micelles is relatively small, the fraction of charged micelles is large (around 7%) and the generation rate is low. Often the current due to generation is much smaller than the initial current. Another frequently used surfactant Aerosol OT (AOT) shows a different behavior in dodecane compared to OLOA as a result of a smaller micelle size (1.6 nm) [4-6]. For this material, the electrophoretic mobility is much faster, the fraction of charged micelles is much smaller and the generation/recombination is much faster. The current measurements can be explained in first approximation with a simple conductivity, due to the fast generation of charged micelles. Transient currents have been simulated by solving the Poisson-Nernst-Planck (PNP) equations which include the generation and recombination of charged micelles. From the comparison between the simulations and the current measurements, we determine the generation/recombination rate of AOT charged micelles. The dependence of the quasi steady-state current on the applied voltage, micelle concentration, and device thickness are investigated.

[1] A. R. M. Verschueren, P. H. L. Notten, L. J. M. Schlangen, F. Strubbe, F. Beunis and K. Neyts, J. Phys. Chem. B. **112**, 41 (2008).
[2] F. Beunis, F. Strubbe, M. Marescaux, J. Beeckman, A. R. M. Verschueren and K. Neyts, Phys. Rev. E **78**, 011502 (2008).
[3] F. Strubbe, A.R.M. Verschueren, L. J.M. Schlangen, F. Beunis and K. Neyts, *Journal of Colloid and Interface Science*, **300**, 396 (2006).
[4] M. F. Hsu, E. R. Dufresne and D. A. Weitz, Langmuir **21**, 4881 (2005).
[5] G. S. Roberts, T. A. Wood, W. J. Frith and P. Bartlett., J. Chem. Phys. **126**, 19 (2007).
[6] S. K. Sainis, V. Germain, C. O. Mejean and E. R. Dufresne, Langmuir **24**, 1160 (2008).