Appendix K

Derivation of Horizontally and Vertically Polarized Surface Current Density

Considering a horizontally and vertically polarized the incident electric fields as shown in (5.58) and (5.59)

$$\boldsymbol{E}_h^m = \hat{y}E_{hp}^m \exp(-jk_{xm}x - jk_{zm}z) \quad \text{(K.1)}$$

$$\boldsymbol{E}_v^m = E_{vp}^m(\hat{\boldsymbol{x}}\cos q_m + \hat{\boldsymbol{z}}\sin q_m)\exp(-jk_{xm}x - jk_{zm}z) \quad \text{(K.2)}$$

where $k_{xm} = k_2 \sin q_m$ and $k_{zm} = -k_2 \cos q_m$. k_2 and q_m are the wave number in medium 2 or perfectly conducting medium and the incident angle, respectively. Then magnetic fields of each polarization are derived and obtained as

$$\boldsymbol{H}_h^m = \hat{\boldsymbol{n}}_{im} \times \frac{\boldsymbol{E}_h^m}{\boldsymbol{h}_2} = \frac{E_{hp}^m}{\boldsymbol{h}_2}\begin{bmatrix} \cos q_m \\ 0 \\ \sin q_m \end{bmatrix}\exp(-jk_{xm}x - jk_{zm}z) \quad \text{(K.3)}$$

$$\boldsymbol{H}_v^m = \hat{\boldsymbol{n}}_{im} \times \frac{\boldsymbol{E}_v^m}{\boldsymbol{h}_2} = \frac{E_{vp}^m}{\boldsymbol{h}_2}\begin{bmatrix} 0 \\ -1 \\ 0 \end{bmatrix}\exp(-jk_{xm}x - jk_{zm}z) \quad \text{(K.4)}$$

By substituting (K.3) and (K.4) to (5.62), current surface density of each polarisation are

$$\boldsymbol{J}_h = \boldsymbol{n} \times \boldsymbol{H}_h^m = \frac{E_{hp}^m}{\boldsymbol{h}_2}\begin{bmatrix} -Z_y \sin q_m \\ Z_x \sin q_m + \cos q_m \\ Z_y \cos q_m \end{bmatrix}\exp(-jk_{xm}x - jk_{zm}z) \quad \text{(K.5)}$$

$$\boldsymbol{J}_v = \boldsymbol{n} \times \boldsymbol{H}_v^m = \frac{E_{hp}^m}{h_2} \begin{bmatrix} 1 \\ 0 \\ Z_x \end{bmatrix} \exp\left(-jk_{xm}x - jk_{zm}z\right) \tag{K.6}$$