698.

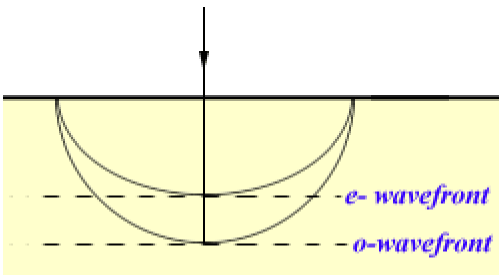
Problem 48.17 (RHK)

Linearly polarized light of wavelength 525 nm *strikes, at normal incidence,* a *wurzite crystal, cut with its faces parallel to the optic axis. We have to find the smallest possible thickness of the crystal if the emergent o-rays and e-rays combine to form linearly polarized light.*

Solution:

For wurzite $n_0 = 2.356$ and $n_e = 2.378$.

Minimum thickness of the crystal required for a linearly polarized light to emerge as a linearly polarized light will be determined by ensuring that the phase difference between the *o*-rays and e-rays after travelling through the crystal be π.



Let *x* be the thickness of the crystal. It is given that the crystal faces are parallel to the optic axis. The e-wavefronts and the o-wavefronts will be as shown in the figure. The wavelengths of the *o*-rays and e-rays in the wurzite crystal will be determined by the speeds of the *o*-rays and the *e*-rays in the crystal. In terms of the refractive indices n_o and n_e, we have

$$\lambda_o = \frac{\lambda}{n_o} = \frac{525}{2.356}\ \text{nm} = 222.8\ \text{nm},$$

and

$$\lambda_e = \frac{\lambda}{n_e} = \frac{525}{2.378}\ \text{nm} = 220.8\ \text{nm}.$$

We want the phase difference between the *o*-rays and e-rays to be π. This requirement gives an equation, from which *x* can be found. It is

$$2\pi\left(\frac{x}{\lambda_e} - \frac{x}{\lambda_o}\right) = \pi,$$

or

$$x = \frac{\lambda}{2(n_o - n_e)} = \frac{525}{2(2.378 - 2.356)}\ \text{nm} = 11.9\ \mu\text{m}.$$