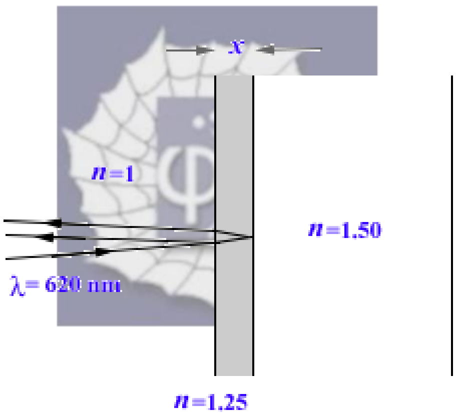
**636.**

## **Problem 45.27 (RHK)**

*We wish to coat a flat slab of glass* $(n = 1.50)$ *with a transparent material* $(n = 1.25)$ *so that light of wavelength* 620 nm (*in vacuum*) *incident normally is not reflected. We have to find the minimum thickness that the coating should have.*




## **Solution:**

The crucial concept to be used in answering this problem is that when light incident from a medium with refractive index $n_1$ is reflected from the interface of a medium with refractive index $n_2$, with $n_2 > n_1$, the reflected wave undergoes a phase change of $\pi$.

Light of wavelength $\lambda = 620$ nm is first reflected from the surface of the coating whose index of refraction is 1.25. As the wave is incident from air whose index of refraction is 1.0, it undergoes a phase change of $\pi$. The wave that is transmitted in the medium, coating material, undergoes reflection with the glass surface, and as the refractive index of glass, 1.50, is greater than that of the coating, it undergoes a phase change of $\pi$. Therefore, the phase difference between the two waves, one that is reflected from the coating and the other that travels inside the coating and is reflected from the glass surface and is refracted again into air will be $2\pi \times 2x / \lambda_{coating}$.

As shown in the figure $x$ is the thickness of the coating and the wavelength inside the coating

$$\lambda_{coating} = \frac{\lambda}{n_{coating}} = \frac{620}{1.25} \text{ nm.}$$

The condition for destructive interference is that the phase difference between the two waves be $\pi, 3\pi, 5\pi, ...$

Therefore, the minimum thickness of the transparent coating of refractive index 1.25 that should be put on the glass surface so that there in no reflected light at near normal incidence will be

$$2\pi \times \frac{2x}{\lambda_{coating}} = \pi,$$

or

$$x = \frac{620}{4 \times 1.25}\ \text{nm} = 124\ \text{nm}.$$