EC-13
18-02-25

Fresnel's Formulae for parallel to the plane of incidence polarisation :— The electric and propagation vectors in two media are shown in Fig ① below. For this situation the magnetic vectors are parallel to the boundary surface.

$$(H_i)_{\parallel} = H_i \qquad (E_i)_{\parallel} = (E_i)_{\parallel} \cos\theta_i$$
$$(H_R)_{\parallel} = H_R \quad \text{and} \quad (E_R)_{\parallel} = (E_R)_{\parallel} \cos\theta_R$$
$$(H_T)_{\parallel} = H_T \qquad (E_T)_{\parallel} = (E_T)_{\parallel} \cos\theta_T$$

Now the boundary conditions of eq. ③ and ④ are reduces to

$$E_i \cos\theta_i - E_R \cos\theta_R = E_T \cos\theta_T \quad \text{— ⑤}$$

and

$$H_i + H_R = H_T \quad \text{— ⑥}$$

The equations ⑤ and ⑥ reduce again as

$$E_i \cos\theta_i - E_R \cos\theta_i = E_T \cos\theta_T \quad \text{— ⑦}$$

and

$$n_1 E_1 + n_2 E_R = n_2 E_T \quad \text{— ⑧}$$

Now, eliminating E_T from eq. ⑦ with the help of eq. ⑧ we get

$$\left(\frac{E_R}{E_i}\right)_{\parallel} = \frac{\frac{n_2}{n_1}\cos\theta_i - \cos\theta_T}{\frac{n_1}{n_2}\cos\theta_i + \cos\theta_T} \quad \text{— (A')}$$

and

$$\left(\frac{E_R}{E_i}\right)_{\parallel} = \frac{\tan(\theta_i - \theta_T)}{\tan(\theta_i - \theta_T)} \quad \text{— (A)}$$

Similarly,

$$\left(\frac{E_T}{E_i}\right)_{\parallel} = \frac{2\cos\theta_i}{\left(\frac{n_2}{n_1}\cos\theta_t + \cos\theta_T\right)} \quad \text{— (B')}$$

and

$$\left(\frac{E_T}{E_i}\right)_{\parallel} = \frac{2\cos\theta_i \sin\theta_2}{\sin(\theta_i+\theta_2)\cos(\theta_i-\theta_2)} \quad \text{— B}$$

The eq. (A'), (A), (B'), and (B) are the required results and it is known as Fresnel's formulae.

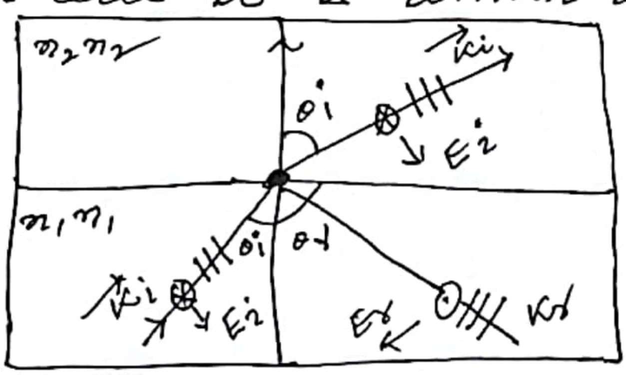

Fig ①