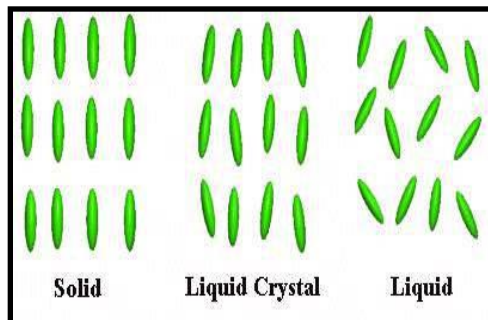




Liquid Crystals

Liquid crystal (LC) is a state of matter that has properties between those of conventional liquids and those of solid crystals. For instance, a liquid crystal may flow like a liquid, but there are still some orientational orders possessed by the Molecule.



Solid Phase-Molecules are aligned themselves in a particular direction and its position also fixed.

Liquid phase -Molecules are randomly arranged, there is no positional or orientational order

Liquid crystals –No fixed position, but it shows some sort of orientational order.

So, Liquid crystals are intermediate state between Solid and liquid, It flows like pure liquid but it shows some sort of orientational order like solid. it also possess anisotropic property, it is associated with crystalline solid, anisotropy means Properties of a material depend on the direction (properties are differ in different direction) and it also has isotropic property, it is associated with pure liquid, isotropy means Properties of a material are same in all directions

Types of Liquid Crystals

Lyotropic crystals

A liquid crystal phase formed when a molecule is dissolved in a suitable solvent under appropriate conditions of concentration, temperature and pressure.



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Example

A mixture of soap and water is an everyday example of a lyotropic liquid crystal.

Thermotropic crystals

Thermotropic liquid crystal materials occur as liquid crystals over a certain temperature range between the solid and liquid phases. (LCD TVs, alarm clocks, etc.)

Example

Biphenyl nitriles are commonly used as thermotropic liquid crystals.

Comparison between Lyotropic and Thermotropic liquid crystals

Comparison between Thermotropic and Lyotropic

<ul style="list-style-type: none">○ THERMOTROPIC○ Absence of solvent○ Rigid organic molecules○ Depends on Temperature○ Structures:<ul style="list-style-type: none">○ Smectic○ Nematic○ Cholesteric	<ul style="list-style-type: none">○ LYOTROPIC○ In solvent○ Surfactants○ Depends on Temperature, Concentration, salt, alcohol○ Structures:<ul style="list-style-type: none">▪ Lamellar▪ Hexagonal etc
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Structure of Liquid crystal forming compounds

1. *p*-Azoxyanisole
2. 4 Pentyl-4'-cyanobiphenyl



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3. Cholesterylmyristate
4. Derivative of triphenylene
5. Derivative of 2-nitroresorcinol

No	Compounds and its structural form	Types of liquid crystals and phase transition temperatures (°C)
1	<p><i>p</i>-Azoxyanisole</p> <chem>COc1ccc(cc1)/N=N/Oc2ccc(O)cc2</chem>	Cr 116 N 186 I
2	<p>4-pentyl-4'-cyanobiphenyl</p> <chem>CCCCCc1ccc(cc1)-c2ccc(C#N)cc2</chem>	Cr 22 N 35 I
3	<p>Cholesterylmyristate</p> <chem>CCCCCCCCCCCCCCCC(=O)O[C@H](CCCC12CCC3[C@H]4CC[C@@H]3[C@@]1(C)CC2)C</chem>	Cr 71 Sm 79 Ch 85 I
4	<p>Derivative of triphenylene</p> <chem>Rc1ccc2c(c1)c3ccc(R)cc3c4c2ccc(R)cc4R</chem> R = <chem>-OCO-C11H23</chem>	Cr 80 D 122 I
5	<p>Derivative of 2-nitroresorcinol</p> <chem>Rc1ccc(cc1)/C=N/c2ccc(cc2)C(=O)Oc3cc(ccc3[N+](=O)[O-])OC(=O)c4ccc(cc4)/C=N/c5ccc(R)cc5</chem>	Cr 85 B 173 I

Properties of Liquid crystals

1. Flow like liquids due to loss of positional disorder
2. Liquid crystals optically birefringent due to its orientational disorder
3. Align parallel to an electric field



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4. High chemical stability
5. Liquid crystals phase over a large temperature range
6. A true liquid is isotropic meaning that its properties are uniform in all directions
7. Thermal and electrical conductivity vary with direction

Applications of Liquid Crystals

1. Display application of liquidcrystals: The most common application of liquid crystals technology is liquid crystal displays (LCDs.)
2. Thermal mapping and non- destructive testing
3. Medicinal Uses: Cholesteric liquid crystal mixtures have also been suggested for measuring body skin temperature, to outlines tumours etc.
4. Optical Imaging and Liquid Crystals Interactions with Nanostructure
5. Liquid Crystal in Chromatography
6. Liquid Crystal in solvent and spectroscopy
7. Digital watches and parking meters
8. Telecommunications
9. High speed computing and digital cameras
10. Personal digital assistance