10.13 (a) We can use Eq. (10.92) to express the diffracted electric field as

$$\vec{E}(\vec{x}) = -\frac{ie^{ikr}}{4\pi r}\vec{k}\times\oint_{S_1}\left[\frac{c\vec{k}\times(\vec{n}\times\vec{B}(\vec{x}'))}{k} - \vec{n}\times\vec{E}(\vec{x}')\right]e^{-i\vec{k}\cdot\vec{x}'}da'$$

Since $\vec{E} = E_0(\vec{\varepsilon}_1\cos\alpha - \vec{\varepsilon}_3\sin\alpha)\,e^{ik[z\cos\alpha + x\sin\alpha]}$, $\vec{B} = \frac{E_0}{c}\vec{\varepsilon}_2\, e^{ik[z\cos\alpha + x\sin\alpha]}$, then

$$(\vec{n}\times\vec{E}_i)_{z=0} = E_0\,\vec{\varepsilon}_2\cos\alpha\, e^{ikx'\sin\alpha}, \qquad (\vec{n}\times\vec{B}_i)_{z=0} = -\frac{E_0}{c}\vec{\varepsilon}_1\, e^{ikx'\sin\alpha}.$$

The diffracted electric field now becomes

$$\vec{E}(\vec{x}) = \frac{ie^{ikr}}{4\pi r}E_0\,\vec{k}\times\oint_{S_1}e^{-i\vec{k}\cdot\vec{x}'}\left[\frac{\vec{k}\times\vec{\varepsilon}_1}{k} + \vec{\varepsilon}_2\cos\alpha\right]da'$$

$$= \frac{ie^{ikr}}{4\pi r}E_0\,\vec{k}\times\oint_{S_1}e^{-i\vec{k}\cdot\vec{x}'}\left[\vec{\varepsilon}_2(\cos\theta + \cos\alpha) - \vec{\varepsilon}_3\sin\theta\sin\phi\right]da',$$

where we have used $\vec{k}\times\vec{\varepsilon}_1 = k(\vec{\varepsilon}_2\cos\theta - \vec{\varepsilon}_3\sin\theta\sin\phi)$. Compare with Eq. (10.117), we can see that $\cos\alpha$ is replaced by $(\cos\theta + \cos\alpha)/2$, and there is an additional factor proportional to $\vec{k}\times\vec{\varepsilon}_3$.