

Physik der Weichen Materie

Flüssigkristalle

- 1.1 Allgemeine Definition
- 1.2 Thermotrope Flüssigkristalle
- 1.3 Phasen
 - 1.3.1 Nematische Phase
 - 1.3.2 Smektische Phase
 - 1.3.3 Kolumnare Phase
 - 1.3.4 Flüssigkristalline Polymere
- 2. Ordnungszustände
 - 2.1 Strukturuntersuchungen
 - 2.2 Orientierungsordnung
 - 2.3 Theoretische Überlegungen
- 3. Phasenübergänge
 - 3.1 Entropie
 - 3.2 Freie Energie
 - 3.3 Ordnung des Phasenübergangs
- 4. Eigenschaften
 - 4.1 Mechanische Eigenschaften
 - 4.1.1 Elastizität
 - 4.1.2 Viskosität
 - 4.1.3 Grenzflächeneffekte
 - 4.1.4 Topologische Defekte
 - 4.2 Externe Felde
 - 4.2.1 Elektrische Felder
 - 4.2.2 Magnetische Felder
 - 4.3 Elektro-optische Eigenschaften
 - 4.3.1 Devices
 - 4.3.2 Dünnschichttransistoren
 - 4.3.3 Ferroelektrische Displays
 - 4.3.4 Polymer-dispergierte Flüssigkristalle
 - 4.3.5 Temperatureffekte

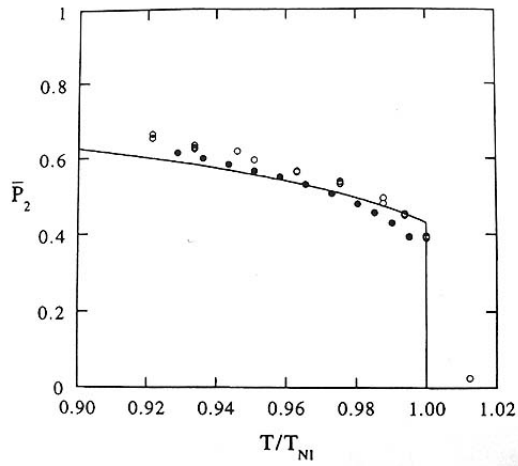
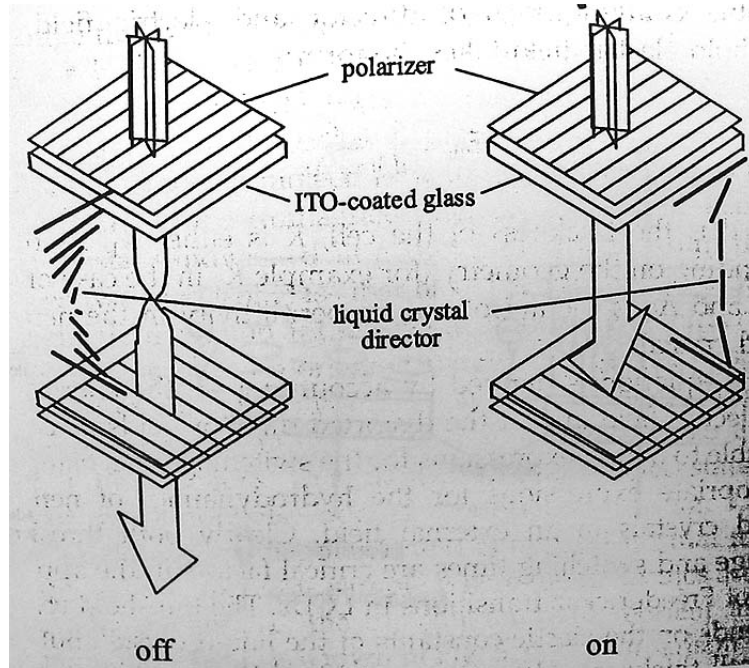
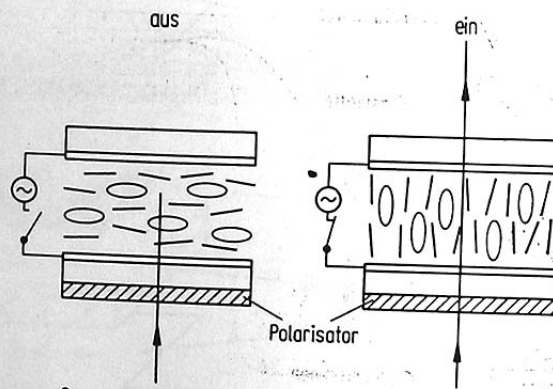
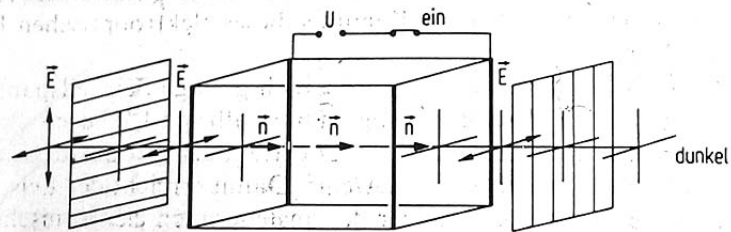
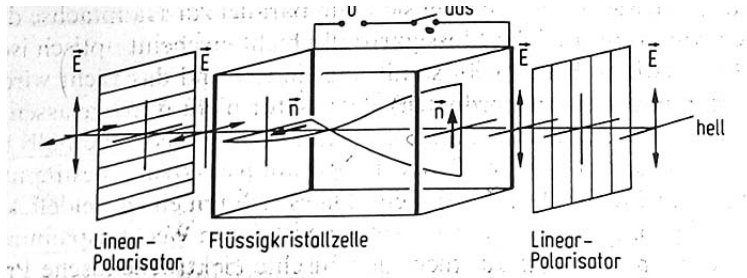
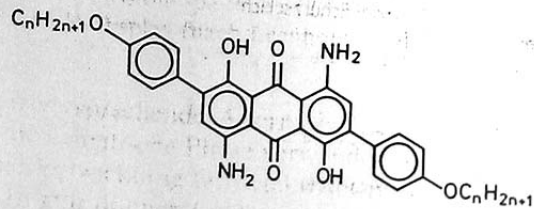


Figure 5.17 Orientational order parameter \bar{P}_2 versus reduced temperature. Experimental data for the nematogen PAA (Fig. 5.1). Open circles: data from neutron diffraction experiments; closed circles: data from NMR experiments; line: Maier-Saupe theory. [Data from I.W. Hamley *et al.*, *J. Chem. Phys.*, **104**, 10046 (1996)]

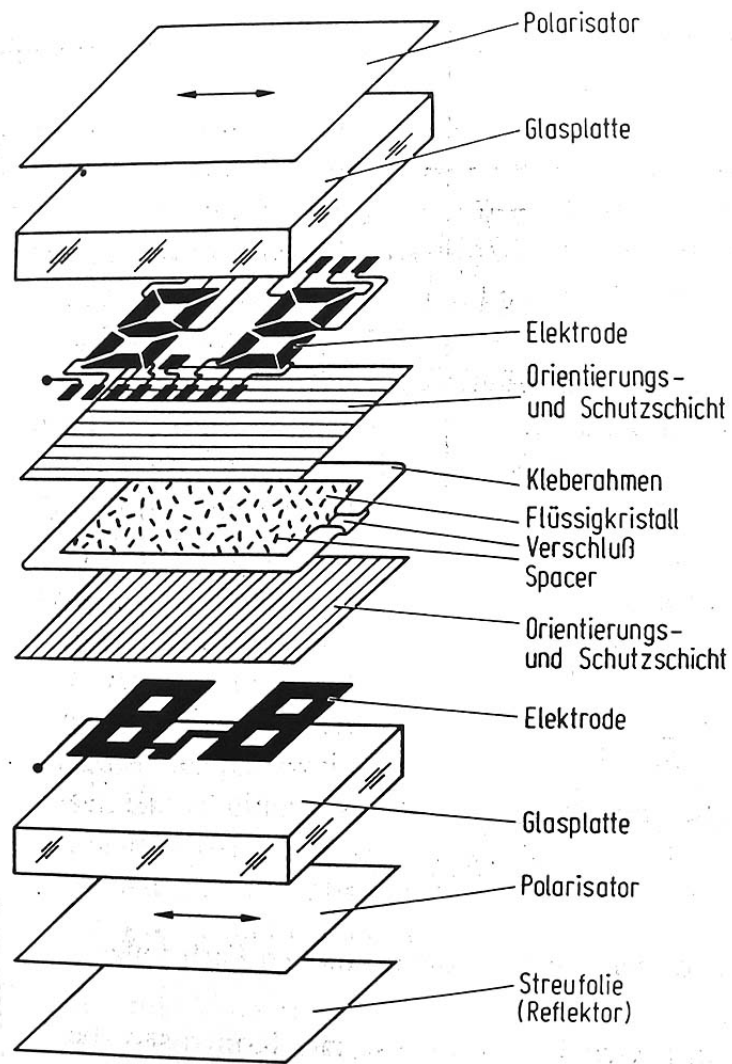




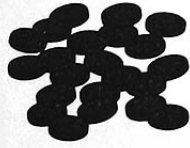
○ Farbstoffmolekül
| Flüssigkristallmolekül



6 Flüssigkristalle



PHASE TYPES



Nematic (N_D)



Columnar (eg. Col_{hd})

PACKING WITHIN COLUMNS



Disordered (d)

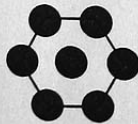


Ordered (o)



Tilted (t)

STACKING OF COLUMNS



Hexagonal (h)



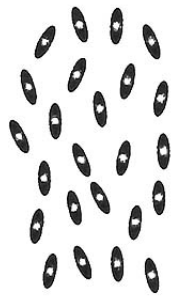
Rectangular (r)



Oblique (ob)



Isotropic (I)



Nematic (N)



Chiral Nematic (N*)

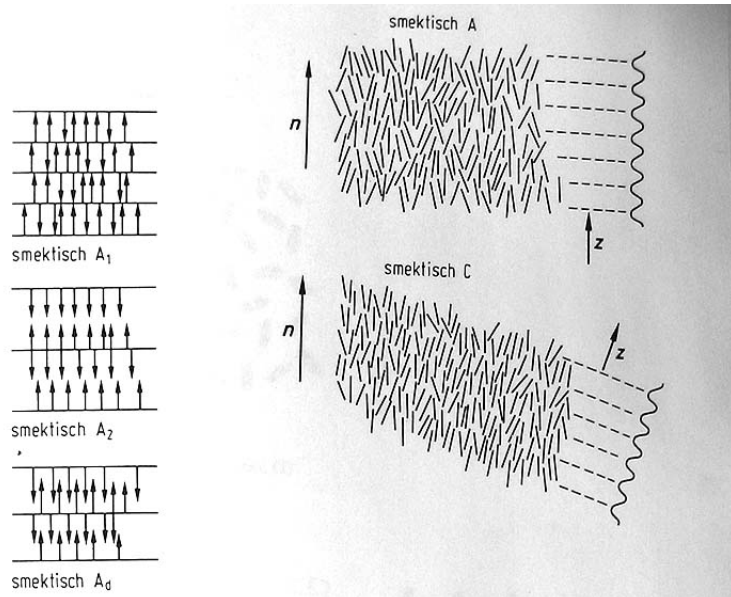


Abb. 6.39 Strukturschemata der smektischen Phasen

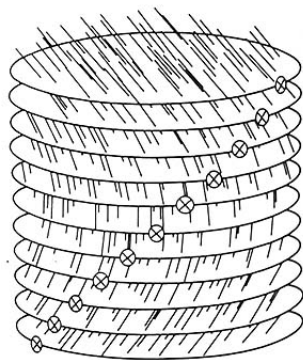
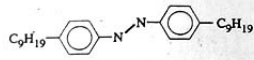


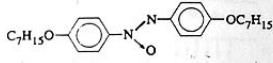
Abb. 6.40 Helixstruktur in der smektischen C-Phase chiraler Moleküle.

4,4'-dinonylazobenzene



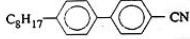
Cr 37 SmB 40 SmA 53 I

4,4'-diheptylazoxybenzene (HOAB)



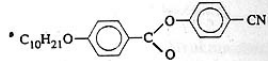
Cr 74.5 SmC 95.5 N 124 I

4-octyl-4'-cyanobiphenyl (8CB)



Cr 21 SmA 32.5 N 40 I

4-cyanophenyl-*trans*-4'-decyloxyphenylcarboxylate

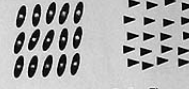


Cr 79 SmA 79 N 86.5 I

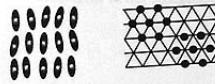
Figure 5.3 Examples of smectogens, together with phase transition temperatures (°C)



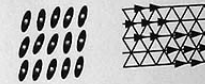
Smectic A (SmA)



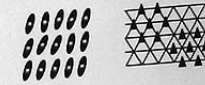
Smectic C (SmC)



Smectic B (SmB)



Smectic I (SmI)



Smectic F (SmF)

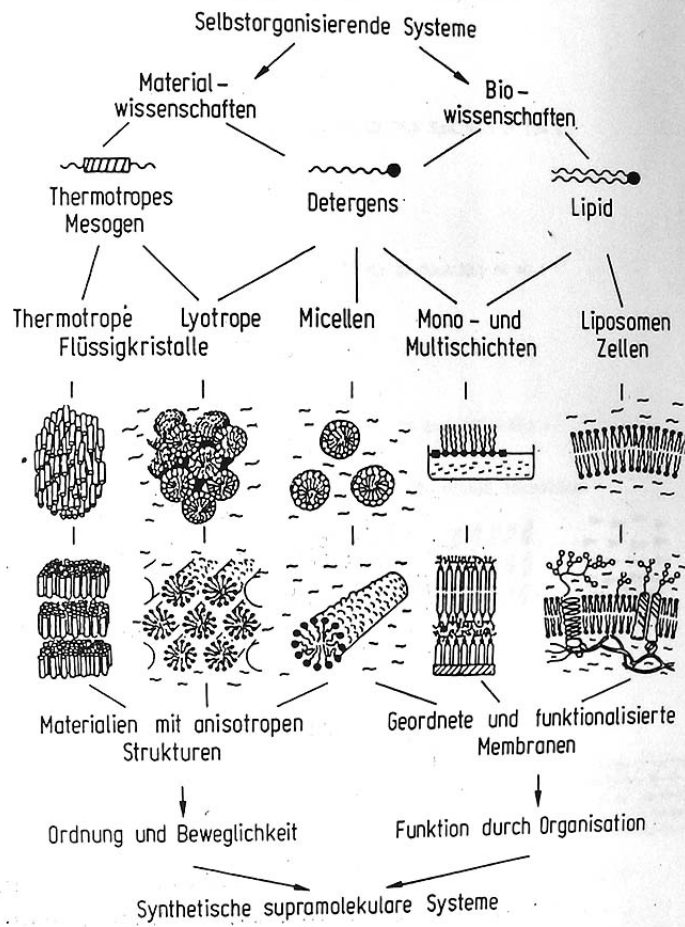
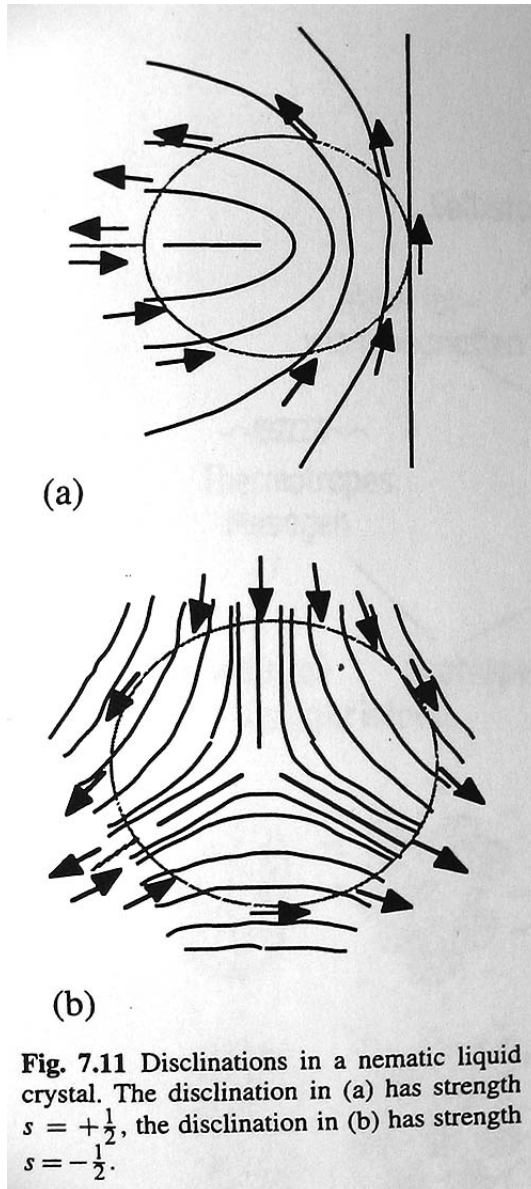


Abb. 6.56 Selbstorganisation verschiedener Flüssigkristallssysteme (nach Ringsdorf et al. [13]).



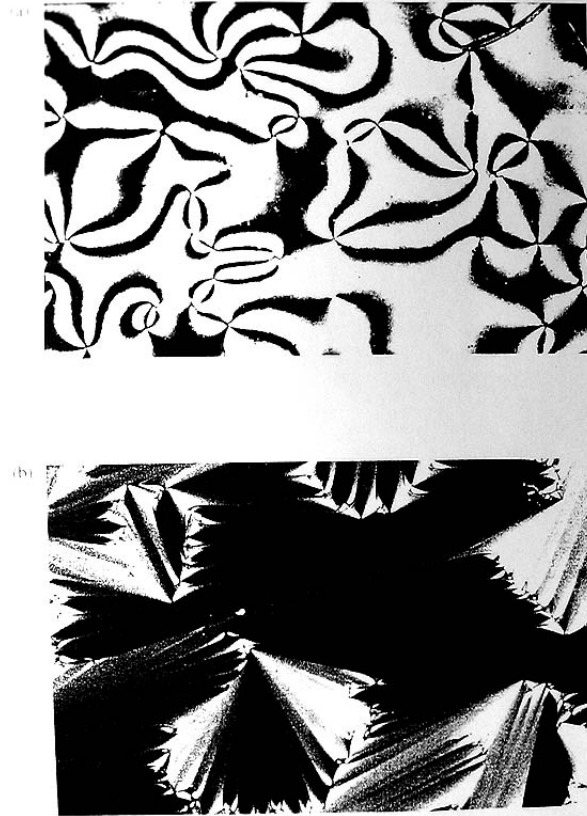


Figure 5.10 Textures of liquid crystal phases observed with a polarizing optical microscope: (a) nematic, (b) smectic A, (c) smectic C and (d) smectic B. (Photographs courtesy of Professor D. Demus)

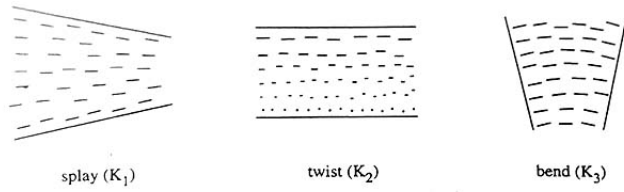


Figure 5.20 (a) Splay, (b) twist and (c) bend deformations in a nematic liquid crystal. The director is indicated by a dot, when normal to the page and by a dash when parallel. The corresponding Frank elastic constants (Eq. 5.19) are indicated

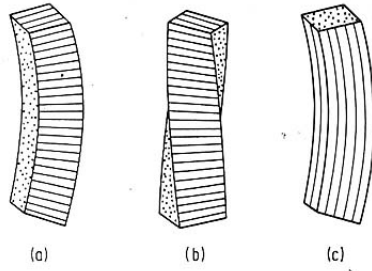
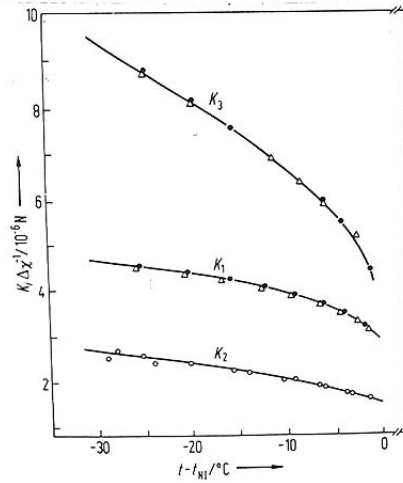


Abb. 6.16 Die drei Grunddeformationen eines nematischen Flüssigkristalls



Frank elastic constants of a nematic phase (PAA)

