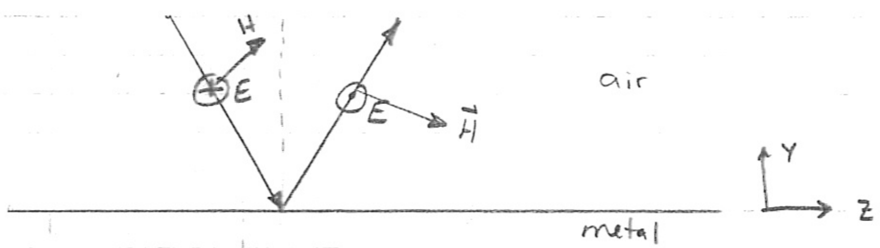
Plane wave : $f = 1\,MHz$

incident angle $30°$ onto a metallic surface

linear polarization out of page

Average intensity of $1\,W/m^2$



Basic plane wave form : $\vec{E}_i = E_0\,\hat{x}\,e^{j\vec{k}\cdot\vec{r}}$

$$\vec{k} = \frac{\omega}{c}\left(-\cos\theta\,\hat{y} + \sin\theta\,\hat{z}\right)$$

$$\vec{H} = \frac{1}{\eta}\,\hat{k}\times\vec{E} = \frac{1}{\eta}\begin{vmatrix}\hat{x} & \hat{y} & \hat{z}\\ 0 & -\cos\theta & \sin\theta\\ E_0 & 0 & 0\end{vmatrix}$$

$$= \frac{E_0}{\eta}\left(\sin\theta\,\hat{y} + \cos\theta\,\hat{z}\right)$$

$$\vec{H} = \frac{E_0}{\eta}\left(\sin\theta\,\hat{y} + \cos\theta\,\hat{z}\right)e^{j\frac{\omega}{c}(-\cos\theta y + \sin\theta z)}$$

$$\vec{S} = \vec{E}\times\vec{H}^*$$

$$\bar{S}_{ave} = \frac{1}{2}\,Re\{\bar{E}\times\bar{H}^*\}$$

$$\vec{E}\times\vec{H}^* = \begin{vmatrix}\hat{x} & \hat{y} & \hat{z}\\ E_0\,e^{j\vec{k}\cdot\vec{r}} & 0 & 0\\ 0 & \frac{E_0^*}{\eta^*}\sin\theta\,e^{-j\vec{k}\cdot\vec{r}} & \frac{E_0^*}{\eta^*}\cos\theta\,e^{-j\vec{k}\cdot\vec{r}}\end{vmatrix}$$

$$\vec{S} = -\frac{|E_0|^2}{\eta}\cos\theta\,\hat{y} + \frac{|E_0|^2}{\eta}\sin\theta\,\hat{z}$$

$$\vec{S}_{av} = \frac{1}{2}\,Re\{\bar{E}\times\bar{H}^*\} = \frac{|E_0|^2}{2\eta}\underbrace{\left(-\cos\theta\,\hat{y} + \sin\theta\,\hat{z}\right)}_{\text{direction of }\hat{k}}$$

$$|\vec{S}_{av}| = 1\,\frac{W}{m^2} = \frac{|E_0|^2}{(2)(377)}$$

$$E_0 = 27.5\,V/m$$

$$\vec{E}_i = 27.5\,\hat{x}\,e^{j(-0.018y + 0.011z)}\ V/m$$

$$\vec{H}_i = \left(0.0365\,\hat{y} + 0.0632\,\hat{z}\right)e^{j(-0.018y + 0.011z)}\ V/m$$

$$\vec{E}_r = -27.5\,\hat{x}\,e^{j(-0.018y + 0.011z)}\ \frac{V}{m} \qquad \vec{H}_r = \left(-0.0365\,\hat{y} + 0.0632\,\hat{z}\right)e^{j(0.018y + 0.011z)}\ A/m$$

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