$(\varepsilon_1, \varepsilon_2) \in \mathbb{R}_+^2$

$$\mathbf{E}(\mathbf{r}) = \mathbf{E}_0 e^{i\mathbf{k}\cdot\mathbf{r}}$$

$$\mathbf{k}_i = \begin{pmatrix} k_{ix} \\ k_{iy} \\ k_{iz} \end{pmatrix} \quad \mathbf{k}_r = \begin{pmatrix} k_{rx} \\ k_{ry} \\ k_{rz} \end{pmatrix} \quad \mathbf{k}_t = \begin{pmatrix} k_{tx} \\ k_{ty} \\ k_{tz} \end{pmatrix}$$

$$\mathbf{E}_i(\mathbf{r}) = \mathbf{E}_0 e^{i\mathbf{k_i}\cdot\mathbf{r}}, \mathbf{E}_r(\mathbf{r}) = r\mathbf{E}_0 e^{i\mathbf{k_r}\cdot\mathbf{r}}, \mathbf{E}_t(\mathbf{r}) = t\mathbf{E}_0 e^{i\mathbf{k_t}\cdot\mathbf{r}}$$

$\mathbf{E}^{\|}$

$$z = 0$$

$\mathbf{k}_i, \mathbf{k}_t, \mathbf{k}_r$

$\mathbf{k}_{\parallel}$

$$e^{i\mathbf{k_i}\cdot\mathbf{r}} + re^{i\mathbf{k_r}\cdot\mathbf{r}} = te^{i\mathbf{k_t}\cdot\mathbf{r}}\Big|_{z=0}$$

$$k_y = 0$$

$$e^{ik_{ix}x} + re^{ik_{rx}x + k_{ry}y} = te^{ik_{tx}x + k_{ty}y}, \forall(x, y)$$

$$x = 0$$

$$1 + re^{ik_{ry}y} = te^{ik_{ty}y}, \forall y$$

r, t

(x, y)

$$1 + r\cos(k_{ry}y) = t\cos(k_{ty}y)$$

$$k_{ry} = k_{ty} = 0$$

$$k_y = 0$$

$$e^{ik_{ix}x} + re^{ik_{rx}x} = te^{ik_{tx}x}, \forall x$$

$$e^{-ik_{ix}x}$$

$$1 + re^{i(k_{rx} - k_{ix})x} = te^{i(k_{tx} - k_{ix})x}, \forall x$$

$$k_{rx} = k_{tx} = k_{ix}$$

$$\theta_i = \theta_r, \quad n_1 \sin\theta_i = n_2 \sin\theta_t$$

k_x, k_y

$$\mathbf{k}_i \cdot \mathbf{k}_i = k_0^2 \varepsilon_i \quad \Rightarrow k_i = k_0 \sqrt{\varepsilon_i} = k_0 n_i$$

$$\begin{cases} k_{ix} = n_1 k_0 \sin\theta_i \\ k_{rx} = n_1 k_0 \sin\theta_r \\ k_{tx} = n_2 k_0 \sin\theta_t \end{cases}$$

$$\begin{cases} \theta_i = \theta_r \\ n_1 \sin\theta_i = n_2 \sin\theta_t \end{cases}$$

$$(x0z) \Rightarrow \mathbf{k}_1 = k_{1x}\mathbf{e}_x + k_{1z}\mathbf{e}_z$$

$$z = 0$$

$$k_{ix} = k_{rx} = k_{tx} \equiv k_x$$

$$\mathbf{k} \cdot \mathbf{k} = \varepsilon k_0^2$$

$$\Rightarrow \left\{ \begin{array}{l} k_x^2 + k_{iz}^2 = \varepsilon_1 k_0^2 \\ k_x^2 + k_{rz}^2 = \varepsilon_1 k_0^2 \\ k_x^2 + k_{tz}^2 = \varepsilon_2 k_0^2 \end{array} \right. \quad \Rightarrow k_{iz} = \pm\sqrt{\varepsilon_1 k_0^2 - k_x^2} = -k_{rz}$$

E^y

$$1 + r = t.$$

H^x

$$H^x$$

$$\mathbf{k} \times \mathbf{E} = \omega \mathbf{B} = \omega \mu \mathbf{H}$$

$$\omega \mu H_x = k_z E_y$$

$$\frac{k_{iz}}{\mu_1}E_{iy} + \frac{k_{rz}}{\mu_1}E_{ry} = \frac{k_{tz}}{\mu_2}E_{ty}$$

$$k_{rz} = -k_{iz}$$

$$\frac{k_{iz}}{\mu_1} - \frac{k_{iz}}{\mu_1} r = \frac{k_{tz}}{\mu_2} t,$$

$$1 - r = \frac{\mu_1}{\mu_2} \frac{k_{tz}}{k_{iz}} t$$

$$
\begin{cases}
1 + r = t \\
1 - r = \dfrac{\mu_1}{\mu_2} \dfrac{k_{tz}}{k_{iz}} t
\end{cases}
$$

r

t

$$t_{12}^s = \frac{2\mu_2 k_{z1}}{\mu_2 k_{z1} + \mu_1 k_{z2}}, \qquad r_{12}^s = \frac{\mu_2 k_{z1} - \mu_1 k_{z2}}{\mu_2 k_{z1} + \mu_1 k_{z2}}.$$

$$t_{12}^s = \frac{2}{1+K_s}, \qquad r_{12}^s = \frac{1-K_s}{1+K_s}, \qquad K_s := \frac{\mu_1}{\mu_2}\frac{k_{z2}}{k_{z1}}$$

Z

$$\rho_{12}^{p} = \frac{\varepsilon_2 k_{z1} - \varepsilon_1 k_{z2}}{\varepsilon_2 k_{z1} + \varepsilon_1 k_{z2}} = \frac{1 - K^p}{1 + K^p}, \quad r_{12}^{s} = \frac{\mu_2 k_{z1} - \mu_1 k_{z2}}{\mu_2 k_{z1} + \mu_1 k_{z2}} = \frac{1 - K^s}{1 + K^s}$$

$$\tau_{12}^{p} = \frac{2\varepsilon_2 k_{z1}}{\varepsilon_2 k_{z1} + \varepsilon_1 k_{z2}} = \frac{2}{1 + K^p}, \quad t_{12}^{s} = \frac{2\mu_2 k_{z1}}{\mu_2 k_{z1} + \mu_1 k_{z2}} = \frac{2}{1 + K^s}$$

$$K^p := \frac{\varepsilon_1 k_{z2}}{\varepsilon_2 k_{z1}}$$

$$K^s := \frac{k_{z2}}{k_{z1}}$$

$\mu = 1$

$$r_{ij} = -r_{ji}.$$

θ

$$r^p = \frac{n_2 \cos\theta - n_1 \sqrt{1 - \frac{n_1^2}{n_2^2} \sin^2\theta}}{n_2 \cos\theta + n_1 \sqrt{1 - \frac{n_1^2}{n_2^2} \sin^2\theta}}$$