$\Theta\epsilon\mu\alpha$ 1

(α)

$$\vec{E} = \frac{1}{2\epsilon_0}\begin{cases} \left[(\sigma_1+\sigma_2)\sin\phi\ \hat{i}_x + [(\sigma_1-\sigma_2)\cos\phi+\sigma_3)]\hat{i}_z\right] & \text{for region 1,} \\ \left[(\sigma_1-\sigma_2)\sin\phi\ \hat{i}_x + [(\sigma_1+\sigma_2)\cos\phi+\sigma_3)]\hat{i}_z\right] & \text{for region 2,} \\ \left[-(\sigma_1+\sigma_2)\sin\phi\ \hat{i}_x + [(-\sigma_1+\sigma_2)\cos\phi+\sigma_3)]\hat{i}_z\right] & \text{for region 3,} \\ \left[-(\sigma_1+\sigma_2)\sin\phi\ \hat{i}_x + [(-\sigma_1+\sigma_2)\cos\phi-\sigma_3)]\hat{i}_z\right] & \text{for region 4,} \\ \left[(-\sigma_1+\sigma_2)\sin\phi\ \hat{i}_x - [(\sigma_1+\sigma_2)\cos\phi+\sigma_3)]\hat{i}_z\right] & \text{for region 5,} \\ \left[(\sigma_1+\sigma_2)\sin\phi\ \hat{i}_x + [(\sigma_1-\sigma_2)\cos\phi-\sigma_3)]\hat{i}_z\right] & \text{for region 6.} \end{cases}$$

(β)

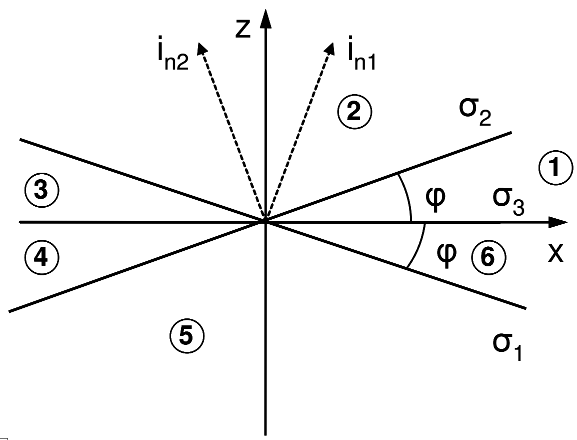
$$\begin{aligned} \sigma_1 &= -\sigma_2 \\ \sigma_3 &= -2\sigma_1\cos\phi \end{aligned}$$

(γ)

$$W_e = \begin{cases} 0 & \text{for region 1,} \\ \frac{1}{2}\frac{\sigma_1^2}{\epsilon_0} & \text{for region 2,} \\ \frac{2\sigma_1^2\cos^2\phi}{\epsilon_0} & \text{for region 3,} \\ 0 & \text{for region 4,} \\ \frac{1}{2}\frac{\sigma_1^2}{\epsilon_0} & \text{for region 5,} \\ \frac{2\sigma_1^2\cos^2\phi}{\epsilon_0} & \text{for region 6,} \end{cases}$$

If $0 \le \phi \le \pi/3$ then $(W_e)_{max} = 2\sigma_1^2\cos^2\phi/\epsilon_0$

If $\pi/3 < \phi < \pi/2$ then $(W_e)_{max} = \sigma_1^2/2\epsilon_0$


z
i_{n2}
i_{n1}
2
σ_2
1
3
φ
σ_3
4
φ
6
x
5
σ_1

$\underline{\Theta\epsilon\mu\alpha\ \ 2}$

(α)

$$\frac{K_0}{2} + \frac{J_{01}d_1}{\pi} - \frac{J_{02}d_2}{\pi} = 0$$

(β)

$$\vec{H} = \hat{i}_z \begin{cases} 0 & -\infty < x \leq -a - d_1/2 \\ \dfrac{K_0}{2} - \dfrac{J_{01}d_1}{\pi}\sin\left(\pi\dfrac{x+a}{d_1}\right) - \dfrac{J_{02}d_2}{\pi} & -a - d_1/2 \leq x \leq -a + d_1/2, \\ \dfrac{K_0}{2} - \dfrac{J_{01}d_1}{\pi} - \dfrac{J_{02}d_2}{\pi} & -a + d_1/2 \leq x < 0, \\ -\dfrac{K_0}{2} - \dfrac{J_{01}d_1}{\pi} - \dfrac{J_{02}d_2}{\pi} & 0 < x \leq b - d_2/2, \\ -\dfrac{K_0}{2} - \dfrac{J_{01}d_1}{\pi} + \dfrac{J_{02}d_2}{\pi}\sin\left(\pi\dfrac{x-b}{d_2}\right) & b - d_2/2 \leq x \leq b + d_2/2, \\ 0 & b + d_2/2 \leq x < +\infty \end{cases}$$

(γ)

$$\frac{W_m}{S} = \frac{3}{4}\mu_0\frac{J_{01}^2 d_1^3}{\pi^2}$$

(δ)

$$\vec{f} = -\hat{i}_x\mu_0 K_0\left(\frac{K_0}{2} + \frac{2J_{01}d_1}{\pi}\right) = -\hat{i}_x\mu_0 K_0\left(\frac{J_{01}d_1}{\pi} + \frac{J_{02}d_2}{\pi}\right)$$

$\underline{\Theta\epsilon\mu\alpha\ \ 3}$

(α)

$$\begin{aligned} \nu &= 4.775 \times 10^9\, Hz \\ \lambda_0 &= 0.628\, m \\ \theta &= 36.87\, deg = 0.6435\, rad \\ \text{Polarization} &= \text{Linear (parallel or TM)} \end{aligned}$$

(β)

$$\begin{aligned} \vec{E}_i &= -Z_0 H_{i0}[\hat{i}_x\cos\theta - \hat{i}_y\sin\theta]\exp[-j(k_{ix}x + k_{iy}y)] \\ \vec{E}_i &= [-3013.84\hat{i}_x + 2260.38\hat{i}_y]\exp[-j(6x+8y)]\ (V/m) \end{aligned}$$

$$\vec{\mathcal{E}}_i = -Z_0 H_{i0}[\hat{i}_x \cos\theta - \hat{i}_y \sin\theta] \cos[\omega t - k_{ix}x - k_{iy}y]$$

$$\vec{\mathcal{E}}_i = [-3013.84\hat{i}_x + 2260.38\hat{i}_y] \cos[3 \times 10^9 t - 6x - 8y] \ (V/m)$$

(γ)

$$\vec{E}_r = Z_0 H_{i0}[\hat{i}_x \cos\theta + \hat{i}_y \sin\theta] \exp[-j(k_{ix}x - k_{iy}y)]$$

$$\vec{E}_r = [3013.84\hat{i}_x + 2260.38\hat{i}_y] \exp[-j(6x - 8y)] \ (V/m)$$

$$\vec{H}_r = H_{i0}\hat{i}_z \exp[-j(k_{ix}x - k_{iy}y)]$$

$$\vec{H}_r = 10\hat{i}_z \exp[-j(6x - 8y)] \ (A/m)$$

(δ)

$$\vec{H}_1 = H_{i0}\hat{i}_z \exp(-jk_{ix}x) 2\cos(k_{iy}y)$$

$$\vec{\mathcal{H}}_1 = 20\hat{i}_z \cos(8y) \cos[3 \times 10^9 t - 6x] \ (A/m)$$

$$\vec{E}_1 = -Z_0 H_{i0}[\hat{i}_x \cos\theta - \hat{i}_y \sin\theta] \exp[-j(k_{ix}x + k_{iy}y)] + Z_0 H_{i0}[\hat{i}_x \cos\theta + \hat{i}_y \sin\theta] \exp[-j(k_{ix}x - k_{iy}y)] +$$

$$\vec{\mathcal{E}}_1 = 3013.84 \times 2\sin(8y) \cos[3 \times 10^9 t - 6x + \pi/2]\hat{i}_x + 2260.38 \times 2\cos(8y) \cos[3 \times 10^9 t - 6x]\hat{i}_y \ (V/m)$$

(ϵ)

$$\vec{K} = -2H_{i0}\hat{i}_x \exp(-jk_{ix}x)$$

$$\vec{\mathcal{K}} = -20\hat{i}_x \cos[3 \times 10^9 t - 6x] \ (A/m)$$

$$\sigma = -2\epsilon_0 Z_0 H_{i0} \sin\theta \exp(-jk_{ix}x)$$

$$\sigma = -4520.76\epsilon_0 \cos[3 \times 10^9 t - 6x] \ (C/m^2)$$

($\sigma\tau$)

$$\vec{f} = \vec{f}_e + \vec{f}_m$$

$$\vec{f}_e = -\hat{i}_y 2\epsilon_0 (Z_0 H_{i0})^2 \sin^2\theta \cos^2(\omega t - k_{ix}x) \ (Nt/m^2)$$

$$\vec{f}_e = -\hat{i}_y 9.0475 \times 10^{-5} \cos^2(3 \times 10^9 t - 6x) \ (Nt/m^2)$$

$$
\begin{aligned}
\langle \vec{f}_e \rangle &= -\hat{i}_y 4.523 \times 10^{-5} \, (Nt/m^2) \\
\vec{f}_m &= \hat{i}_y 2\mu_0 (H_{i0})^2 \cos^2(\omega t - k_{ix} x) \, (Nt/m^2) \\
\vec{f}_m &= \hat{i}_y 2.5133 \times 10^{-4} \cos^2(3 \times 10^9 t - 6x) \, (Nt/m^2) \\
\langle \vec{f}_m \rangle &= \hat{i}_y 1.2566 \times 10^{-4} \, (Nt/m^2) \\
\langle \vec{f} \rangle &= \langle \vec{f}_e \rangle + \langle \vec{f}_m \rangle
\end{aligned}
$$