

Gelled lyotropic liquid crystals: visual, rheological and thermal phase studies

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Gelled lyotropic liquid crystals (Gelled LLCs) can be prepared by (a) adding a gelator to an existing LLC phase or (b) replacing the solvent in a gel network by an LLC (Figure 1). Generally speaking, gelled LLCs combine the mechanical stability of a gel with the microstructure of an LLC phase [1] which makes them an interesting candidate in transdermal drug delivery systems [2]: drugs can be solubilized in the LLC phase whereas the gel provides convenient application. From a fundamental point of view, there are two questions that have to be answered: (1) Are gelled LLCs orthogonal self-assembled systems [3], i.e. do the two coexisting structures form simultaneously but independently? (2) Does the chronology of gel and LLC formation influence the domain size of the LLC and the alignment of the gelator fibers, respectively [4,5]? To answer these questions, a water – surfactant system that forms LLC phases with moderate melting temperatures and a gel whose sol-gel transition temperature depends on the concentration, are required. We choose the system H₂O – heptaethylene glycol monododecyl ether (C₁₂E₇) [6] as it forms three LLC phases, namely the lamellar phase L_α, the bicontinuous cubic phase V₁ and the hexagonal phase H₁ in specific temperature and concentration ranges. Moreover, we choose the organogelator dibenzylidene-D-sorbitol (DBS) [7] as its presence, irrespective of its concentration, only slightly influences the LLC phase boundaries of the system H₂O – C₁₂E₇ as opposed to the organogelator 12-hydroxyoctadecanoic acid (12-HOA). The latter was found to act as co-surfactant and to stabilize the lamellar phase [8]. In this contribution we present rheological and differential scanning calorimetry (DSC) measurements of the binary system H₂O – C₁₂E₇, the gelled system H₂O – C₁₂E₇ – DBS as well as of the respective binary gel ethylene glycole – DBS and we discuss the results in term of orthogonal self-assembly. Rheology and DSC measurements revealed that the sol-gel transition temperatures of the gelled LLCs are about 50 K below the sol-gel transition temperatures of the binary gel. However, phase diagram measurements and transmission electron microscopy (TEM) pictures show that the general LLC and gel phase behaviour is maintained in the gelled LLCs. In addition, the gelled LLCs and the binary gel show similar rheological properties.

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