CHRISTIAN EMINENT COLLEGE, INDORE

(Academy of Management, Professional Education and Research)

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E-Content

On

"Production Of Plane Polarised Light"

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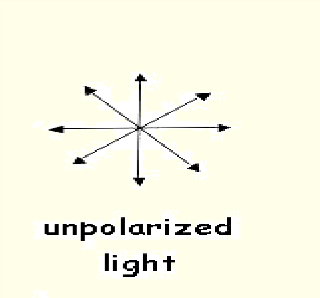
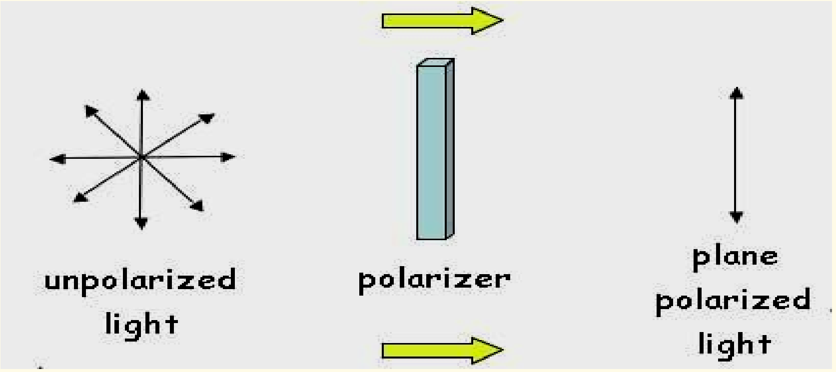
POLARISATION OF LIGHT

If by any device the vibration of electric vector (E) do not remain symmetrical relative to the direction of travel of light, the light is called polarised light and this phenomena is called the polarisation of light.





If the vibration are along a line in a plane perpendicular to the direction of propagation of light. The light is called plane polarised or the linearly polarised light.

If the vibration are along a circle or an ellipse in the plane perpendicular to the direction of propagation of light, the light is called the circularly polarised light or the elliptically polarised light.

Production of Plane Polarised Light

The plane polarised light from unpolarised light can be produced by the following methods:

(1) by reflection

(2) by refraction through piles of plates

(3) by double refraction

(4) by dichroism

(5) by scattering

Production of Plane Polarised Light by Reflection:

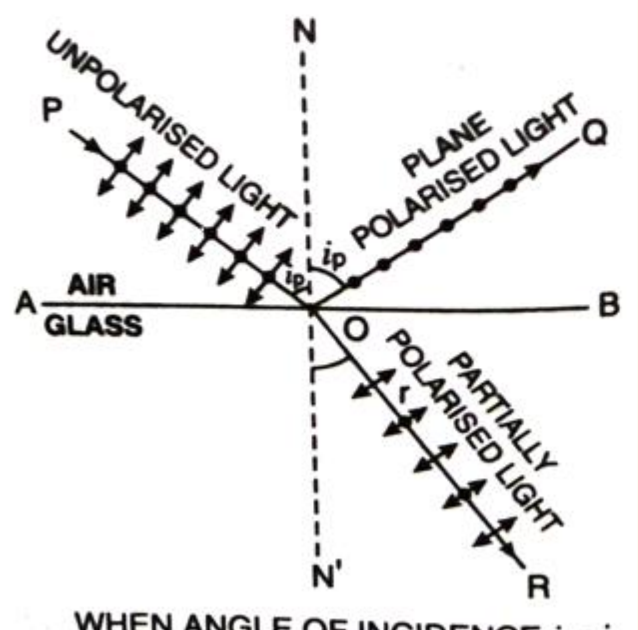
When an unpolarised light is reflected from a transparent surface (such as glass), the light reflected from its surface can be perfectly plane polarised, partially plane polarised or unpolarised, depending upon the angle of incidence.

The angle of incidence at which the reflected light from a transparent surface is perfectly plane polarised, is called the polarising angle or the Brewster's angle. It is denoted by i_p.

The value of Brewster's angle depends on the nature of the reflecting surface and the wavelength of incident light. Thus to get a plane polarised light by reflection, the incident light must be monochromatic.

Production of Plane Polarised Light by Reflection:

Thus if a light ray is incident on the transparent surface at an angle equal to the polarising angle or Brewster's angle i_p , the reflected light is perfectly plane polarised in which vibrations are confined only in a plane normal to the plane of incidence, while the refracted light remains partially plane polarised having more vibrations parallel to the plane of incidence and less vibrations normal to the plane of incidence.

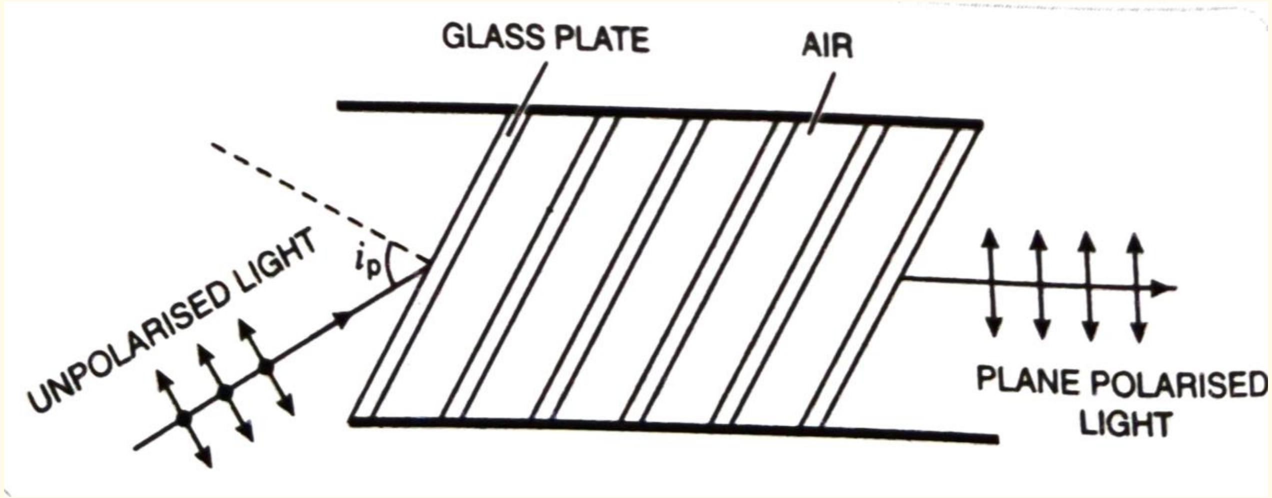


WHEN ANGLE OF INCIDENCE $i = i_p$

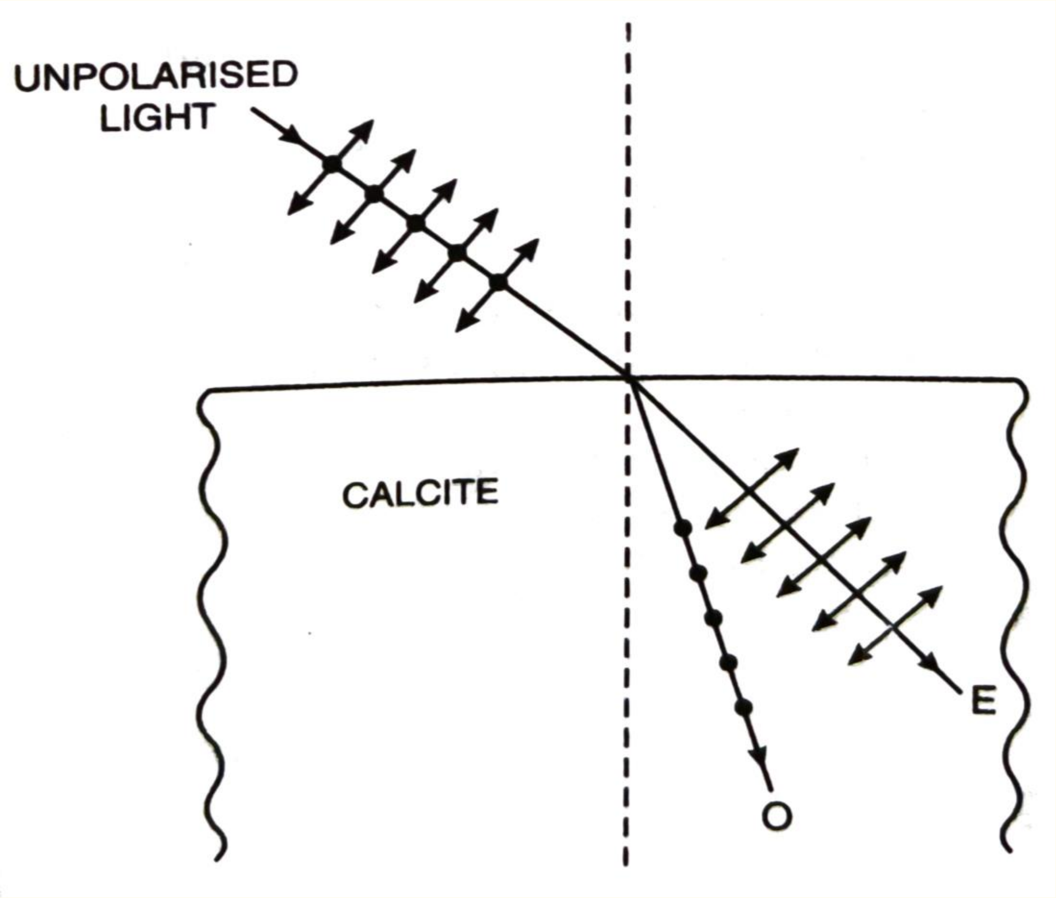
Production of Plane Polarised Light by Refraction Through Piles of Plates:

When an unpolarised light is incident on a boundary surface separating the two media, the refracted light is always partially plane polarised. Thus, if unpolarised light is made incident at polarising angle on piles of plates with their refracting surfaces parallel to each other, some part of the component of vibrations perpendicular to the plane of incidence in the light incident at each surface is reflected and the component of vibrations parallel to the plane of incidence is refracted. Thus due to refraction at the successive plates, the amplitude of vibrations perpendicular to the plane of incidence decreases in the refracted light and if the number of plates is quite large, the emergent light from the last plate has only the vibrations parallel to the plane of incidence i.e. the emergent light is nearly plane polarised.

Production of Plane Polarised Light by Refraction Through Piles of Plates:



Production of Plane Polarised Light by Double Refraction :



Production of Plane Polarised Light by Double Refraction :

Some crystals have the property that light ray incident on it, it splits into two refracted rays. This phenomenon is called double refraction and such crystals are called double refracting crystals. For example quartz, calcite, tourmaline, topaz, aragonite etc. are the double refracting crystals.

It is found that out of these two refracted rays, one ray obeys the laws of refraction is called ordinary ray or O-ray while the other refracted ray does not obey the laws of refraction is called the extra ordinary ray or E-ray.

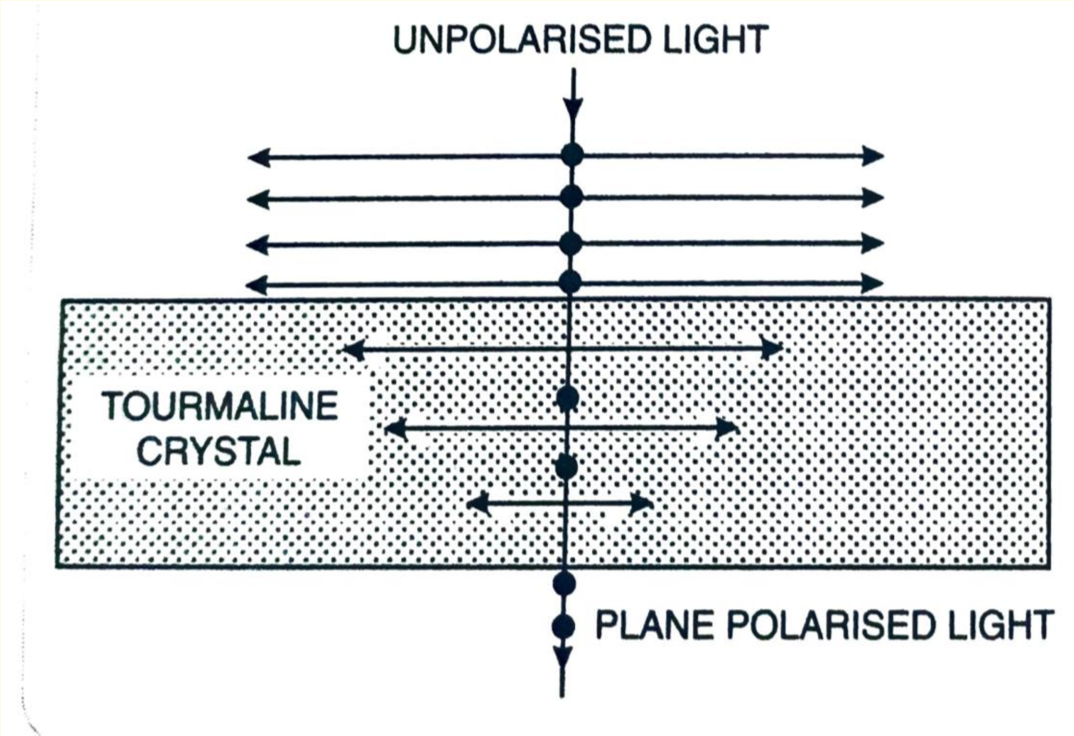
Both the ordinary and extraordinary rays are plane polarised with vibrations in mutually perpendicular planes. In the ordinary ray, the vibrations are perpendicular to the plane of incidence while in the extraordinary ray, the vibrations are parallel to the plane of incidence.

Production of Plane Polarised Light by Dichroism:

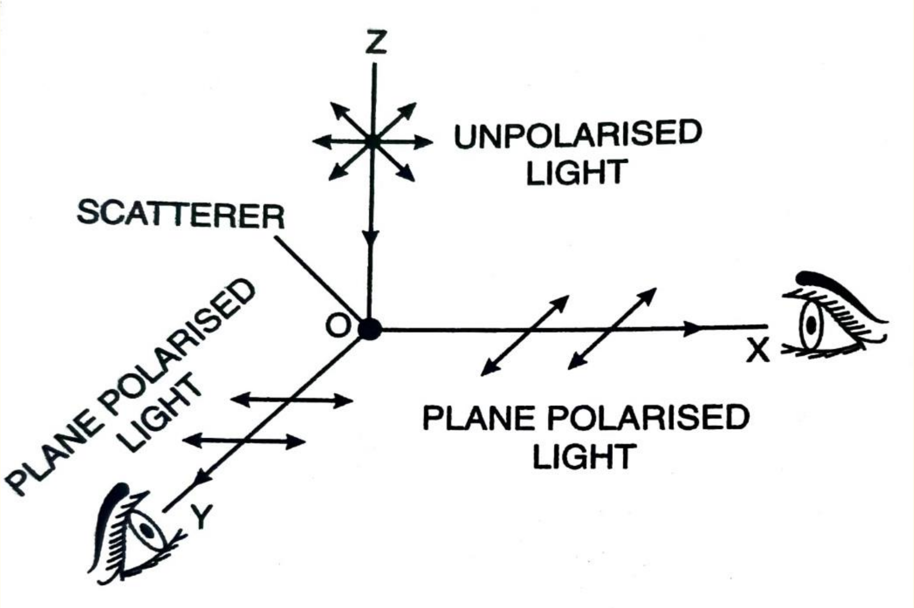
Some of the double refracting crystals (such as tourmaline, quinine iodo-sulphate etc.) have the property that when a ray of unpolarised light is incident on a strip of thickness nearly 1 mm of such crystal, it splits in two polarised refracted rays (ordinary and extra-ordinary). Out of these two rays, the ordinary ray in which there are vibrations perpendicular to the principal section of the crystal, is completely absorbed by the crystal and the extra-ordinary ray which has vibrations parallel to the principal section of the crystal, is transmitted through the crystal. Thus the emergent light is plane polarised with yellow-green colour.

Polaroids are based on this principle. This phenomenon of selective absorption of crystals is called dichroism.

Production of Plane Polarised Light by Dichroism:



Production of Plane Polarised Light by Scattering:



Production of Plane Polarised Light by Scattering:

When a beam of unpolarised white light passes through a medium containing the particles of the size of wavelength of light, it gets scattered from its direction on striking with the particles (i.e. scatterer). This is called the scattering of light. If the scattered light is examined normally from the direction of incident light, the light is plane polarised. This process is called the polarisation by scattering.

In fig. the beam of incident unpolarised light along Z axis strikes the scatterer at O. After scattering, by seeing along the X- axis, only those vibrations are seen which are parallel to Y direction. Similarly when seen along the Y-axis, only the vibrations parallel to X direction are seen. Thus the light normal to the direction of incident light is plane polarised.

Thank You