

Answer on Question #74821, Physics / Optics

Question. A thin film of glass of refractive index 1.5 is inserted in one arm of Michelson Interferometer. Calculate the thickness of the film if a shift of 10 fringes is observed. The wavelength of the light used is 589 nm.

Given. $n = 1.5$; $n_0 = 1$; $k = 10$; $\lambda = 589 \text{ nm}$.

Find. $l - ?$

Solution.

For Michelson Interferometer

without the film

$$\Delta_1 = 2dn_0 - 2tn_0 = m_1\lambda$$

with the film

$$\Delta_2 = 2ln + 2(d - l)n_0 - 2tn_0 = m_2\lambda$$

d, t – Michelson Interferometer arms lengths.

So,

$$\Delta = \Delta_2 - \Delta_1 = 2ln + 2(d - l)n_0 - 2tn_0 - 2dn_0 + 2tn_0 = (m_2 - m_1)\lambda$$

$$\Delta = 2ln + 2dn_0 - 2ln_0 - 2tn_0 - 2dn_0 + 2tn_0 = (m_2 - m_1)\lambda$$

$$\Delta = 2ln - 2ln_0 = k\lambda \rightarrow l = \frac{k\lambda}{2(n - n_0)} = \frac{10 \cdot 589 \cdot 10^{-9}}{2(1.5 - 1)} = 589 \cdot 10^{-8} \text{ m} = 5.89 \mu\text{m}$$

Answer. $l = 5.89 \mu\text{m}$.

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