**22.65. Model:** The number of wavelengths in one arm of the interferometer increases as the refractive index of the electro-optic crystal increases. Each bright-dark-bright fringe shift corresponds to an additional path-difference increase of one wavelength. A path-difference of one-half wavelength thus will cause the bright fringe to shift to a dark fringe.

**Visualize:** Please refer to the interferometer in Figure 22.20.

**Solve:** We will follow the treatment of Section 22.6 in the textbook. For an initial index of refraction $n$ of the electro-optic crystal, the number of wavelengths inside the crystal is (including motion in both directions)

$$m_1 = \frac{2d}{\lambda_{\text{vac}}/n}$$

Similarly, the number of wavelengths inside the crystal when its refractive index increases to $n'$ is

$$m_2 = \frac{2d}{\lambda_{\text{vac}}/n'}$$

The increase in the number of wavelengths due to a change in refractive index from $n$ to $n'$ is

$$\Delta m = m_2 - m_1 = \frac{2d}{\lambda_{\text{vac}}}(n' - n)$$

Because the external voltage causes a bright fringe to shift to a dark one, $\Delta m = \frac{1}{2}$. Thus,

$$\frac{1}{2} = \frac{2d}{\lambda_{\text{vac}}}(n' - n) \Rightarrow n' = n + \frac{\lambda_{\text{vac}}}{4d} = n + \frac{0.981 \times 10^{-6}\ \text{m}}{4(0.100 \times 10^{-3}\ \text{m})} \Rightarrow \Delta n = n' - n = 0.0025$$

Thus, $n' = 1.5500 + 0.0025 = 1.5525$.