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Thermal transitions of non-ionic detergent micelles

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The phase behavior of non-ionic detergent molecules such as polyethylene glycol mono-*n*-alkyl ethers (C_iE_j) in aqueous solution has been widely studied in the last two decades by a variety of methods. At very low concentrations, these detergents dissolve as monomers and form micelles at higher concentrations (above cmc). Increasing temperature induces an increase of attractive interactions, leading even to two separeted phases above the temperature of the cloud point (Tc). DSC studies on polyethylene glycol mono-*n*-alkyl ether detergents above the cmc, but below Tc, have led to the discovery of a hitherto unknown endothermic transition, shown to be reversible as reported for $C_{14}E_{18}$ [1)]. The corresponding transition temperature markedly depends on the number of ethylene oxide groups and to some extent also on the length of the alkyl chains.

In order to obtain informations about the molecular nature of this thermal transition, investigations at different temperatures have been carried out to characterize the nanoparticulate and structural properties of the assembled non-ionic detergent molecules. Besides viscosity measurements, also studies based on dynamic light scattering and small-angle neutron as well as X-ray scattering have been performed. A correlation is found between the thermal transition temperature and the onset temperature of the observed viscosity and particle size increase. Below the transition temperature spherical detergent micelles are formed. Above the transition temperature rod-like structures are observed, which have the tendency to grow upon increasing temperature. The thermal transition itself is attributed to a cooperative structural change of the polar head group of the detergent molecules which is thought to represent the basic molecular origin of the sphere-rod transition and the subsequent growth phenomena.

(1) E. Grell, E. Lewitzki, M. von Raumer and A. Hömann, J. Therm. Anal. Calor. 57.371 (1999)