Formation of nanoparticles in reverse microemulsions using poly(ethyleneimine) and maltose-modified poly(ethyleneimine)

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The influence of unmodified branched poly(ethyleneimine) (PEI) and maltose-modified hyperbranched poly(ethyleneimine) (mal-PEI) on the phase behaviour of the inverse micellar region (L2 phase) of microemulsions has been investigated. Both polymers can be incorporated into a quaternary w/o microemulsion consisting of water / toluene-pentanol (1:1)/ anionic surfactant SDS, as well as in a ternary w/o microemulsion consisting of water / heptanol/ zwitterionic surfactant SB. For both of them the area of the L2 region is decreased by replacing PEI with mal-PEI.

Polyelectrolytes can act as reducing and stabilizing agents in the nanoparticle formation process [1]. Therefore, polyelectrolyte-modified microemulsions can be used as a template phase for the nanoparticle formation. Gold nanoparticles [2] and CdS quantum dots [3] are produced by a simple mixing procedure of two microemulsions and can be redispersed after a complete solvent evaporation.

UV-vis and fluorescence measurements in the microemulsion illustrate the capping effect of the polycations on the formation of the CdS quantum dots and the effect of the different polycations on the formation of the nanoparticles. The UV absorption maximum of the mal-PEI-modified system is shifted from 400 nm to 340 nm by replacing with PEI. Furthermore, the redispersed nanoparticles have been characterised by using UV-vis and fluorescence spectroscopy, in combination to dynamic light scattering and transmission electron microscopy (TEM). From the quaternary microemulsion, only nanoparticle aggregates of about 100 nm can be redispersed, but from the ternary microemulsion, well-stabilized polycation capped nanoparticles of 10 nm can be obtained.