A new class of UV-sensitive surfactants for fixation of the bicontinuous microemulsion structure by polymerization

Renke Rommerskirchen 1,*, Thomas Sottmann 1, Axel Griesbeck 2, Alan de Kiff 2, Reinhard Strey 1

Department of Chemistry, University of Cologne, 50939 Cologne, Germany

1 Institute of Physical Chemistry; 2 Institute of Organic Chemistry
*e-mail: renke.rommerskirchen@uni-koeln.de

Microemulsions provide a variety of nanostructures. Hence, they are promising candidates as templates for nano-materials. By fixing the structure of the microemulsion by polymerizing the oil component, the chemical nature of the oil-phase changes; i.e. it becomes more hydrophobic. Consequently the phase boundaries are shifted to higher temperatures. Concomitantly, the initial nanostructure also occurs at higher temperatures. Up to date the nanostructures only were fixed successfully by using highly viscous sugar solutions [1] or using polymerizable co-surfactants [2]. We suggest counteracting the trend by using UV-sensitive co-surfactants. To demonstrate the idea we created microemulsions using a new class of phthalimidoaminoalkyl acids as UV-sensitive and surface active species. Irradiation of UV-Light causes these molecules to eliminate carbon dioxide [3, 4]. The remaining molecule is rather non polar so that the one-phase region and also the bicontinuous nanostructure shifts to considerably lower temperatures. In this fashion we were able to vary the phase behaviour of a microemulsion in situ (see Fig. 1).

The goal is to compensate the shift of the phase boundaries of a microemulsion system during the polymerization process of a non-polar hexylmethacrylate (C6MA) oil-phase to higher temperatures by decarboxylation the surfactant. First polymerization experiments lead to solids that exhibit nanostructures of characteristic sizes in the range of a typical bicontinuous liquid microemulsion structure of 50 – 150 nm.

Figure 1: Phase behavior of a polymerizable microemulsion with the UV-sensitive co-surfactant α-C11 before UV-irradiation (circle) and with the decarboxylated co-surfactant after 2h of UV-irradiation (square). Polymerization experiments were performed at 37.5°C and γ = 0.18 (cross).