# BREWSTER'S ANGLE →

The two polarizations of light reflected from an interface between two different dielectric media (i.e, media with different real refractive indices ) see the same configuration of the interface only with normal incidence (i.e, the light is incident perpendicular to the surface). Thus the two polarizations must be identically reflected. However, if the light is incident obliquely, one polarization "sees" the bound electrons of the surface differently and therefore is reflected differently. The reflected wave is polarized to some extent; the amount of polarization depends on the angle of incidence and the index of refraction n. The polarization mechanism is simply pictured as a forced electron oscillator.

The bound electrons in the dielectric material are driven by the incident oscillating electric field of the radiation $Ee^{i(kz_0 \pm \omega t)}$, and hence vibrate at frequency $\nu = \frac{\omega}{2\pi}$. Due to its acceleration, the electron reradiates radiation at the same frequency $\nu$ to produce the reflected wave. The state of polarization of the reflected radiation is a function of the polarization state of the incident wave, the angle of incidence, and the indices of refraction on either side of the interface. If the reflected wave and the refracted wave are orthogonal (i.e., $\theta_i + \theta_r = 90^\circ \Rightarrow \theta_r = 90^\circ - \theta_i$), then the reflected wave is completely plane polarized parallel to the surface. This results because the electrons driven in the plane of the incidence will not emit radiation at the angle required by the law of reflection. This angle of complete polarization is called Brewster's Angle $\theta_B$.

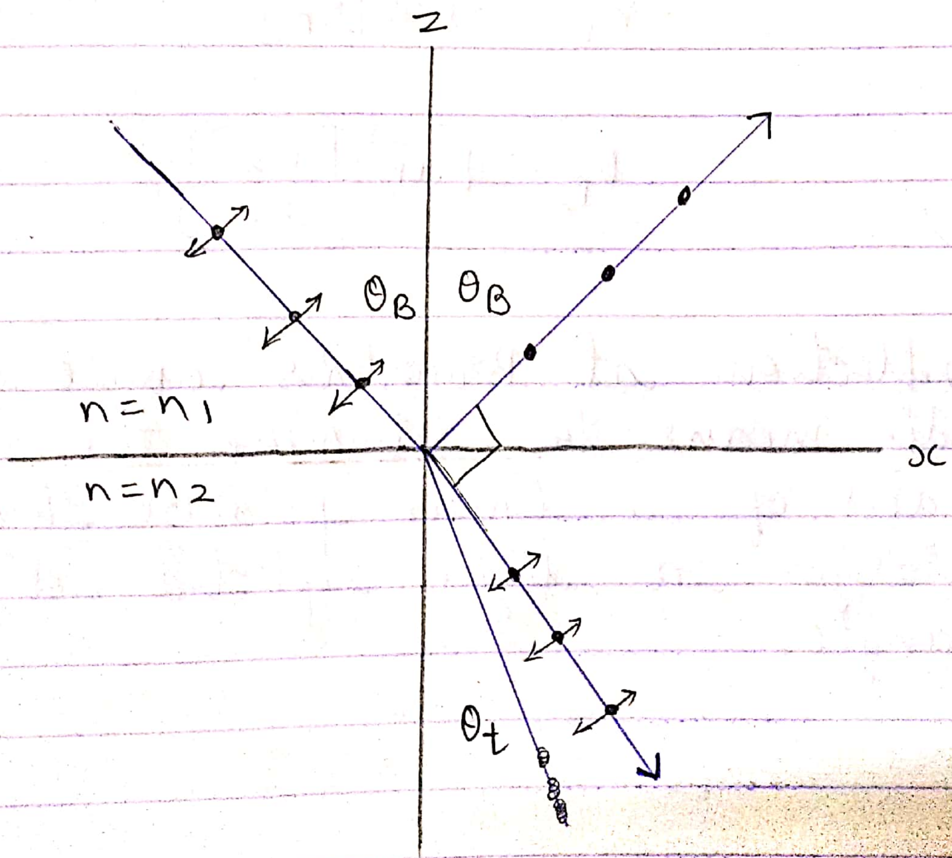


Fig: Polarization at of reflected light at Brewster's angle.

For Snell's law,

$$n_1 \sin[\theta_1] = n_2 \sin[\theta_2]$$

At Brewster's angle,

$$n_1 \sin[\theta_B] = n_2 \sin[90^\circ - \theta_B]$$

$$= n_2 \left( \sin 90^\circ \cos\theta_B - \cos 90^\circ \sin\theta_B \right)$$

$$= + n_2 \cos[\theta_B]$$

$$n_1 \sin[\theta_B] = n_2 \cos[\theta_B]$$

$$= \frac{n_2}{n_1} = \frac{\sin[\theta_B]}{\cos[\theta_B]} = \tan[\theta_B]$$

$$= \theta_B = \tan^{-1}\left[\frac{n_2}{n_1}\right]$$

The reflection at Brewster's angle provides a handy means to determine the polarization axis of a linear polarizer through the polarizer at light reflected at a steep angle.

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