Molecules for Liquid Crystals Display

Pre-seminar Material

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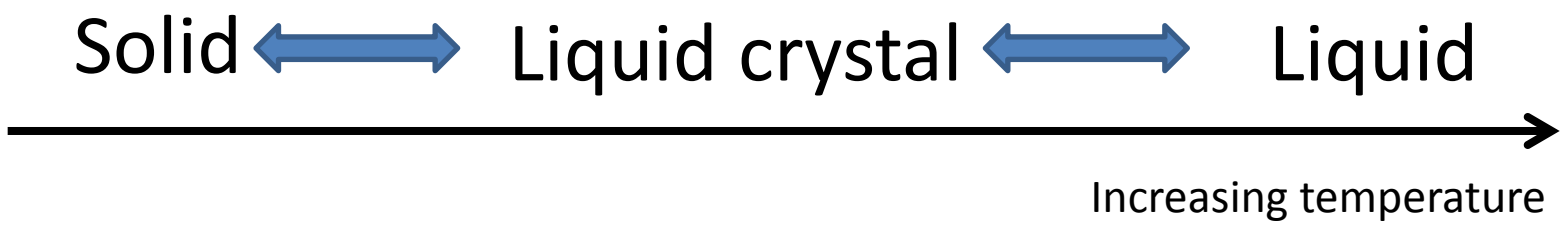
Curriculum Link

This seminar builds on knowledge learnt in the DSE curriculum:

- **Chemistry: Topic XIV**

Liquid Crystals

- All matters exist in three states, namely solid, liquid and gas.
- **Liquid crystals** do not fit into these three states of matters.
- Liquid crystal has properties between those of a liquid and those of a solid crystal.



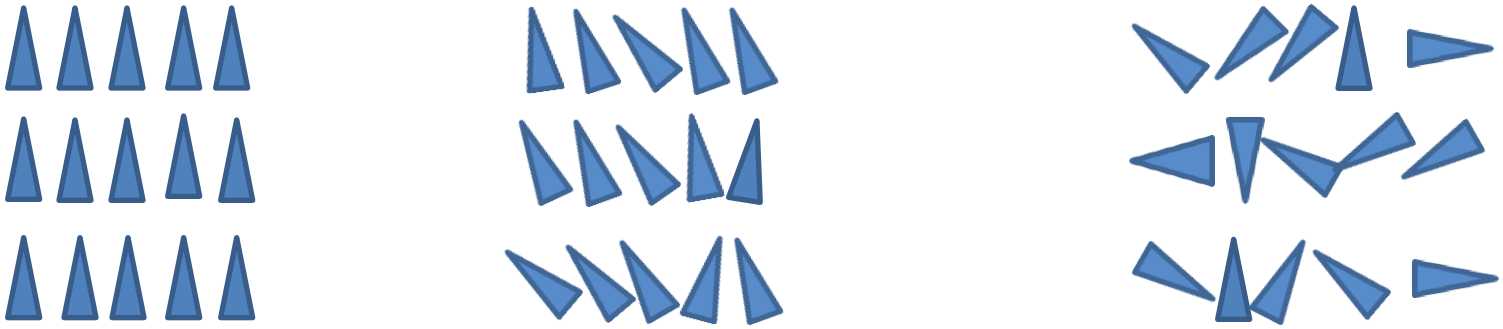
- Liquid crystal phase can be thought of as the "4th state of matter".

Structural Properties of Liquid Crystals

- **Positional order**
  - Having a regular arrangement
- **Directional order**
  - Pointing to the same general direction

Property	Solid	Liquid crystal	Liquid
Positional order	✓	×	×
Directional order	✓	✓	×

Pictorial Representations of Solid, Liquid and Liquid Crystal



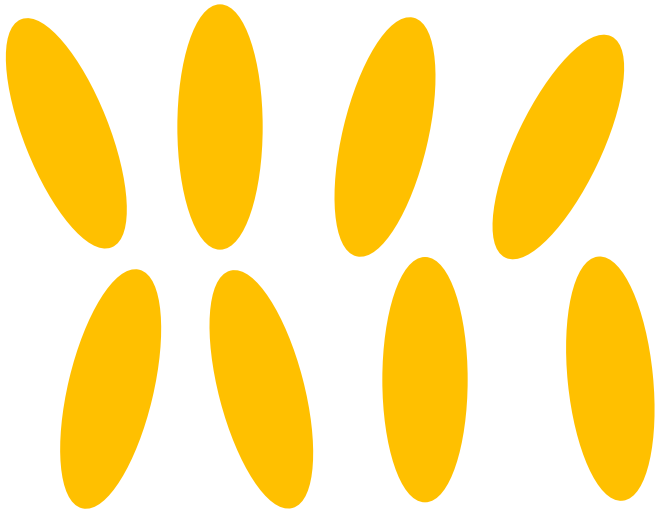
Solid Liquid crystal Liquid

Key: Liquid crystal molecule (representing its position and direction)

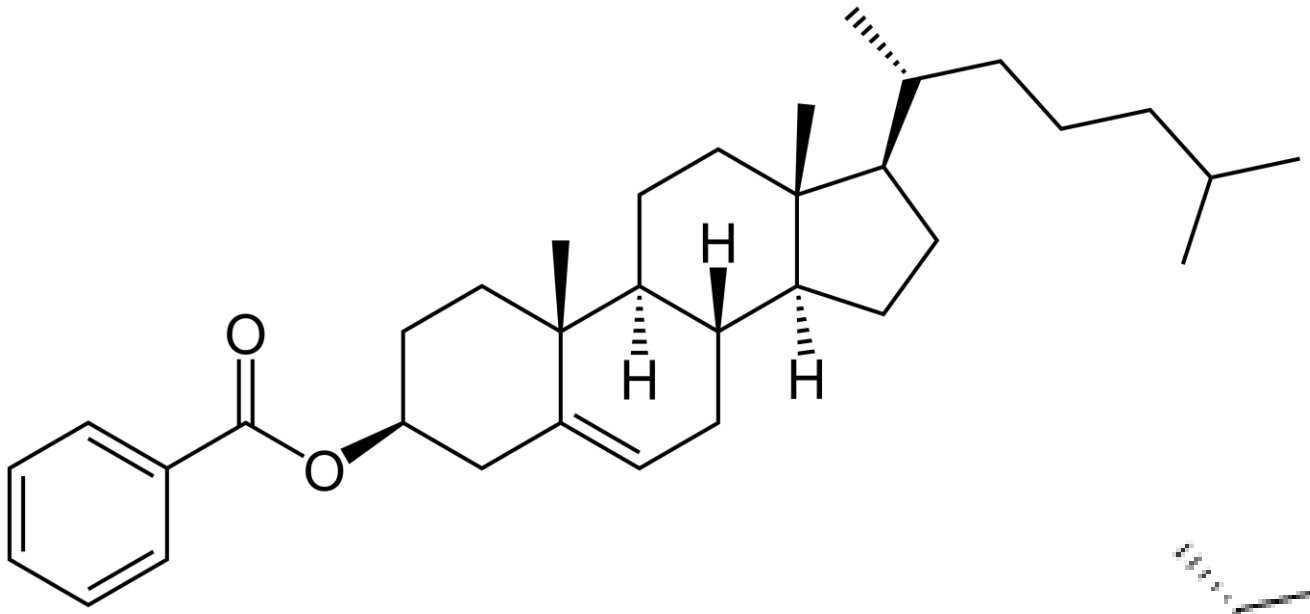
Molecular Characteristics of Liquid Crystals

The molecules of liquid crystals

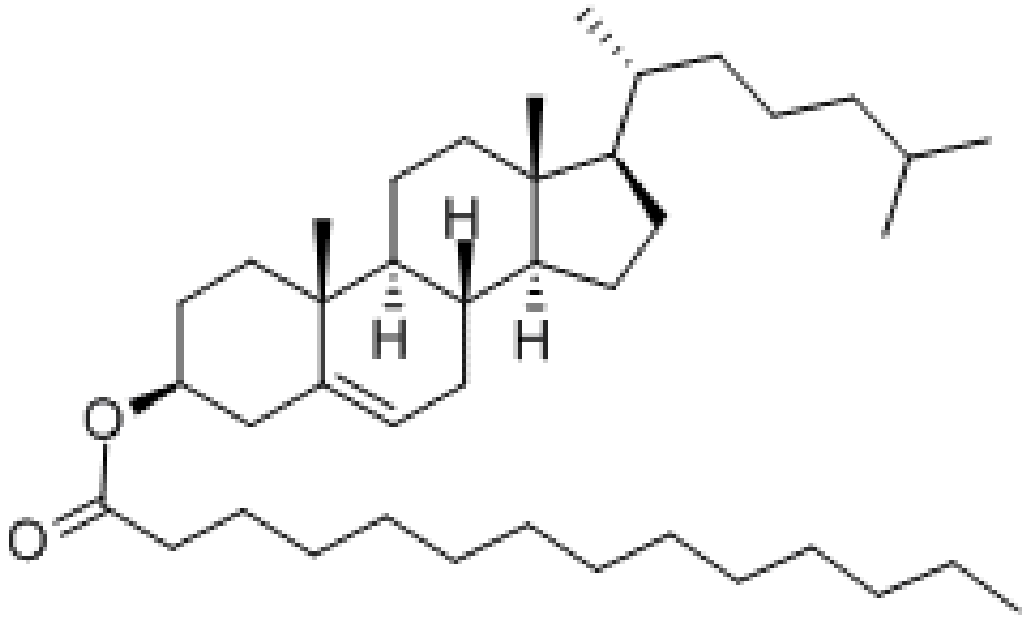
- are usually rod-shaped,
- have uneven distribution of electrons leading to intermolecular forces that cause the molecules to line up in the same general direction



Examples of Liquid Crystals

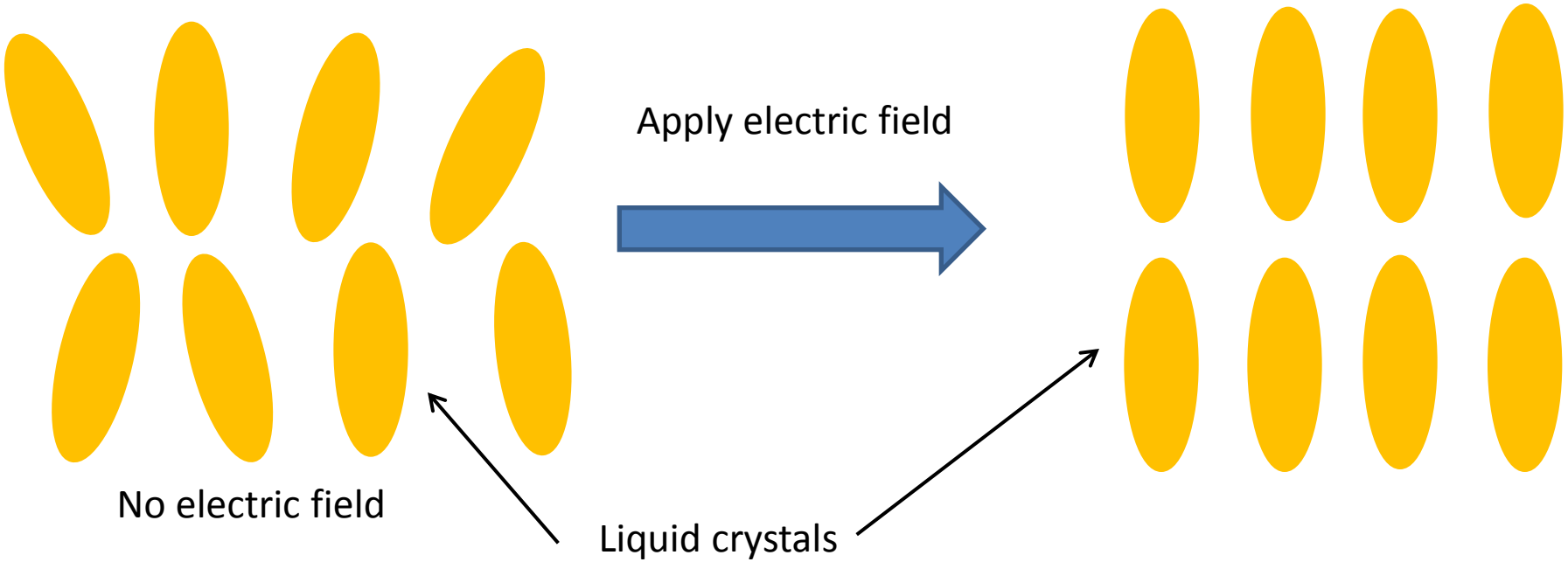


Cholesteryl benzoate



Cholesteryl myristate

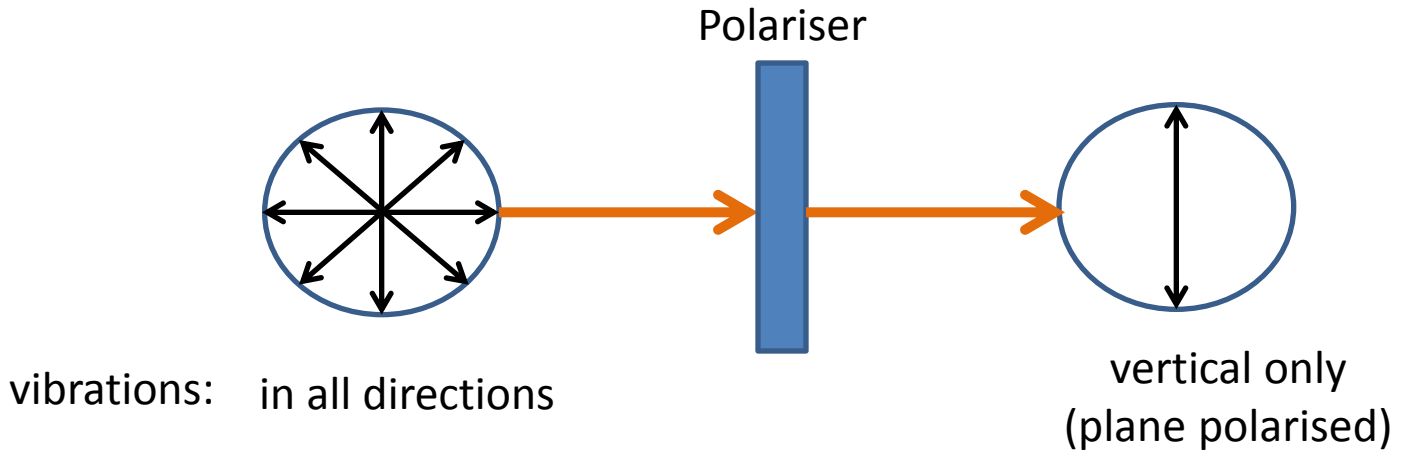
Effect of Electric Field on Orientation of Liquid Crystal Molecules



- Liquid crystal molecules take up different orientations inside and outside an electric field.

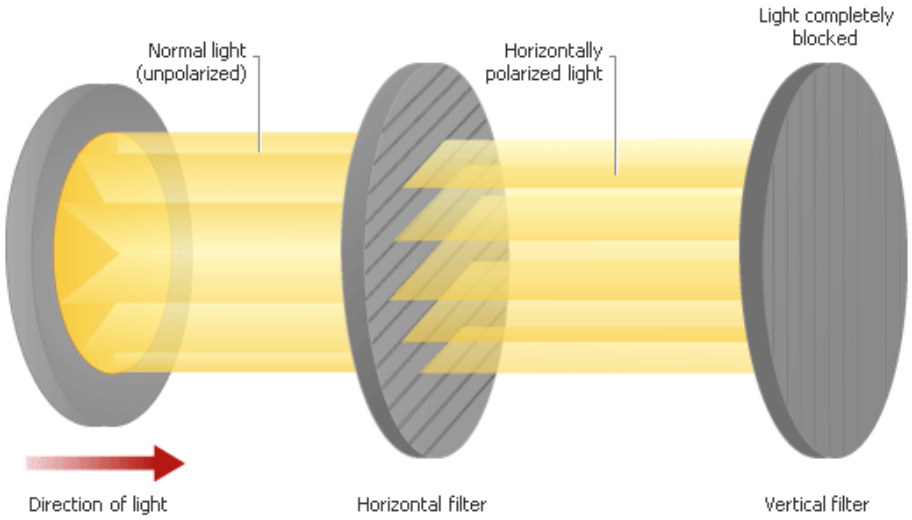
Liquid Crystals: Effect on a Beam of Plane-Polarised Light

- Ordinary white light consists of waves vibrating in all directions at right angles to the path along which the light is travelling.
- When light passes through a **polariser**, only waves vibrating in one particular plane are transmitted and the light is said to be ***plane-polarised***.



Liquid Crystals: Effect on a Beam of Plane-Polarised Light

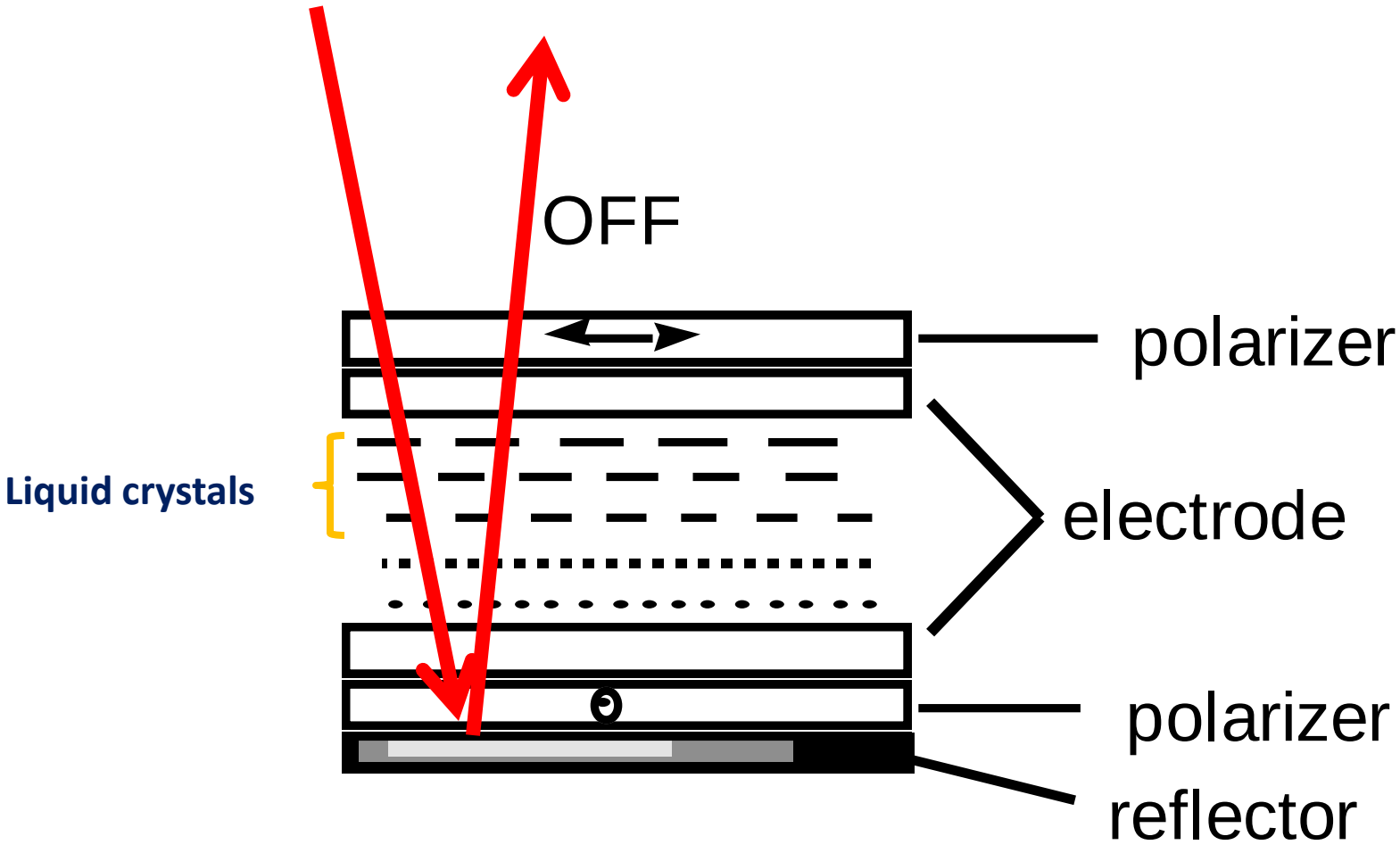
- A beam of plane-polarised light can pass through another polariser if the axes of the two polarisers are parallel. If they are perpendicular to each other, then all light will be absorbed.



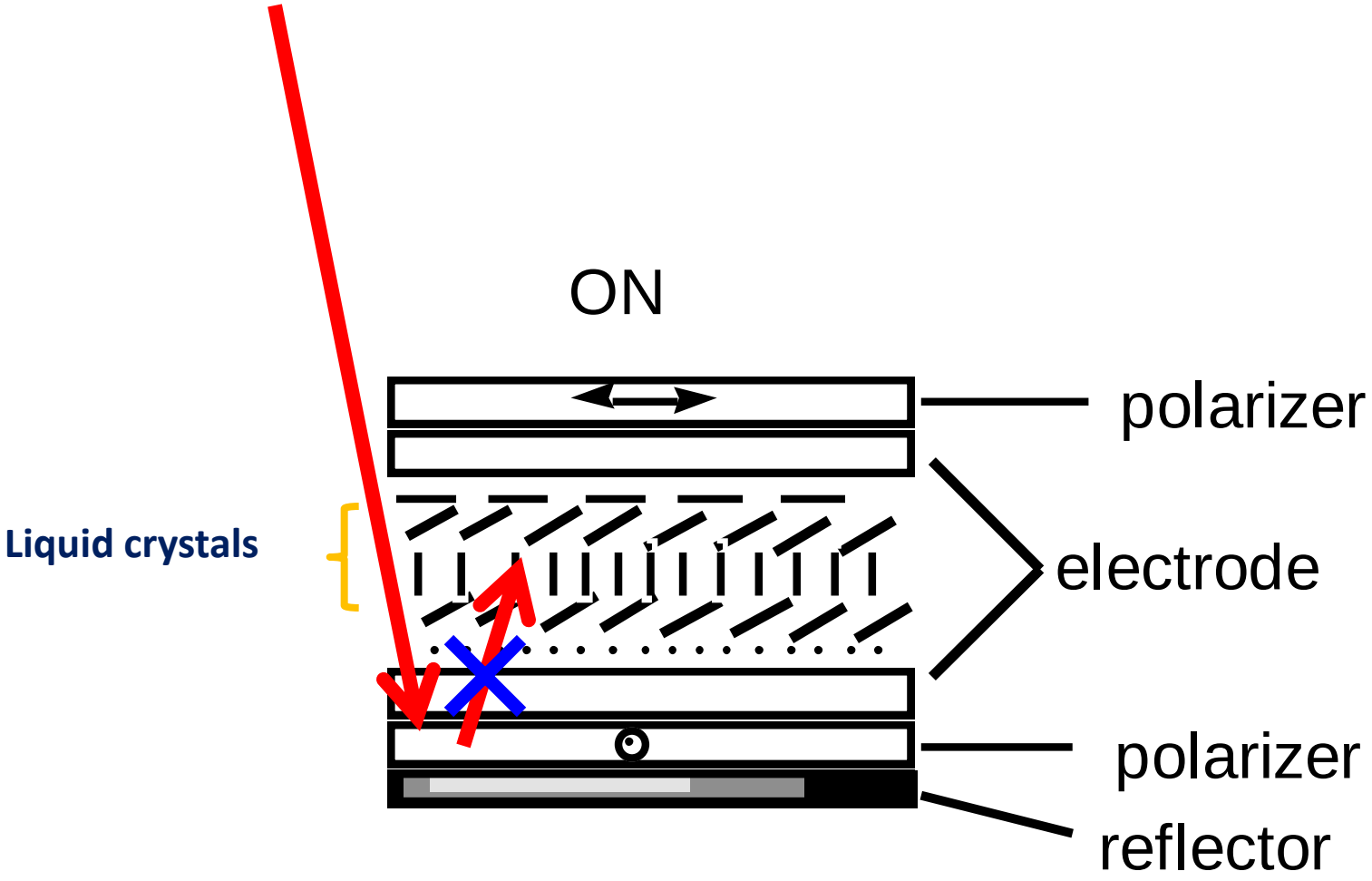
- Most liquid crystals can fuction as a polariser.

How Liquid Crystal Displays Work ?

Light can be reflected from the reflector.
The panel appears “bright” because light can be reflected when the electrodes are placed in parallel.



Light reflected cannot pass through the liquid crystal molecules when the electrodes are not placed in parallel.
Therefore, panel appears “dark”.



For details of the working principle and applications of LCD, please refer to the seminar.

Glossary (詞彙)

Liquid Crystal Display	液晶展示屏
Position order	位置有序
Directional order	方向有序
Rod-shaped	棒狀的
Cathode ray tube	陰極射線管
Cholesteryl benzoate	膽固醇苯酸酯
Cholesteryl myristate	膽固醇肉荳蔻酸酯
phosphorescence	燐光
polarizer	起偏鏡
reflector	反射鏡
Light emitting diode	發光二極管

EDB Glossary

- The link to EDB Glossary (Chinese/English) is http://www.edb.gov.hk/tc/curriculum-development/kla/science-edu/ref-and-resources/glossary.html