Gelled Lyotropic Liquid Crystals–
Impact of gelator on liquid crystalline self-organization

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Gelled lyotropic liquid crystalline phases are soft materials in which the anisotropy of a lyotropic liquid crystal (LLC) is combined with the mechanical stability of a gel. Here we present results obtained by a systematical investigation of the preparation and the phase behaviour of this new class of complex fluids. We will discuss how the monomeric gelator as well as the gel network influence structures and properties of the lyotropic liquid crystalline phases.
The studied LLC system consists of sodium dodecylsulfate (SDS) as surfactant, decanol as co-surfactant and water. At constant temperature (25°C) and fixed water content (70 wt.%) various liquid crystalline phases (lamellar Lα, nematic Nd and Nc, hexagonal H_1) are formed depending on the decanol to SDS ratio. Using the low molecular weight organogelator 12-hydroxyoctadecanoic acid, we developed a procedure for the simultaneous formation of the LLC phase and the gel network which leads to anisotropic and highly viscous gels (see Figure 1a).
The coexistence of gel network and lamellar L_α phase was demonstrated by freeze-fracture electron microscopy (FFEM). Twisted gel fibers and lamellar layer steps were observed side by side (Figure 1b). Small angle X-ray (SAXS) scattering results indicate a higher translational order for gelled than for non-gelled lamellar phases. Additionally, an arrested lamellar layer spacing was found in the gelled state, as can be seen in Figure 1c).
Gelled nematic phases however could not be observed since the surface active gelator is monomerically integrated into micelles acting partly as co-surfactant which reduces the micelle curvature and thereby leads to a widening of the lamellar regime.

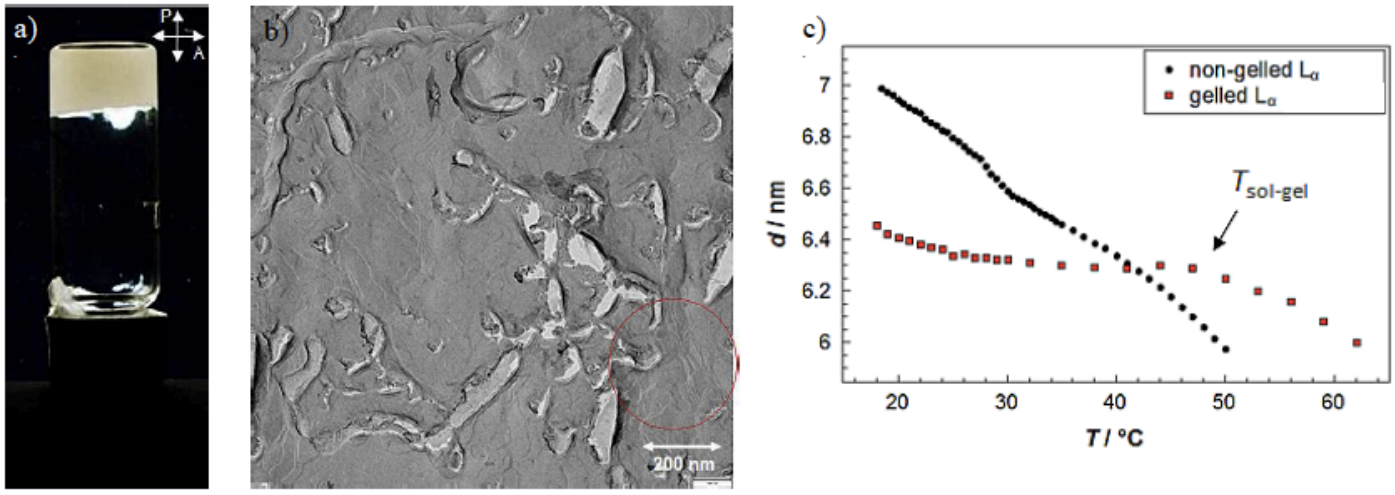

Figure 1: a) Picture of the gelled lyotropic lamellar phase between crossed polarizers. The gel shows no flow but strong optical birefringence. b) Freeze-fracture electron microscopy picture of the gelled L_α phase. A helically twisted gel fiber and lamellar layer steps (highlighted by the red circle) were found next to each other. c) Lamellar layer spacing of the non-gelled and the corresponding gelled Lα phase versus temperature measured by small angle X-ray scattering. For the gelled Lα phase an arrested layer spacing was observed below the sol-gel transition temperature $T_{sol-gel}$.

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