L2 # DIGITAL LIGHT BEAM DEFLECTOR WITH LIQUID CRYSTALS L2

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In this letter, we report a new method for optical switching based on the electro-optical properties of liquid crystal materials and, in particular, of the nematic type. The basis of this new method is the use of twisted wedge structure that has not been reported before elsewhere. In the past several years, great efforts in integrated optics have been made to develop optical switching devices with fast speed by using electro-optic, acousto-optic or magneto-optic materials. A mechanically operated optical switch made of grade-index rod lenses and electromagnets has been proposed too . Switches of this kind include one input and two output waveguides and, depending on the applied voltage, one incident light on the switch exits either in one or another of the two output waveguides.

Our contribution consists in two facts:

a) to use a nematic liquid crystal as the anisotropic media.

b) to use a rather special structure which is a wedge where the orientation of the nematic liquid crystal is the twisted one.

This scheme is in Fig. 1, where the laser radiation coming from the left, is polarized along the z direction. The long axis of the molecules in the first electrode is along the z direction too. At the second electrode they are along the x direction.

The ray after crossing the wedge, will be split as ordinary or extraordinary ray ; depending on the applied voltage, forming angles α_o or α_e with the y direction, whose values are:

$$\alpha_o = \sin^{-1}\left(n_o \sin\alpha\right) - \alpha$$
$$\alpha_e = \sin^{-1}\left(n_o \sin\left(\frac{n_e}{n_o}\alpha\right)\right) - \alpha$$

(n_o and n_e are the ordinary and extraordinary refraction index) and so the angle difference is given by:

$$\Delta\alpha = \sin^{-1}\left(n_o \sin\left(\frac{n_e}{n_o}\alpha\right)\right) - \sin^{-1}\left(n_o \sin\alpha\right)$$

that for small values of α (wedge angle), which is our case, becomes:

$$\Delta\alpha \simeq \alpha\left(n_e - n_o\right) = \alpha\,\Delta n$$

If the observation plane is at a distance d away from the cell, the linear separation between both rays will be:

$$\Delta z \simeq \alpha d \Delta n$$

The nematic liquid crystal used has been MBBA+PEBAB whose dielectric anisotropy is positive. A plot of the cell transmitance versusapplied voltage is shown in Fig.2. At 0 volts line A corresponds to the extraordinary ray, while line B corresponds to the ordinary ray. The maximum frecuency response achieved by us with this structure has been 12.5 Khz.

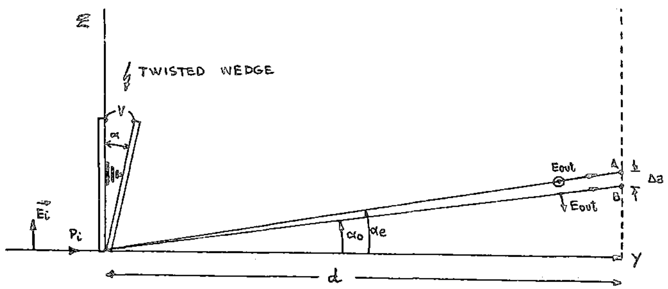

Fig. 1

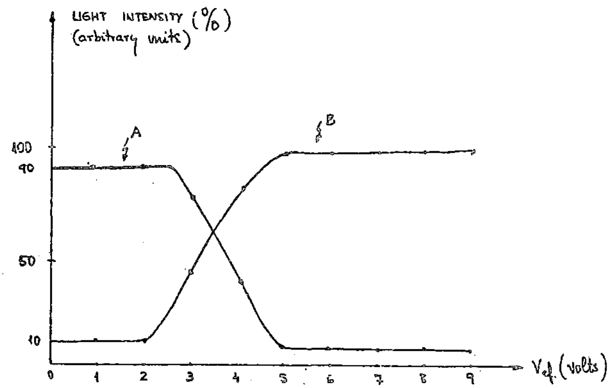

Fig. 2