TE10波的特点

我们已经知道,在波导一般解中:

$$\nabla_t^2 \vec{e}_t + k_c^2 \vec{e}_t = 0$$

由分离变量得:

$$k_c^2 = k^2 + \gamma^2 = k^2 - \beta^2$$

可以解得在TE模情况下:

$$egin{cases} L = \mu \iint \overrightarrow{h_t} \cdot \overrightarrow{h_t} dS = \mu \ C = \epsilon \iint \overrightarrow{e_t} \cdot \overrightarrow{e_t} dS (rac{eta}{k})^2 = \epsilon (rac{\lambda}{\lambda_g})^2 \ eta = \omega \sqrt{LC} = rac{2\pi}{\lambda_g} \end{cases}$$

所以波形阻抗为

$$\eta = \sqrt{rac{L}{C}} = \sqrt{rac{\mu}{\epsilon}}(rac{\lambda_g}{\lambda})$$

而对于TM模情况下:

$$\left\{egin{aligned} L = \mu(rac{\lambda}{\lambda_g})^2 \ C = \epsilon \end{aligned}
ight.$$

此时可以计算出:

$$\left\{egin{array}{l} eta = rac{2\pi}{\lambda_g} \ \eta = \sqrt{rac{\mu}{\epsilon}}(rac{\lambda}{\lambda_g}) \end{array}
ight.$$

这就是其特性阻抗

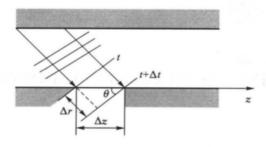


图 2-5-9 z 的可视等相位面和相速 v。

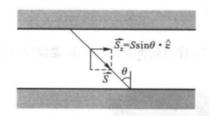


图 2-5-10 Poynting 矢量传播速度

对于平板波导z方向的等相位面:

$$wt - kzsin\theta = Const$$

对式子两端求微分得:

$$wdt - ksin\theta dz = 0$$

故相速度:

$$v_p = rac{dz}{dt} = rac{\omega}{ksin heta} = rac{c}{\sqrt{1-(rac{\lambda}{2a})^2}} > c$$

波导波长:

$$\lambda_g = rac{\lambda}{sin heta} = rac{\lambda}{\sqrt{1-(rac{\lambda}{2a})^2}} > \lambda$$

波的截止

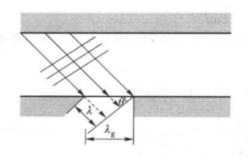


图 2-5-11 λ 和 λ 。的关系

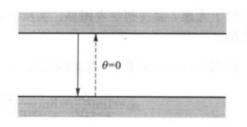


图 2-5-12 曲折波的截止状态(θ=0)—— 此时波无法传播

当 $\theta=0$ 时波无法向前传播,此时波截止此时:

$$sin heta=\sqrt{1-(rac{\lambda}{2a})^2}=0$$

即:

$$\lambda=\lambda_c=2a$$

此时

$$\lambda_c = 2a$$

为截止波长