GEFTA-Fortbildungskurs „Praxis der Untersuchung von Phasenübergängen“
Ansbach, 30./31.10.2001

Flüssigkristalle

Dr. Steffen Neuenfeld, Zentrale Verfahrensentwicklung

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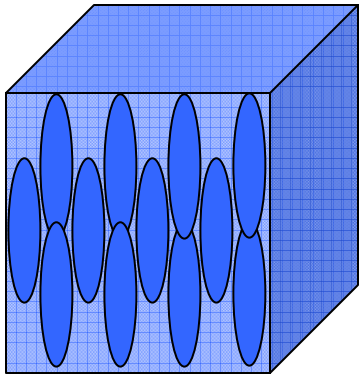
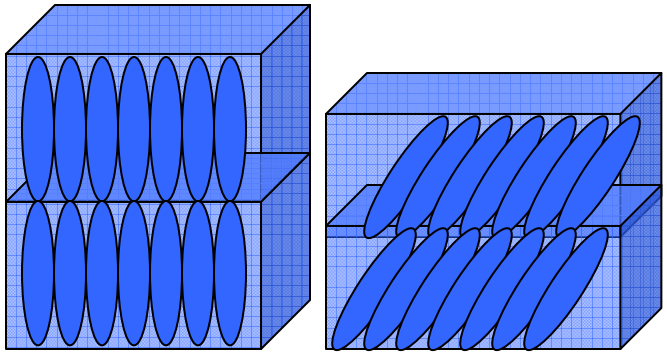
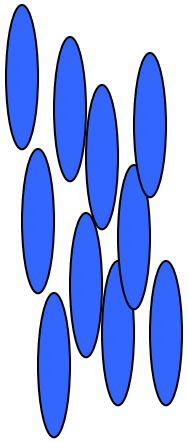
Flüssigkristalle



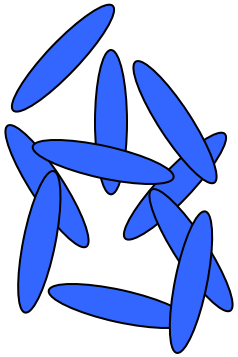
kristallin
(polymorph)



smektisch (A - H)



nematisch



isotrop

Kristall	Flüssigkristall	Flüssigkeit
anisotrope physikalische Eigenschaften		isotrop

Temperatur

Ordnung

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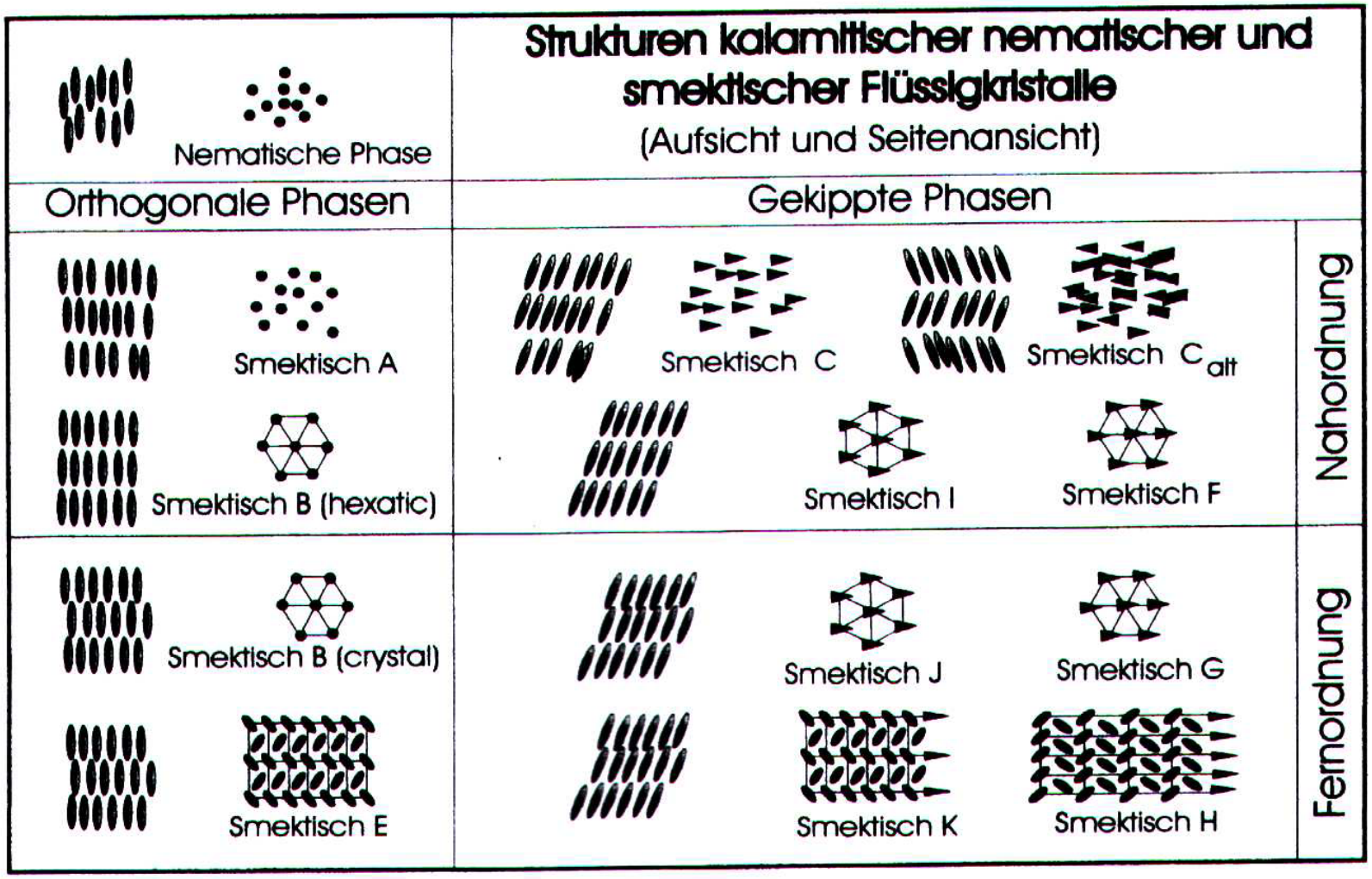

Quelle: Krause, J. in Anwenderseminar Thermische Analyse, Würzburger Tage 1998, ecomed 1999, 116-135

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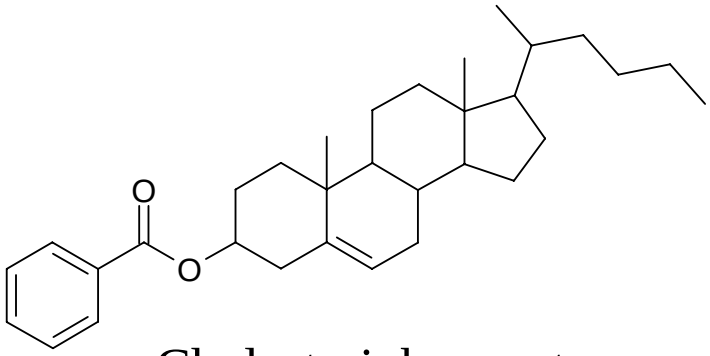
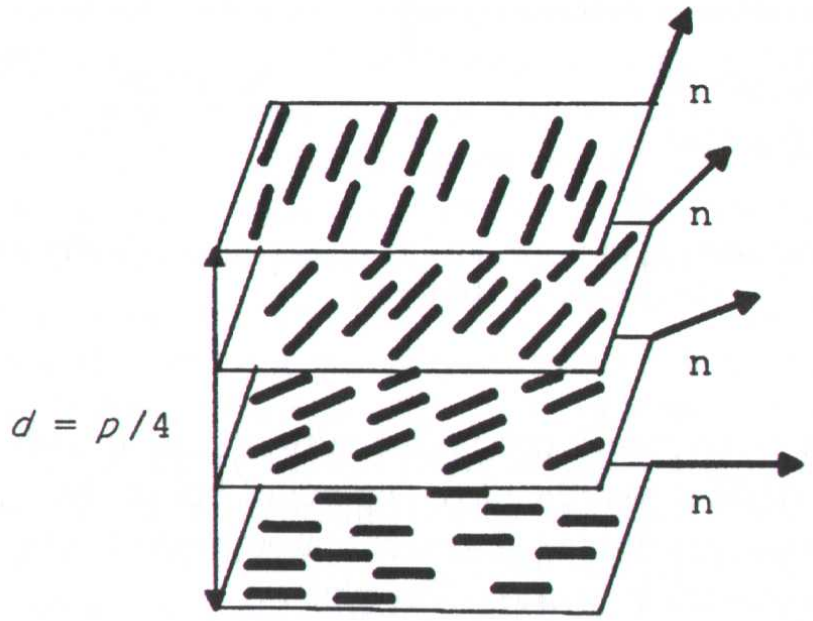
Spezielle nematische Phasen



Cholesterinbenzoat

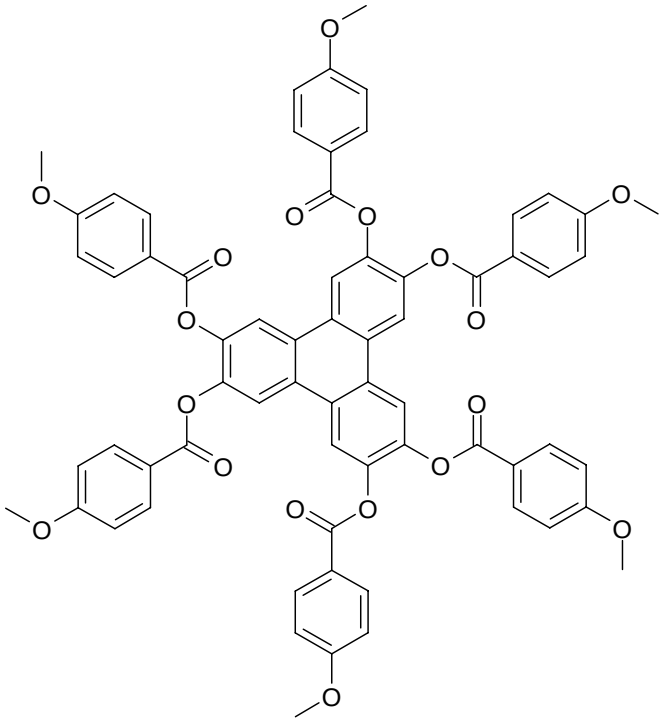
Reinitzer 1888
Schmelzpunkt 145.5°C (trüb)
Klärpunkt 178.5°C

Cholesteristische Phase

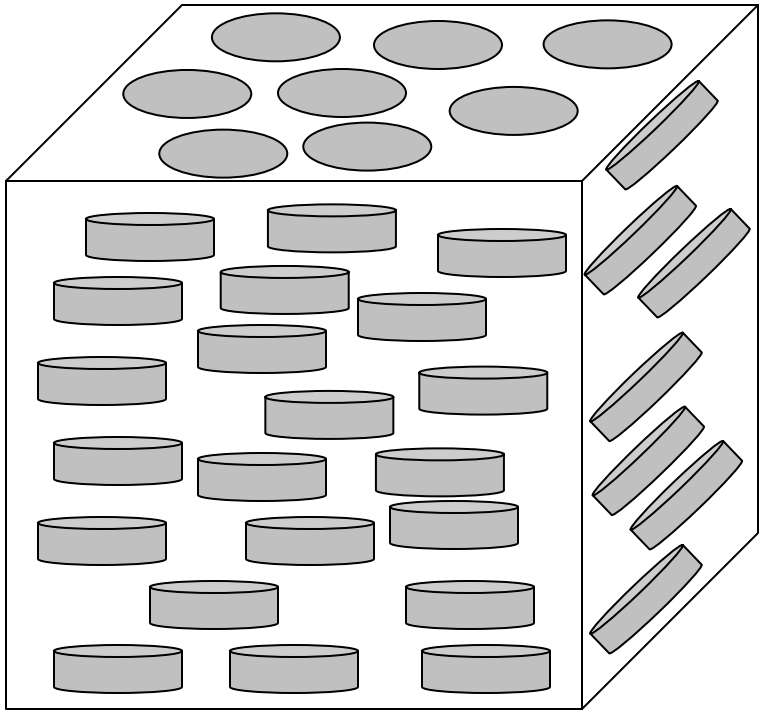


Quelle: Pauluth, D.; Wächtler, A.E.F.: Chirality in Industry II 263-286

Spezielle nematische Phasen



diskotische Phase



Natur der Phasenübergänge

SmA ↔ (N, I)	1. Ordnung	ΔH = 1 - 1,5 kcal/mol (4 - 6 kJ/mol)
	wenige Fälle mit sehr viel geringerem ΔH bekannt, evtl. 2. Ordnung	
SmB ↔ (N, I, andere smektische Phasen)	1.Ordnung	ΔH = 1 - 2 kcal/mol (4 - 8 kJ/mol)
B_{hex} ↔ B_{cryst}	2. Ordnung	
SmC ↔ SmA	2. Ordnung	ΔH extrem niedrig: 0,1 kcal/mol (< 1 kJ/mol)
SmD	keine brauchbaren Daten vorhanden	
SmE ↔ (SmA, SmB, I)	1. Ordnung	ΔH = 1 - 2 kcal/mol (4 - 8 kJ/mol)
SmF ↔ SmG	schwach 1. Ordnung	ΔH ≈ 0,25 kcal/mol (≈ 1 kJ/mol)
SmF ↔ SmC	2. Ordnung oder schwach 1. Ordnung	ΔH = 0,3 - 0,6 kcal/mol (1,2 - 2,4 kJ/mol)
SmG ↔ SmF: s.o.		
SmG ↔ andere Phasen	1. Ordnung	ΔH = 0,5 - 0,75 kcal/mol (2 - 3 kJ/mol)

Quelle: Gray, G.W.; Goodby, J.W.: Smectic Liquid Crystals, Leonard Hill, Glasgow & London, 1984

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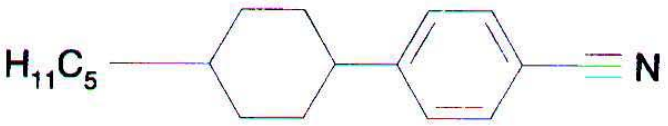
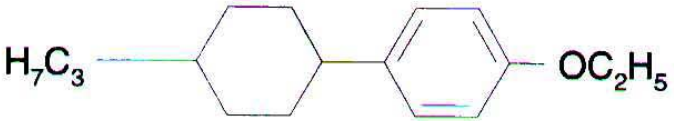
Flüssigkristalle - Beispiele

1 

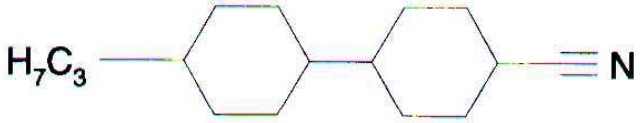
K 31 N 55 I

2 

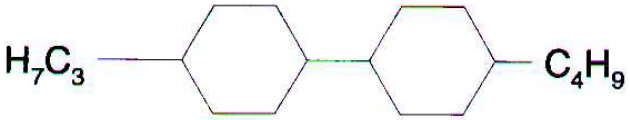
K 42 N (37) I

3 

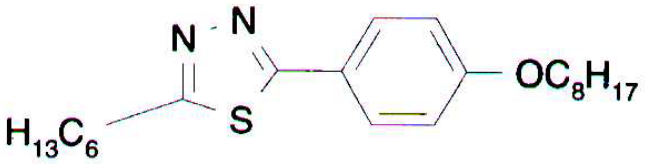
K 52 SmA 67 N 80 I

4 

K 59 SmB (53) N 82 I

5 

K -5 SmB 97 I

6 

K 73 SmC 80 SmA 83 I

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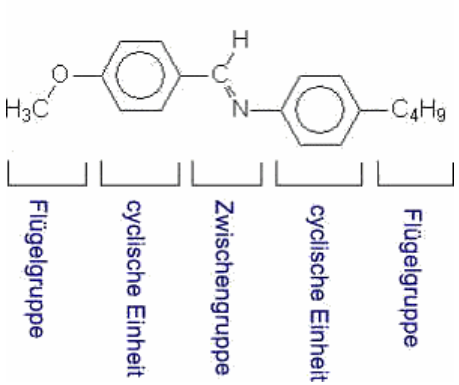
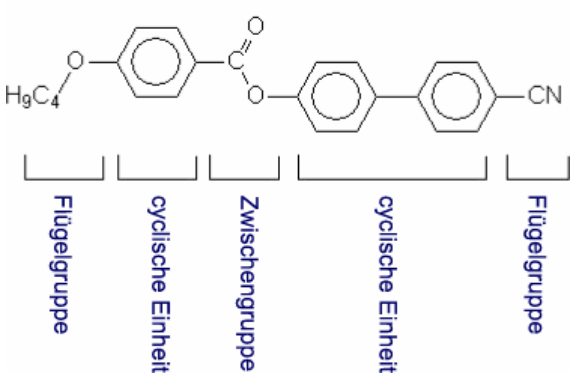
Strukturmerkmale

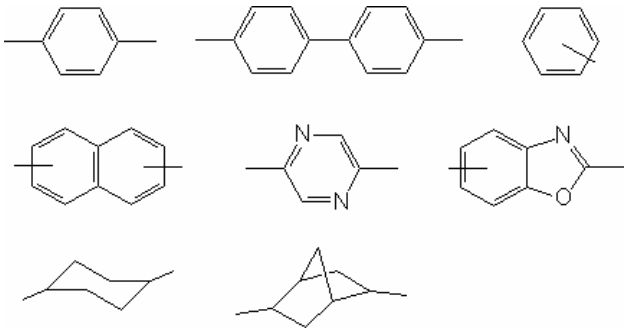
p-Methoxybenzyliden-p-butylanilin MBBA



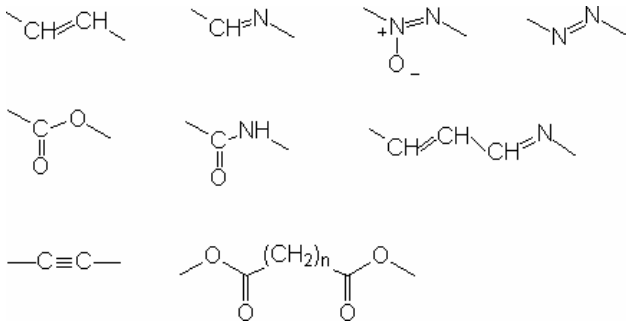
p-Butoxybenzoesäure-(4,4'-biphenylnitril)ester



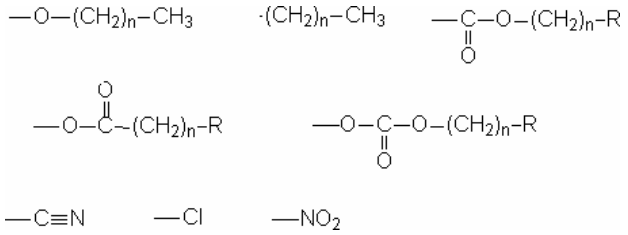
Cyclosche Ringsystem



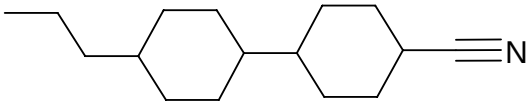
Zwischengruppen



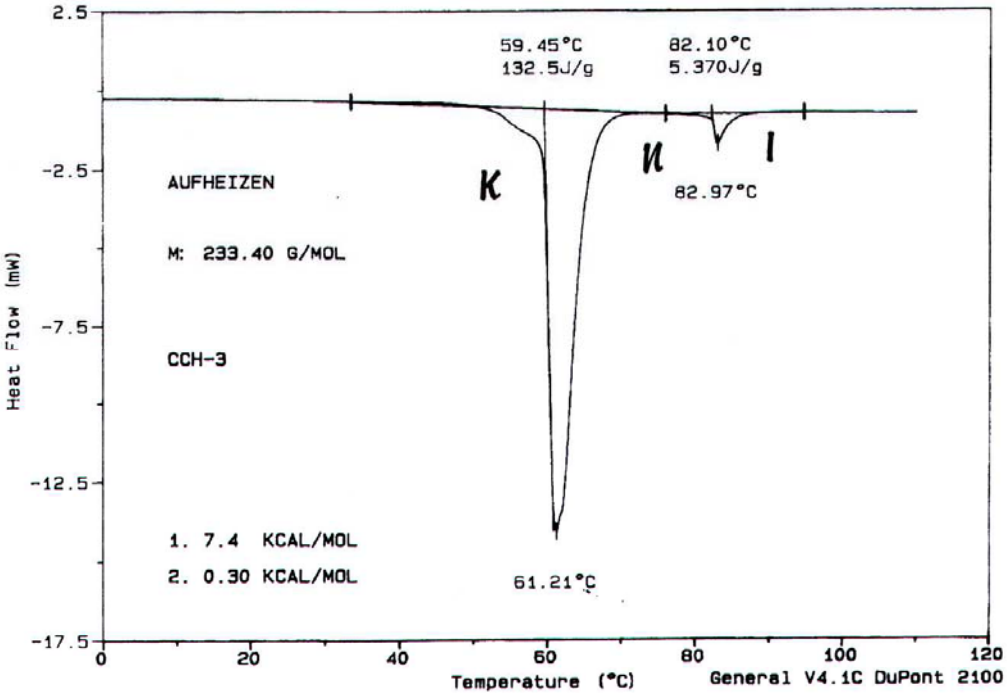
Flankengruppen



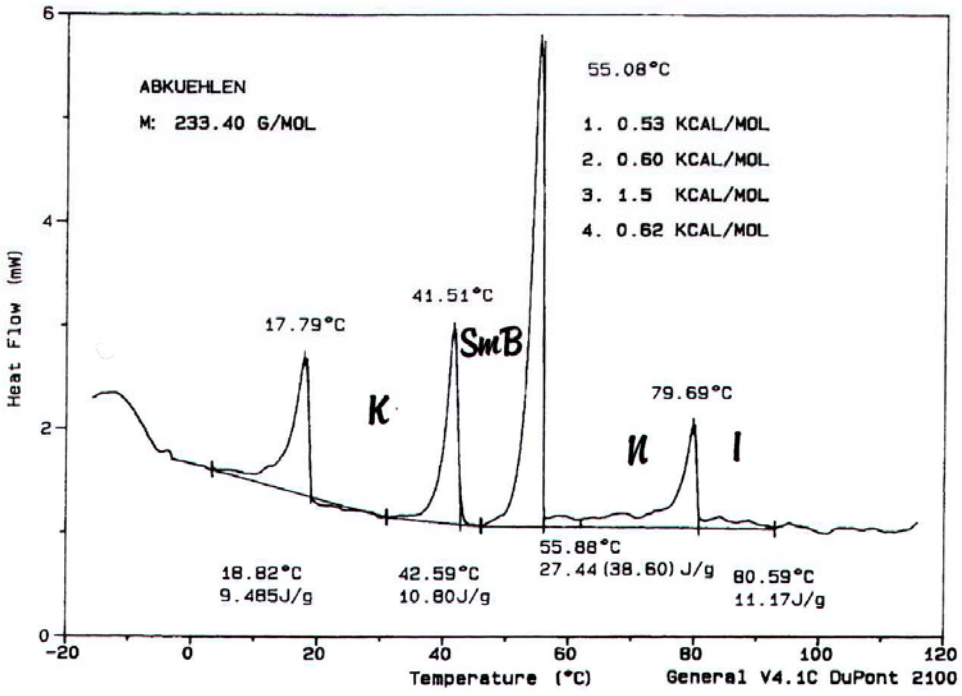
DSC-Messungen - Beispiel CCH-3



Aufheizen K 59 N 82 I

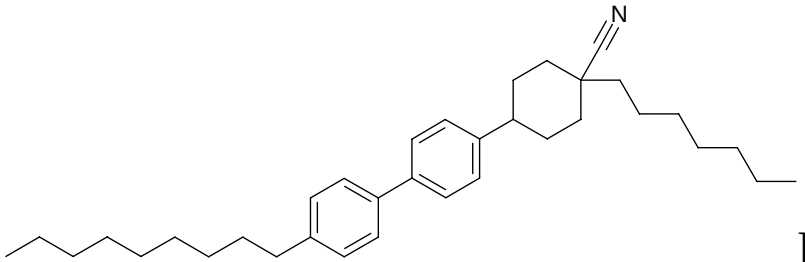


Abkühlen K 59 SmB (53) N 82 I



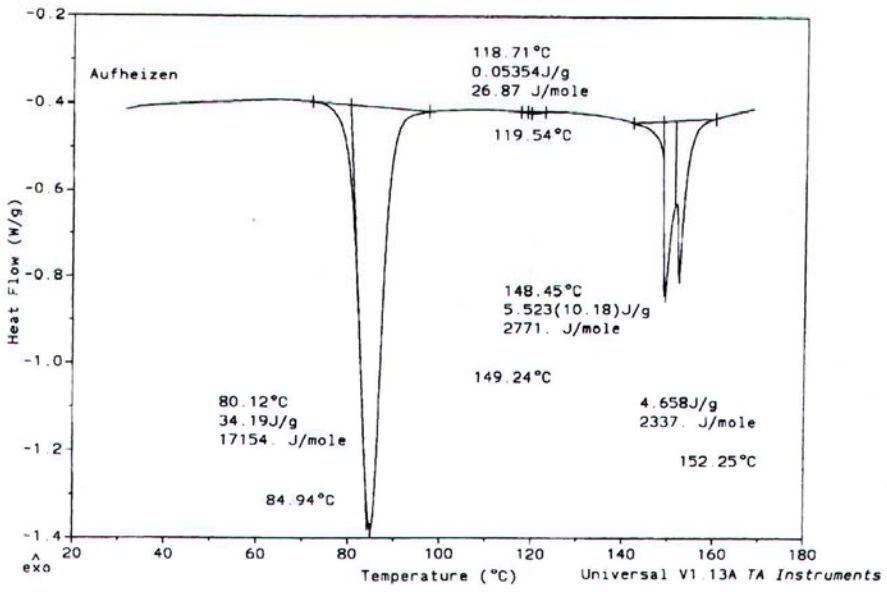
Quelle: Krause, J. in Anwenderseminar Thermische Analyse, Würzburger Tage 1998, ecomed 1999, 116-135

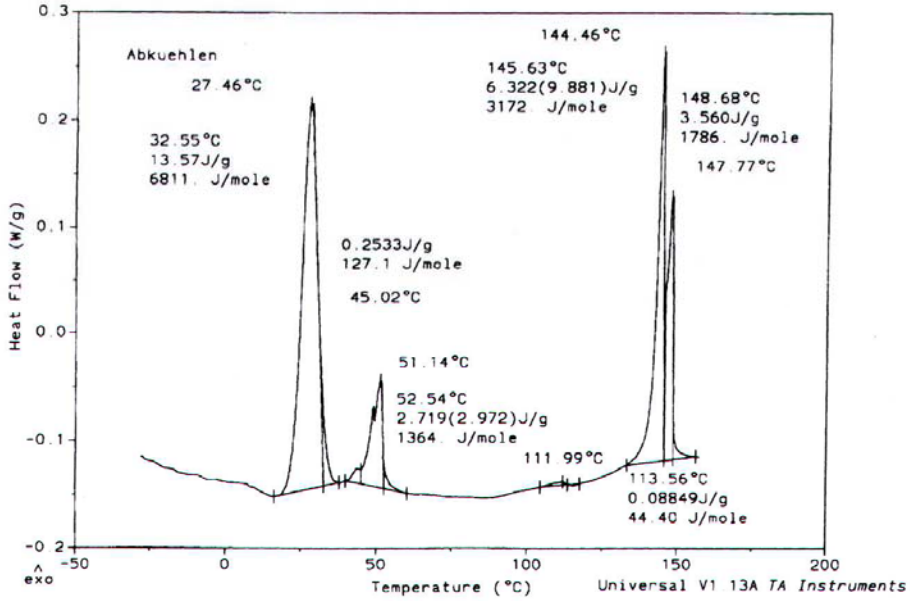
DSC-Messungen - Beispiel IS 1906



K 80 SmF (50) SmI (53) SmC 119 SmA 148 N 152 I

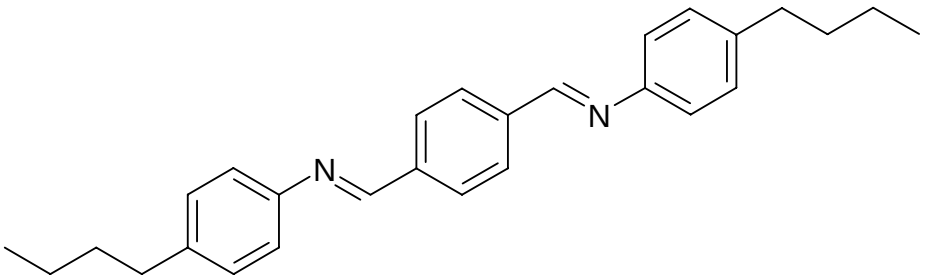
1-Heptyl-4-(4'-nonyl-biphenyl-4-yl)-cyclohexanecarbonitrile

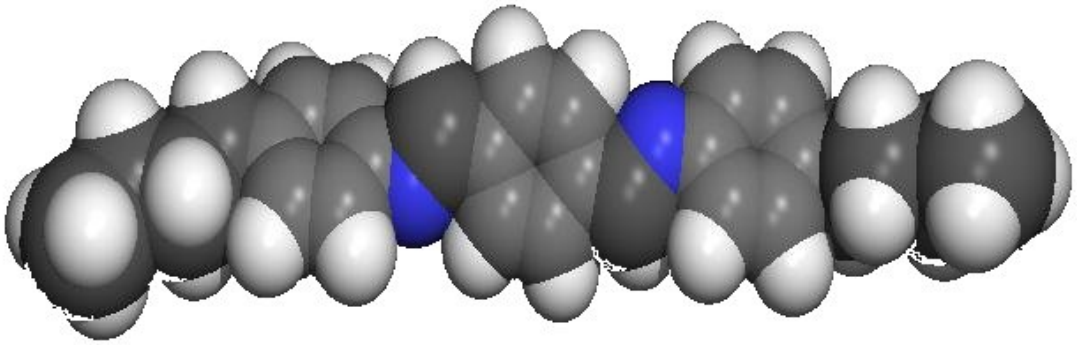




Quelle: Krause, J. in Anwenderseminar Thermische Analyse, Würzburger Tage 1998, ecomed 1999, 116-135

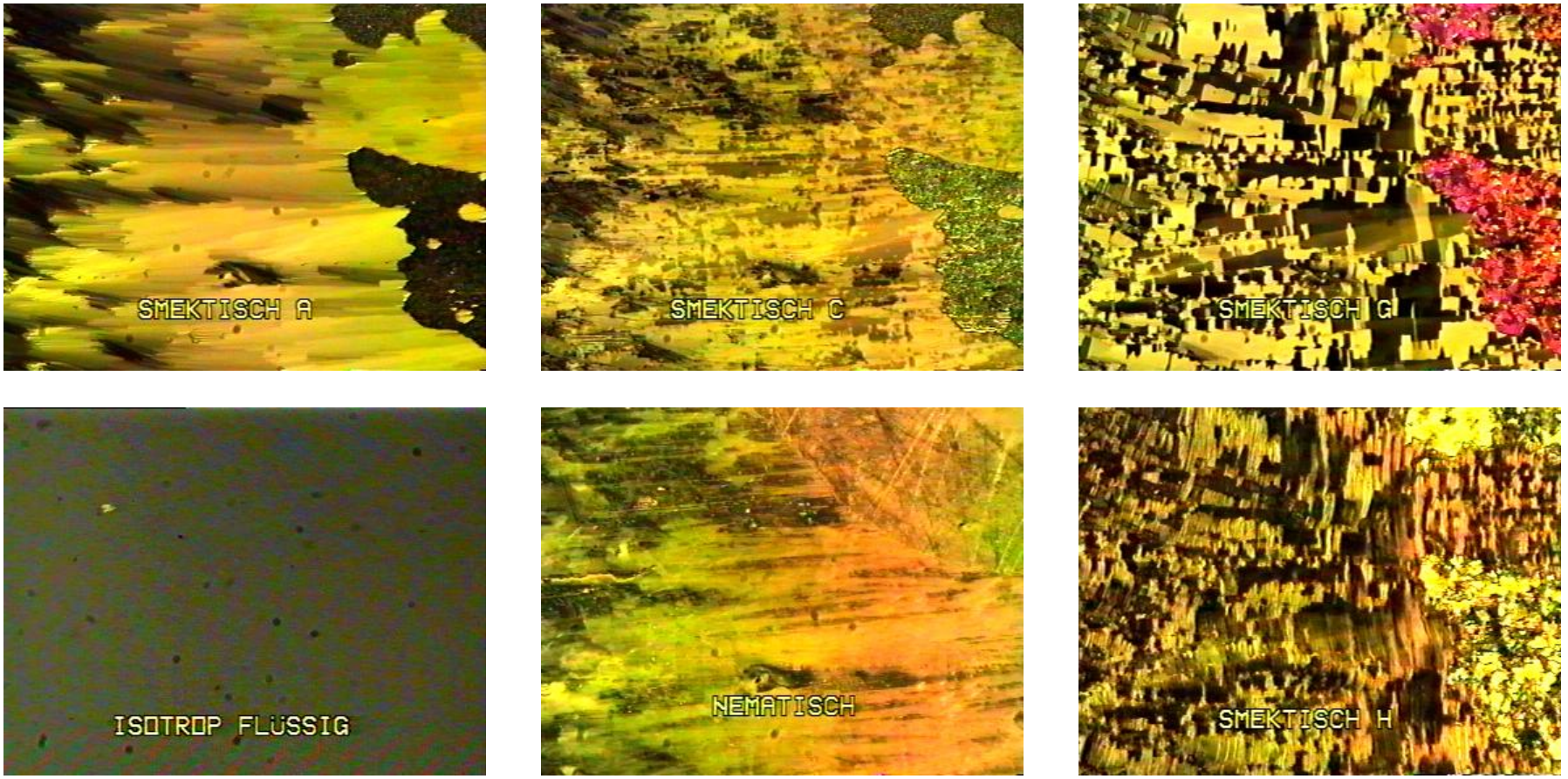
Beispiel TBBA





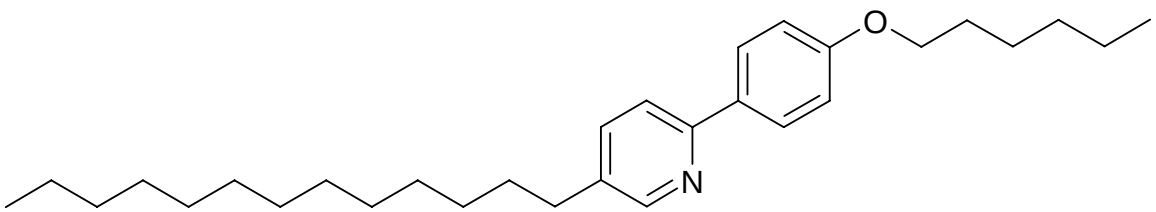
Quelle: TU Berlin Internethomepage AG Heppke

Beispiel TBBA



Quelle: TU Berlin Internethomepage AG Heppke

Beispiel PYRP-606



K 20 SmH 43 SmG 53 SmI 55 SmC 67 N 69 I

IS-2641

1

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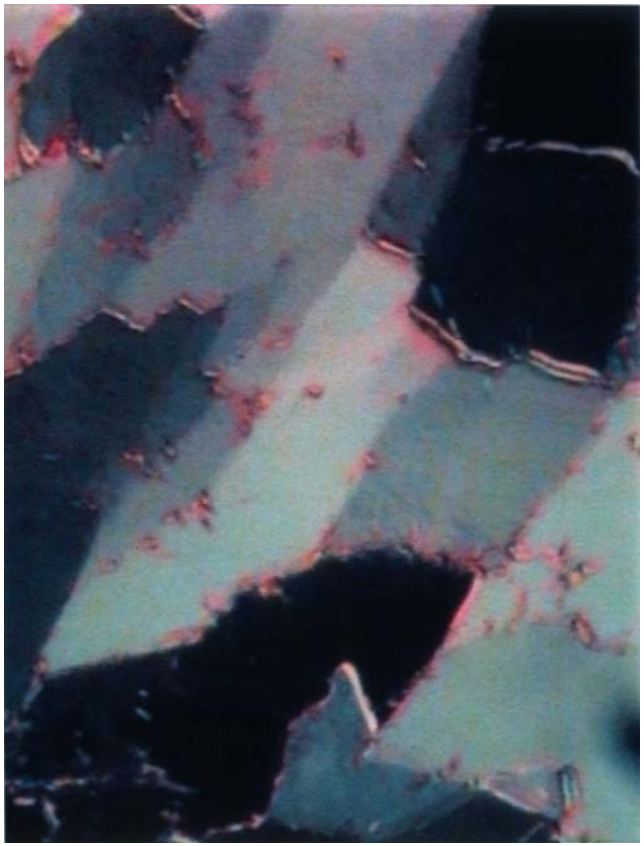

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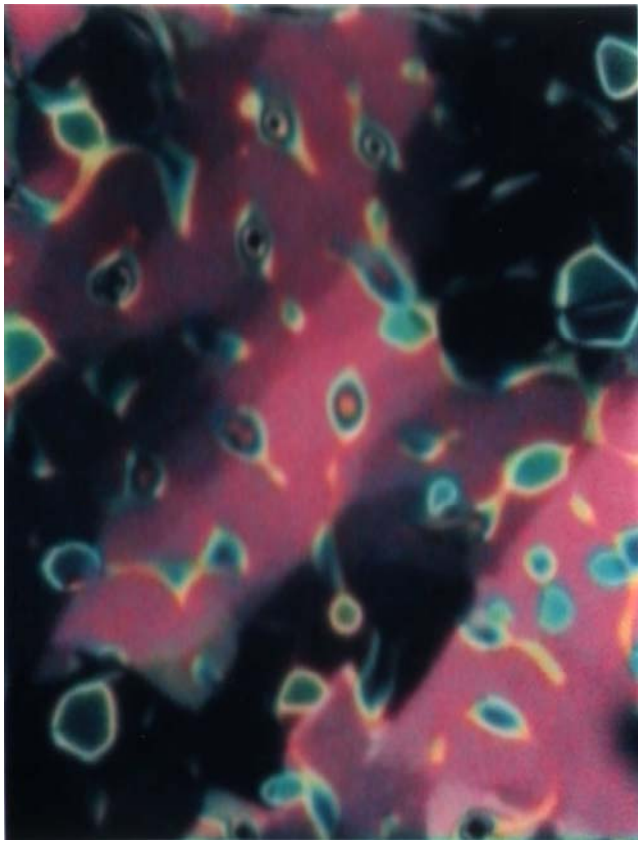

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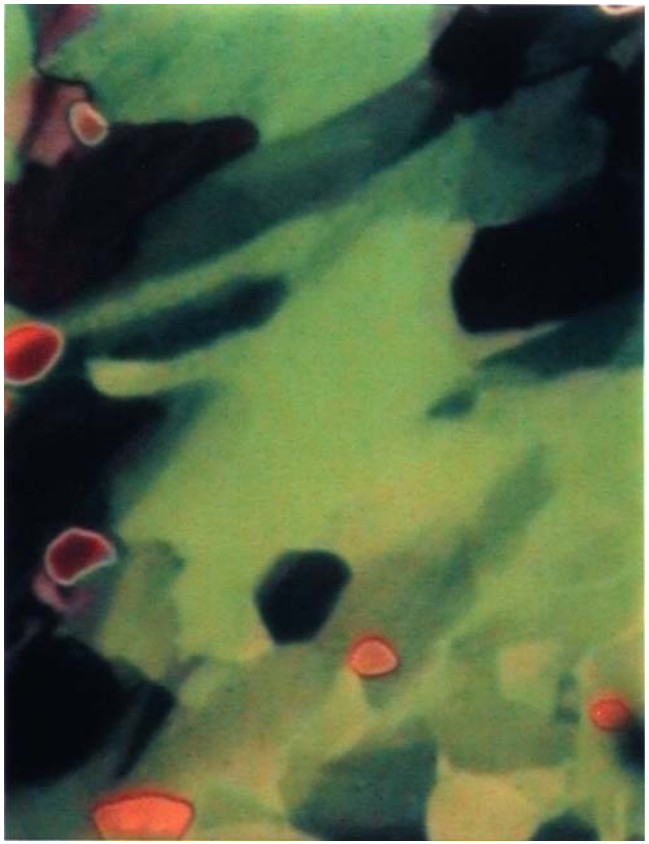

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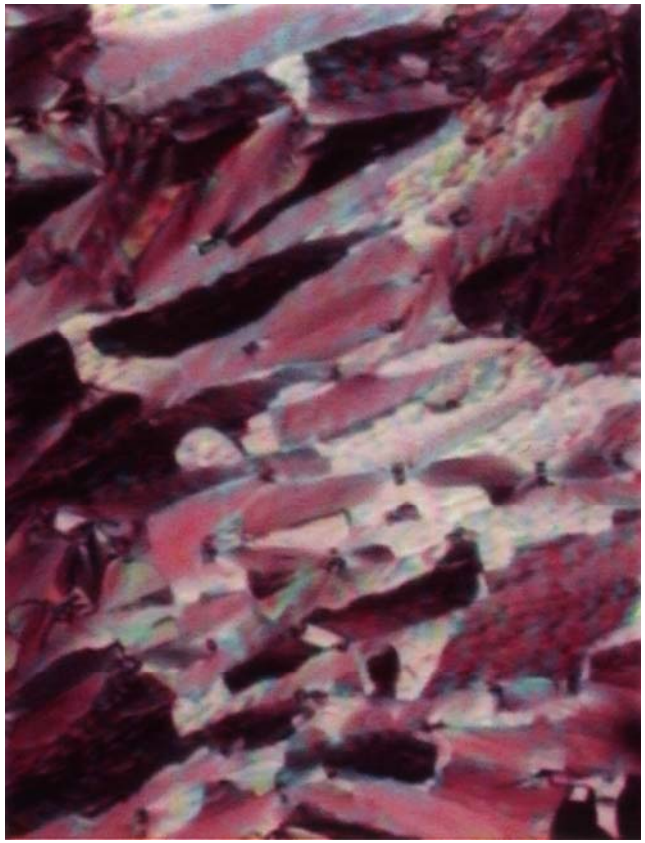

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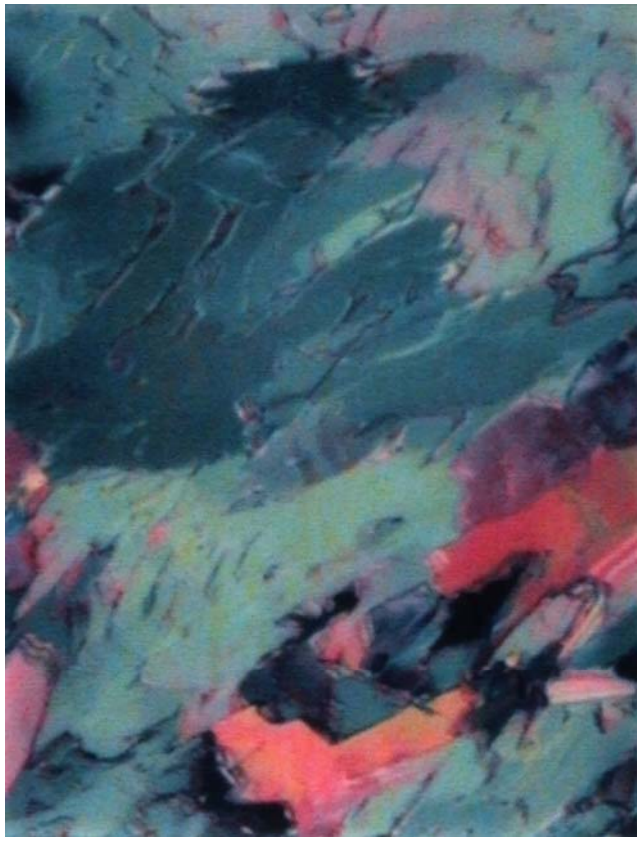

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