Liquid crystals

Solid

Highly ordered

Liquid

Highly Disorder

Free Flow

intermediate

mesomorphic (or) liquid crystalline state.

[Condensed fluid phases with spontaneous anisotropy]

Solid $\xrightarrow{\Delta}$ Turbid Liquid (LC) $\xrightarrow{\text{mpt.}}$ clear liquid.

Anisotropic: properties differ w.r.t its orientation

L.C. 2 Types

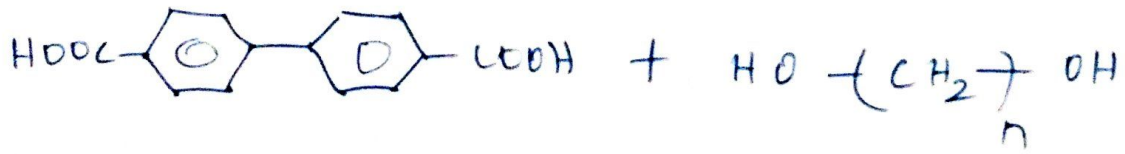
- Thermotropic : LC Formed upon heating
- Lyotropic : LC Formed upon solvent dissolution

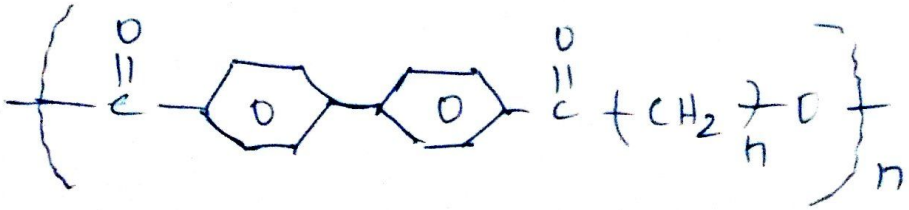
Thermotropic

- Polymeric Comps
  - Mainchain LC polymers
  - sidechain LC polymer
    - either Homo (or) Co polymer
- Low M. wt Comps
  - Rod like molecule (calamitic)
  - Disc like molecule (Discotic)

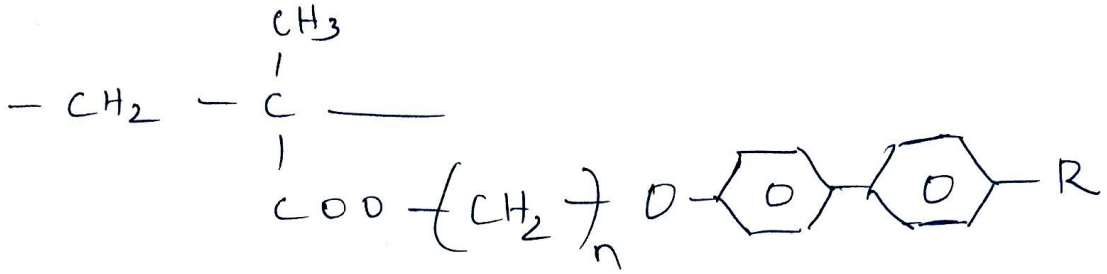
Ex:

Mainchain - LC polymer





Side-chain LC polymer



LYOTROPIC LC

Some compds $\xrightarrow{\text{mix with a substance (or) solvent}}$ LC-polymer Formed.

Change of concentration.

Amphiphilic nature → Lyophilic – solvent attracting

→ Lyophobic – solvent Repelling

attract ~~~~ Repell

Micelles

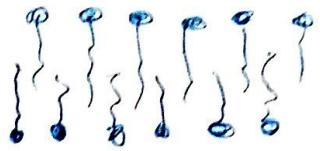
CMC – Critical micelle concentration

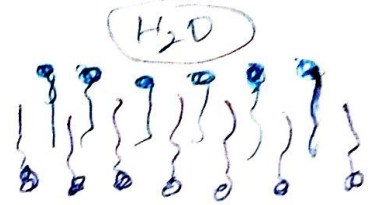
A concentration above which micelles are formed.

Two types (phases)

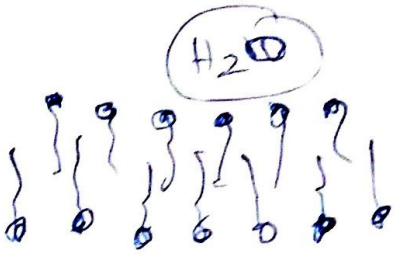
(i) Lamellar phase [Neat (or) G Phase]

- Layers of well defined thickness

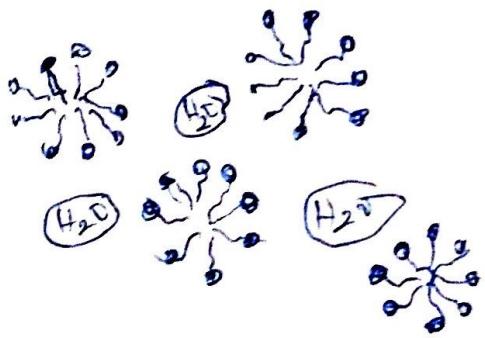




$\xrightarrow{\Delta}$ Collapses & separates as L-C.



(ii) Hexagonal Phase [middle phase



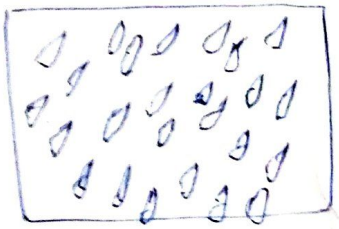
$\xrightarrow{\Delta}$ I.C.

Thermotropic → Main chain + sidechain
LC LC

↓

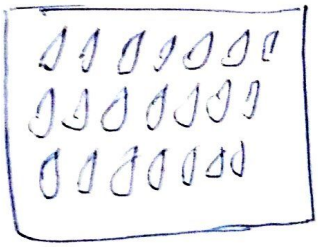
Exist in Three phases

i) Nematic



maintain Directional order
But Distributed randomly
no Long range order

ii) Smectic

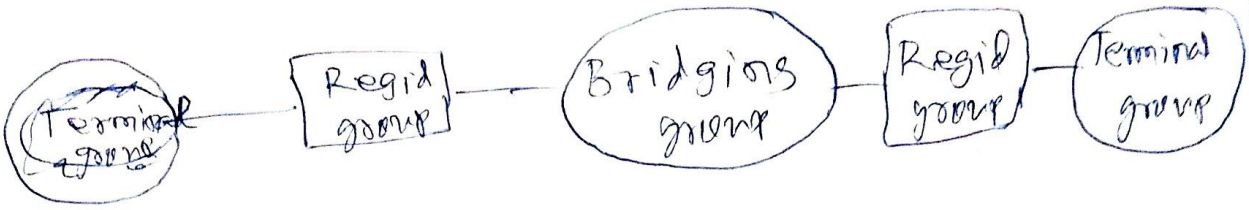


Orientation as well as position, ordered
Regular layer/plane

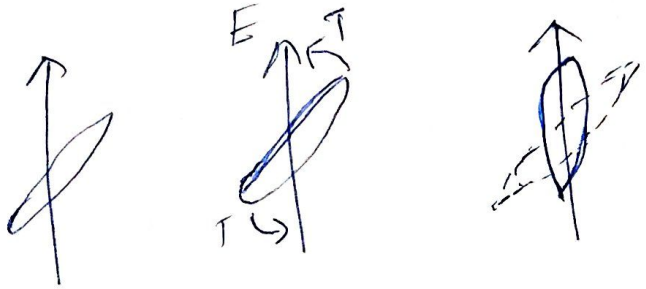
iii) Choleteric (or) Chiral nematic phase.

helical
orientation – Particular direction

Structure Requirement - LC



Direction/orientation of LC under Electric Field



Electric Field with direction E

Applications

Advantages

Working Principle

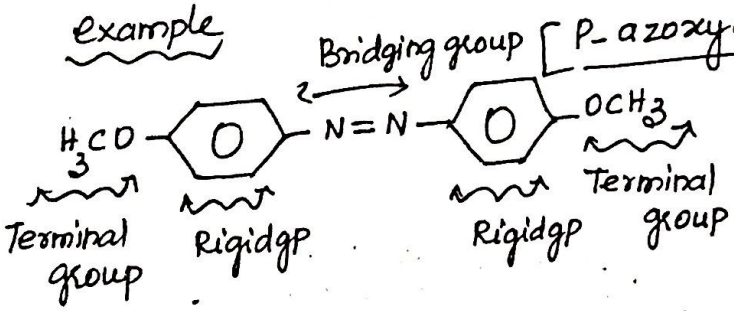
(2) molecular shapes of the compounds (spheroid, ellipsoid and discoid structure decide ✝ which particular phase of liquid will form.

⇒ Aromatic compounds generally consisting of one or more aromatic rings such as unsaturated phenyl, biphenyl or cyclohexane have planar rigid structures. on Introduce the alkyl groups in the proper position, molecules become elongated and exhibits liquid crystal behaviour.

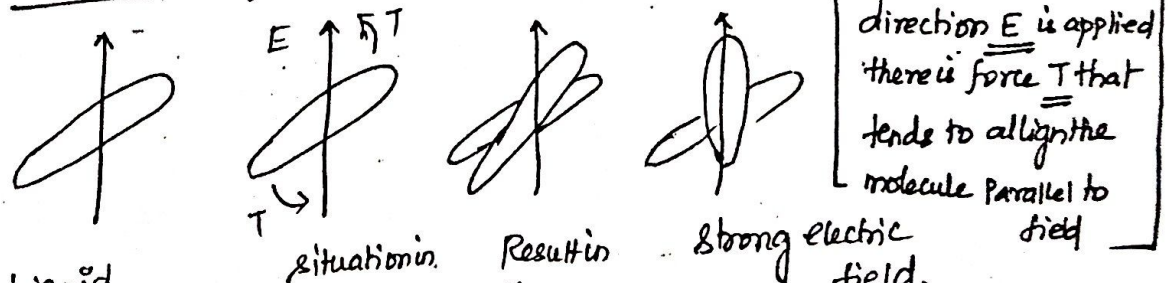
Most known liquid crystalline substances are aromatic system

Commonly used Terminal group	commonly used Rigid group	commonly used Bridging group
1. R (alkyl)	Phenyl	$-C\equiv C-$ (acetylene)
2. $-OR$ (alkoxy)	(Naphthyl)	$-N=N$ (azo)
3. $-NO_2$ (Nitro)		

example



Orientation of liquid crystals in electric field



Liquid crystal (original orientated) — situation in electric field — Result in electric field — Strong electric field.

[when a field with direction E is applied there is force T that tends to allign the molecule parallel to field]

The possibility of suitable behaviour by simply over a liquid crystal cell

Applications

watches, Laplop, computer screens
potable color Tv
optical imaging, Thermograph, Radiation sensing

Advantages

1. Low power consumption Per unit area
2. Compatible with IC due to their low operating voltage
3. Flame retardant
4. Viewable over wide range of ambient lighting conditions
5. chemical resistant, Dimensional stability low cost, Heat aging resistance
6. large area display by very small volume of sample