Dec 3, 2009

35.27 $n_1 = 1$

$n_2 = 1.42$

Thus, for destructive interference need

$(m + \frac{1}{2}) \lambda_2 = 2d$

$\lambda_2 = \frac{650}{1.42}$ nm

$d_{\text{min}} = \frac{\lambda_2}{2} = \frac{650}{2 \times 1.42}$ nm

35.30

$\theta$ no shift on reflection

2 $t = m \lambda_2$

Max $t$ is $t = 8 \times 10^{-5}$ m

$m_{\text{max}} = \frac{2\lambda}{\lambda_{air}} = 2.94$

At vertex, there is a dark fringe, so 244 fringes in 9 cm
is 27.1 fringes / cm.

35.32 $n_1 = 2$

$n_2 = 1.85$

$n_3 = 1.52$

a) Constructive int. $\Rightarrow (m + \frac{1}{2}) \lambda_2 = 2t$

$t_{\text{min}}$ when $m = 0$

$t_{\text{min}} = \frac{1}{4} \lambda_2 = \frac{1}{4} \frac{650}{1.85} = 74.3$ nm

b) $m = 1$

$t = \frac{3}{4} \lambda_2 = 223$ nm.

35.34 $n_1 = 1$

$n_2 = 1.35$

$n_3 = 1$

a) # waves = \( \frac{\lambda_2}{\lambda_3} = \frac{648 \times 10^{-9}}{228 \times 10^{-9}} = 2.9 \)

b) $\frac{1}{2} \lambda$ from # of waves + $\frac{1}{2} \lambda$ for reflection $\Rightarrow 0$ phase shift.
For destructive interference \( m\lambda_2 = 2t \)

\[
t_{\text{min}} = \frac{1}{2} k_2 = \frac{1}{2} \frac{486}{1.33} = 180.5 \text{ nm}
\]
1. Two identical microscopic slides in air illuminated with light from a laser are creating an interference pattern. The space between the slides is now filled with water (n=1.33). What happens to the interference fringes?
   [A] They are spaced farther apart.
   [B] They are spaced closer together.
   [C] There is no change.
   [D] Not enough information is provided to give an answer.

\[ \lambda \text{ shorter } \Rightarrow 2\ell = (m+\frac{1}{2})\lambda \]
\[ d = \Delta n \tan \theta \quad \text{and} \quad \Delta t = \frac{\lambda}{2} \]
\[ \Rightarrow \frac{\lambda}{2} = d \times \tan \theta \Rightarrow \lambda \text{ shorter } \Delta \times \text{shorter} \]

2. A thin film of transparent material (n_f = 1.45) is placed on a silicon solar cell (n_s = 3.50) in order to minimize reflection losses. The cell is illuminated from above by normally incident sunlight.

(a) Does the light reflected from the top surface of the film undergo a phase change upon reflection? Yes

(b) Does the light reflected from the bottom surface of the film undergo a phase change upon reflection? Yes

(c) What is the minimum thickness of the film that results in minimizing the reflection of 550 nm light?

Destructive interference when

\[ 2\ell = (m+\frac{1}{2})\frac{\lambda}{n_f} \]
\[ \ell = (m+\frac{1}{2})\frac{\lambda}{2n_f} \]
\[ t_{\min} (m=0) = \frac{\lambda}{4n_f} = \frac{550}{4(1.45)} \]
\[ t_{\min} = 94.8 \text{ nm} \]