Abstract

Complex fluids are extensively used as templates for the synthesis of nanomaterials due to their large variety of nanostructures. However, up to date the challenge is to copy the microemulsion structure to the desired microstructure of the polymer on a one-to-one scale. Recently *Co et al*. used a new class of highly viscous microemulsions that are composed of surfactant, polymerizable oil, and sugar to maintain the microstructure after polymerization [F. Gao, C.-C. Ho, and C.C. Co, *J. Am. Chem. Soc.* **126**, 12746 (2004)]. The addition of sugar enables the reorganization kinetics of the phase behavior to be slowed down so that a changing monomer/polymer ratio during the polymerization does not lead to a phase separation. In this study, we systematically investigate the phase behavior of highly viscous sugar microemulsions. Starting from the sugar-free nonionic system H_2O – *n*-octane – *n*-alkylpolyglycolether (C_iE_j) the amount of sucrose/trehalose within the water phase was increased up to 75%. The addition of sugar shifts the phase boundaries to lower temperatures. The shift of the phase boundaries can be compensated by replacing the C_iE_j-surfactants with a more hydrophilic sugar surfactant. To formulate a highly viscous, polymerizable microemulsion, which can be polymerized via UV-irradiation, *n*-octane was replaced with a methacrylate oil. The obtained structures were investigated by dynamic light scattering, scanning electron microscopy and small angle neutron scattering. It is shown for the first time that the size of the polymeric nanoparticles strongly correlates with the size of the underlying microemulsion. Systematic variations in composition and temperature provide polymer particles with radii between 10 to 100 nm. Furthermore for the first time, both lamellar and bicontinuous structures could be copied nearly one-to-one to the nanoporous polymer material. The unpolymerized microemulsion and the nanomaterial were studied by small angle neutron scattering, scanning electron microscopy as well as by transmission electron microscopy.