Abstract

The low-cost production of nano-porous materials is a challenge in current material research. A promising approach to achieve this goal is provided by the *Principle of Supercritical Microemulsion Expansion* (POSME). This procedure suggests preparing nano-porous materials via the expansion and fixation of microemulsions containing a supercritical (sc) fluid as non-polar component. However, so far the concept of the POMSE-procedure is still not proven. In order to reach this goal, *i.e.* to prepare nano-porous materials from supercritical microemulsions, the fundamental properties of such microemulsions were extensively studied in the first part of this work. Using model systems of the type H_2O – $scCO_2$ – non-ionic fluoro-surfactants it could be shown that the general phase behavior of $scCO_2$-microemulsions is closely related to that of classical state of the art microemulsions. Extensive small angle neutron scattering (SANS) and neutron spin echo (NSE) experiments were conducted in order to investigate the structural and dynamical properties of these novel microemulsion systems. The SANS spectra obtained for balanced $scCO_2$-microemulisons can be described with the model of *Teubner* and *Strey* which - together with the observed phase inversion - strongly supports the existence of a bicontinuous structure. In contrast, SANS-investigations on water-rich microemulsions revealed the existence of discrete CO_2-swollen microemulsion droplets in water. In this case the experimental scattering spectra were described using a newly derived droplet form factor based on an analytical density profile. The assumption of this density profile could be confirmed applying the model-free *Generalized Indirect Fourier Transformation* (GIFT). In the second part of this work the obtained results are used to formulate solidifiable, near-critical microemulsions of the type H_2O/sugar – propane – *n*-alkyl polyglycoside surfactant. Expanding these microemulsions porous sugar foams were obtained for sugar concentrations ≥ 75 wt%. However, it turned out that these foams undergo rapid aging phenomena like coalescence and *Ostwald*-ripening leading to the formation of micrometer sized pores (~ 30 ⌈m). Several tools were applied in order to attenuate these aging phenomena leading to highly porous sugar foams which posses a pore size of 1 ⌈m and therewith proof the feasibility of the POSME-procedure.