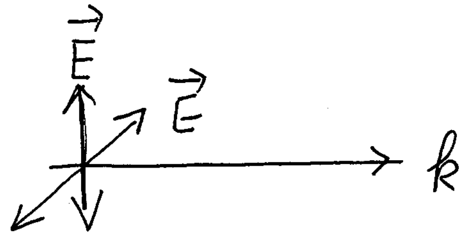
Lect 13 Polarization



E-M waves are transverse-wave

Polaroid sheet — long molecules parallel to each other

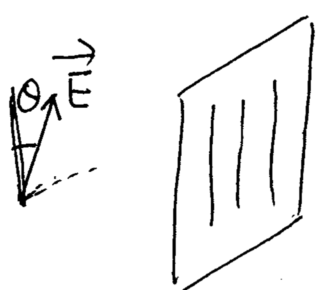
if $\vec{E}$ is parallel to molecule $\Rightarrow$ absorbed

electrons move along molecules, and absorb E.

for $\vec{E} \perp$ molecule, $\rightarrow$ undamped, ~~transmitted~~

if polarization of $\vec{E}$ form an angle of "θ" with the polarization ~~transmission~~ axis

$$\Rightarrow I = I_0 \cos^2\theta$$



$\uparrow E = E_0 \cos\theta$

vertical polarizer

For unpolarized light, after the polarizer

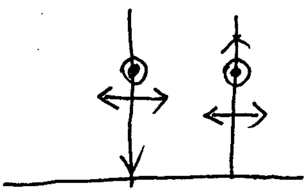
$$I = \frac{1}{2} I_0$$

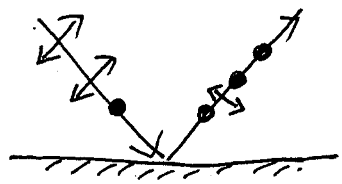
Ex: unpolarized light passes through 2 polaroids with 60° of their axis:

$$I_1 = \frac{I_0}{2}, \quad I_2 = I_1 (\cos 60^\circ)^2 = \frac{I_1}{4}$$

Polarization by reflection

the reflection light has the preference of polarization parallel to the interface. If the normal incidence, ⇒ no polarization



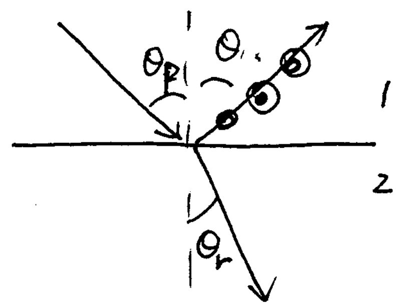


← the parallel component of E // interface doesn't change before/after the reflection.

Brewster's angle

if $\tan\theta_i = \dfrac{n_2}{n_1} = \tan\theta_p$

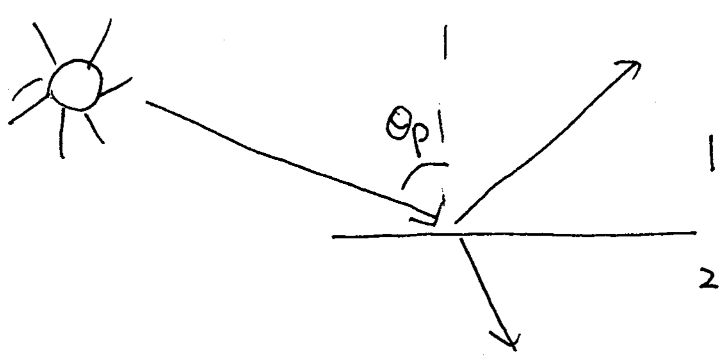
then the reflected light is purely polarized



$$\begin{cases} \dfrac{\sin\theta_i}{\sin\theta_r} = \dfrac{n_2}{n_1} = \dfrac{\sin\theta_p}{\cos\theta_p} \\ \theta_i = \theta_p \end{cases} \Rightarrow \sin\theta_r = \cos\theta_p$$

$$\Rightarrow \theta_r + \theta_p = 90^\circ$$

Ex:



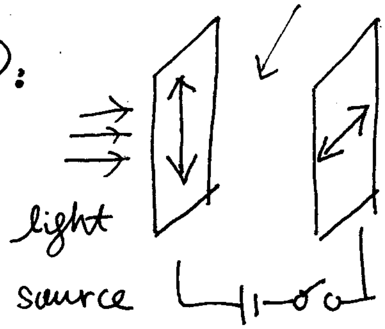
$\tan\theta_p = \dfrac{n_2}{n_1} = 1.33$

$\theta_p = 53.1^\circ$

$\theta_r = 36.9^\circ$

application

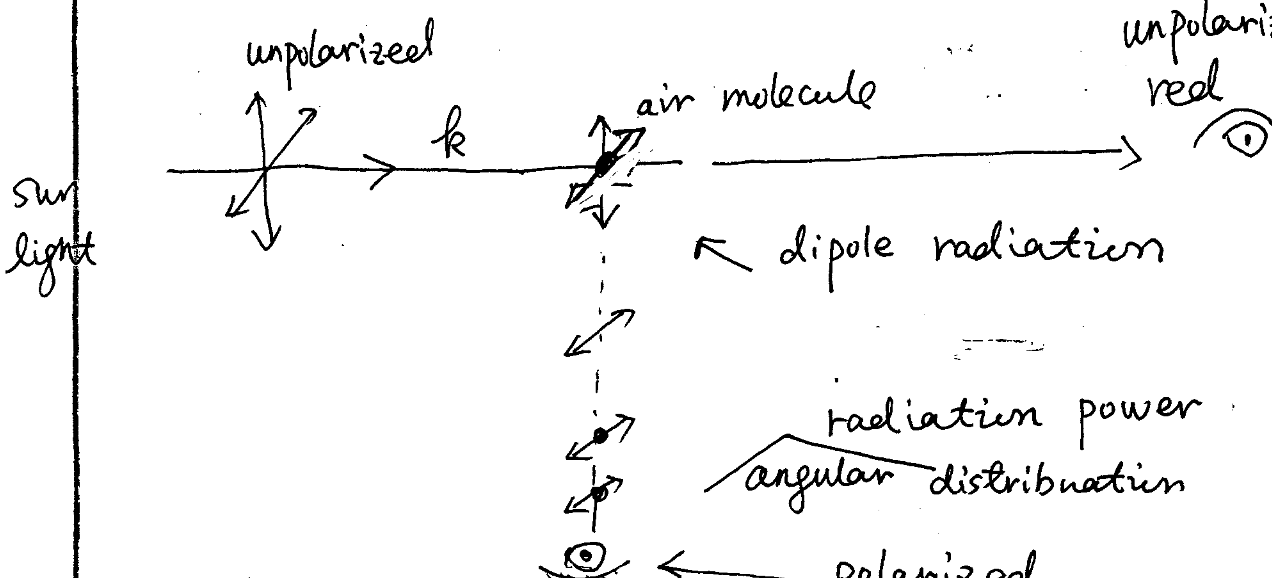
LCD:



① without voltage, liquid crystal molecule twists, which causes the rotation of light polarization planes → transmission

② with voltage, de-twist, light polarization unchanged → dark.

★ Scattering of light by the atmosphere



radiation power maximal

angular distribution

$P \propto \cos^2\theta \cdot \omega^4$ ← blue scattered most

dipole-rad