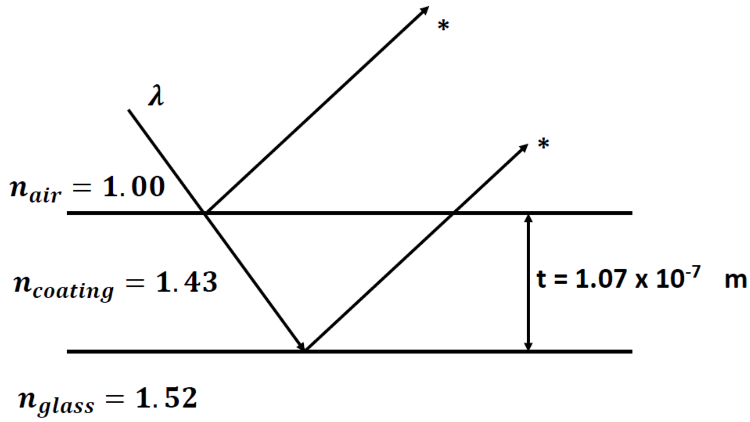
8. A transparent film (n = 1.43) is deposited on a glass plate (n = 1.52) to form a nonreflecting coating. The film has a thickness that is 1.07 x 10^{-7} m. What is the longest possible wavelength (in vacuum) of light for which this film has been designed?



$$\textit{Total Phase Diff} = \textit{Optical Path Diff} + \textit{Phase Shifts} = \left(m + \frac{1}{2}\right)\lambda$$

This is for destructive interference which is what a non-reflecting coating would need.

Since both rays are phase shifted due to going from lower n reflecting from higher n, the two phase shifts cancel. So the only phase difference is the optical path difference.

$$2n_{coating}t = \left(m + \frac{1}{2}\right)\lambda$$

Solve for the wavelength

$$\lambda = \frac{2n_{coating}t}{\left(m + \frac{1}{2}\right)}$$

To get the longest wavelength, we need the smallest denominator. To get the smallest denominator, we make m the smallest it can be which would be zero.

$$\lambda = \frac{2n_{coating}t}{\left(m + \frac{1}{2}\right)} = \frac{2n_{coating}t}{\left(0 + \frac{1}{2}\right)} = 4n_{coating}t = 4(1.43)(1.07\ x\ 10^{-7}\ m) = 6.12\ x\ 10^{-7}\ m$$

$$\boxed{\lambda = 6.12\ x\ 10^{-7}\ m = 612\ nm}$$

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