

完全導体への斜め入射

入射面と E が直交 界面($x = 0$)で $E^{\parallel} = 0, B^{\perp} = 0, E^{\perp} = 0, B^{\parallel} \neq 0$

$$\mathbf{E}_I = \mathbf{E}_{0I} e^{i(k_I \cdot r - \omega t)} \quad \mathbf{E}_R = \mathbf{E}_{0R} e^{i(k_R \cdot r - \omega t)} \quad \mathbf{B}_I = \mathbf{B}_{0I} e^{i(k_I \cdot r - \omega t)} \quad \mathbf{B}_R = \mathbf{B}_{0R} e^{i(k_R \cdot r - \omega t)}$$

$$\mathbf{k}_I = k(-\cos \theta, 0, \sin \theta) = (k_x, 0, k_z)$$

$$\mathbf{k}_R = k(\cos \theta, 0, \sin \theta) = (-k_x, 0, k_z)$$

$$\mathbf{E}_{0I} = E_0(0, -1, 0) \quad \mathbf{E}_{0R} = E_0(0, 1, 0)$$

$$\mathbf{B}_{0I} = B_0(\sin \theta, 0, \cos \theta) \quad \mathbf{B}_{0R} = B_0(-\sin \theta, 0, \cos \theta)$$

$$\mathbf{E} = \mathbf{E}_I + \mathbf{E}_R = \mathbf{E}_{0I} e^{i(k_I \cdot r - \omega t)} + \mathbf{E}_{0R} e^{i(k_R \cdot r - \omega t)}$$

$$= E_0(0, -1, 0) e^{i(k_x x + k_z z - \omega t)} + E_0(0, 1, 0) e^{i(-k_x x + k_z z - \omega t)}$$

$$= (0, E_0(-e^{ik_x x} + e^{-ik_x x}), 0) e^{i(k_z z - \omega t)}$$

$$= (0, -2iE_0 \sin k_x x e^{i(k_z z - \omega t)}, 0)$$

$$\operatorname{Re} \mathbf{E} = (0, 2E_0 \sin k_x x \sin(k_z z - \omega t), 0)$$

$$\mathbf{B} = \mathbf{B}_I + \mathbf{B}_R = \mathbf{B}_{0I} e^{i(k_I \cdot r - \omega t)} + \mathbf{B}_{0R} e^{i(k_R \cdot r - \omega t)}$$

$$= B_0(\sin \theta, 0, \cos \theta) e^{i(k_x x + k_z z - \omega t)} + B_0(-\sin \theta, 0, \cos \theta) e^{i(-k_x x + k_z z - \omega t)}$$

$$= (B_0 \sin \theta (e^{ik_x x} - e^{-ik_x x}), 0, B_0 \cos \theta (e^{ik_x x} + e^{-ik_x x})) e^{i(k_z z - \omega t)}$$

$$= (2iB_0 \sin \theta \sin k_x x, 0, 2B_0 \cos \theta \cos k_x x) e^{i(k_z z - \omega t)}$$

$$\operatorname{Re} \mathbf{B} = (-2B_0 \sin \theta \sin k_x x \sin(k_z z - \omega t), 0, 2B_0 \cos \theta \cos k_x x \cos(k_z z - \omega t))$$

$$\mathbf{E} = 2E_0 \sin k_x x \sin(k_z z - \omega t) \hat{\mathbf{y}}$$

$$\mathbf{B} = -2B_0 \sin \theta \sin k_x x \sin(k_z z - \omega t) \hat{\mathbf{x}} + 2B_0 \cos \theta \cos k_x x \cos(k_z z - \omega t) \hat{\mathbf{z}}$$

$$\text{at } x = 0 \quad E^{\parallel} = E_y = E_z = 0 \quad E^{\perp} = E_x = 0$$

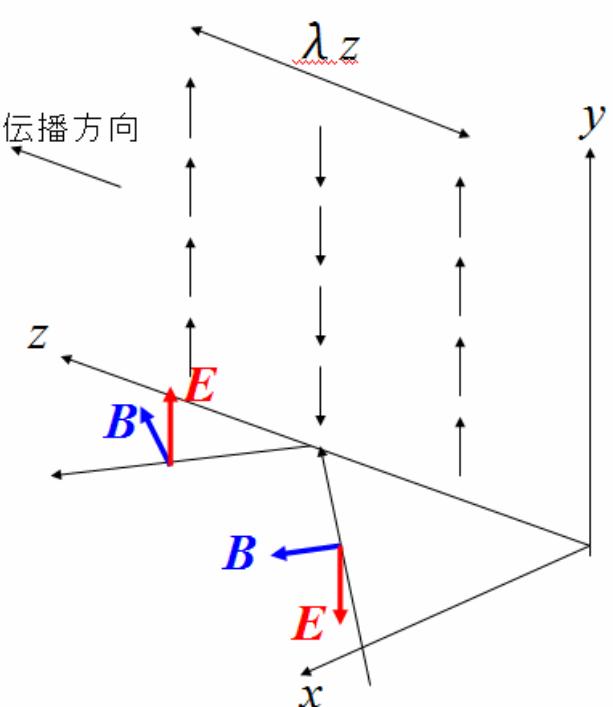
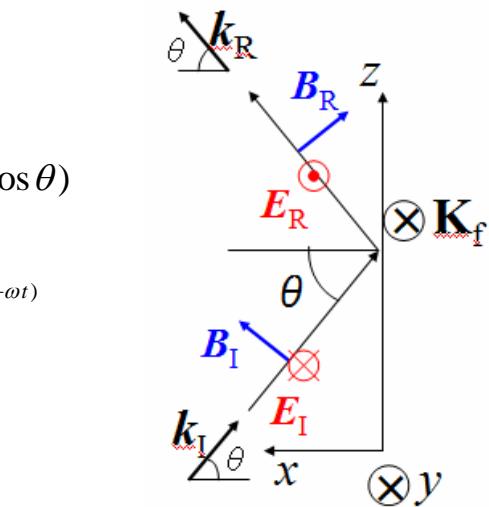
$$B^{\perp} = B_x = 0 \quad B^{\parallel} = B_z = 2B_0 \cos \theta \cos(k_z z - \omega t)$$

$$\sigma_f = 0$$

$$\mathbf{K}_f = -\frac{2}{\mu_0} B_0 \cos \theta \cos(k_z z - \omega t) \hat{\mathbf{y}}$$

$$k_z = k \sin \theta \quad \lambda_z = \frac{\lambda}{\sin \theta}$$

$$k_x = -k \cos \theta \quad \lambda_x = \frac{\lambda}{\cos \theta}$$



TE波 = H波

入射面内に E 界面 ($x = 0$) で $E^{\parallel} = 0, B^{\perp} = 0, E^{\perp} \neq 0, B^{\parallel} \neq 0$

$$\mathbf{E}_I = \mathbf{E}_{0I} e^{i(k_I \cdot \mathbf{r} - \omega t)} \quad \mathbf{E}_R = \mathbf{E}_{0R} e^{i(k_R \cdot \mathbf{r} - \omega t)} \quad \mathbf{B}_I = \mathbf{B}_{0I} e^{i(k_I \cdot \mathbf{r} - \omega t)} \quad \mathbf{B}_R = \mathbf{B}_{0R} e^{i(k_R \cdot \mathbf{r} - \omega t)}$$

$$\mathbf{k}_I = k(-\cos \theta, 0, \sin \theta) = (k_x, 0, k_z)$$

$$\mathbf{k}_R = k(\cos \theta, 0, \sin \theta) = (-k_x, 0, k_z)$$

$$\mathbf{E}_{0I} = E_0 (\sin \theta, 0, \cos \theta) \quad \mathbf{E}_{0R} = E_0 (\sin \theta, 0, -\cos \theta)$$

$$\mathbf{B}_{0I} = B_0 (0, 1, 0) \quad \mathbf{B}_{0R} = B_0 (0, 1, 0)$$

$$\mathbf{E} = \mathbf{E}_I + \mathbf{E}_R = \mathbf{E}_{0I} e^{i(k_I \cdot \mathbf{r} - \omega t)} + \mathbf{E}_{0R} e^{i(k_R \cdot \mathbf{r} - \omega t)}$$

$$= E_0 (\sin \theta, 0, \cos \theta) e^{i(k_x x + k_z z - \omega t)} + E_0 (\sin \theta, 0, -\cos \theta) e^{i(-k_x x + k_z z - \omega t)}$$

$$= (E_0 \sin \theta (e^{ik_x x} + e^{-ik_x x}), \quad 0, \quad E_0 \cos \theta (e^{ik_x x} - e^{-ik_x x})) e^{i(k_z z - \omega t)}$$

$$= (2E_0 \sin \theta \cos k_x x, \quad 0, \quad 2iE_0 \cos \theta \sin k_x x) e^{i(k_z z - \omega t)}$$

$$\operatorname{Re} \mathbf{E} = (2E_0 \sin \theta \cos k_x x \cos(k_z z - \omega t), \quad 0, \quad -2E_0 \cos \theta \sin k_x x \sin(k_z z - \omega t))$$

$$\mathbf{B} = \mathbf{B}_I + \mathbf{B}_R = \mathbf{B}_{0I} e^{i(k_I \cdot \mathbf{r} - \omega t)} + \mathbf{B}_{0R} e^{i(k_R \cdot \mathbf{r} - \omega t)}$$

$$= B_0 (0, 1, 0) e^{i(k_x x + k_z z - \omega t)} + B_0 (0, 1, 0) e^{i(-k_x x + k_z z - \omega t)}$$

$$= (0, \quad B_0 (e^{ik_x x} + e^{-ik_x x}) e^{i(k_z z - \omega t)}, \quad 0)$$

$$\operatorname{Re} \mathbf{B} = (0, \quad 2B_0 \cos k_x x \cos(k_z z - \omega t), \quad 0)$$

$$\mathbf{E} = 2E_0 \sin \theta \cos k_x x \cos(k_z z - \omega t) \hat{x} - 2E_0 \cos \theta \sin k_x x \sin(k_z z - \omega t) \hat{z}$$

$$\mathbf{B} = 2B_0 \cos k_x x \cos(k_z z - \omega t) \hat{y}$$

$$\text{at } x = 0 \quad E^{\parallel} = E_z = E_y = 0 \quad E^{\perp} = E_x = 2E_0 \sin \theta \cos(k_z z - \omega t)$$

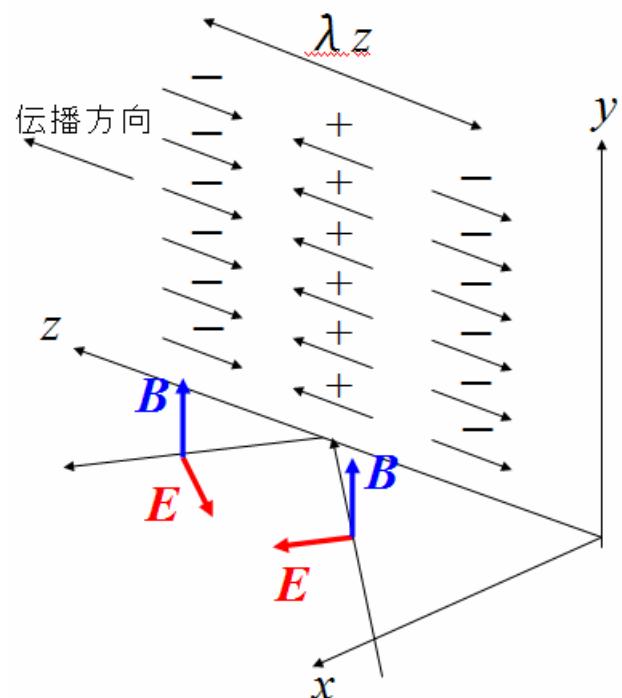
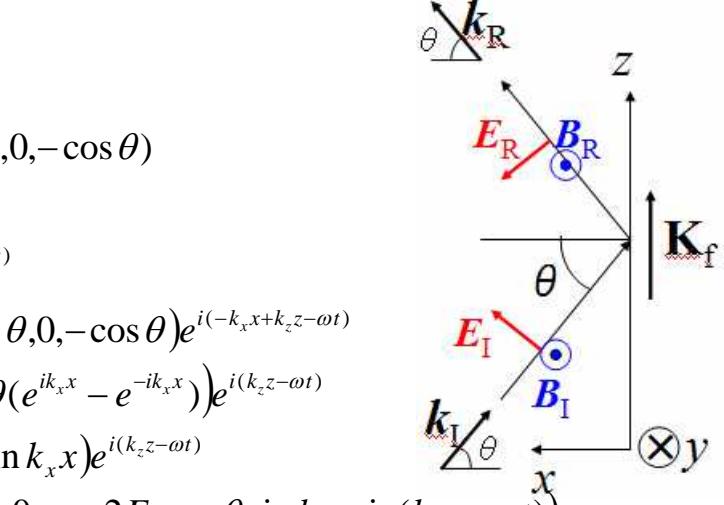
$$B^{\perp} = B_x = 0 \quad B^{\parallel} = B_y = 2B_0 \cos(k_z z - \omega t)$$

$$\sigma_f = 2\epsilon_0 E_0 \sin \theta \cos(k_z z - \omega t)$$

$$\mathbf{K}_f = \frac{2}{\mu_0} B_0 \cos(k_z z - \omega t) \hat{z}$$

$$k_z = k \sin \theta \quad \lambda_z = \frac{\lambda}{\sin \theta}$$

$$k_x = -k \cos \theta \quad \lambda_x = \frac{\lambda}{\cos \theta}$$



TM波 = E波

の場合、 $x = 0$, $\theta \rightarrow \pi / 2$ の導体面に沿った進行波は存在できない。

の場合、 $x = 0$, $\theta \rightarrow \pi / 2$ の進行波が存在。

