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Fast transient response of light deflectors based on periodically poled $LiNbO_3$

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Recently, integrated-optical elements, such as lenses, prisms, and gratings, have been demonstrated by domain-inversion in thin Lithium Niobate wafers and by applying a homogeneous electric field between the planar surface electrodes, see e.g. [1]. However, to the best of our knowledge, so far only the static response of these electro-optic (EO) devices has been characterized. We report on the transient response of a light deflector based on a poled grating in $LiNbO_3$.

Z-cut Lithium Niobate wafers of thickness $d = 300$ µm have been periodically poled via an applied electric field yielding gratings, with $L = 20$ mm and $\Lambda = 40$ µm, which are uniform along *y*-axis, Fig. 1. In order to facilitate fast switching the capacitance of the device has been minimized to $C \sim 10$ pF by evaporating a top strip electrode of width $w = 300$ µm and a planar bottom electrode. To obviate the need for impedance matching the pulse amplifier is positioned in close vicinity to the EO device. For the optical experiment a circular Gaussian beam of $\lambda = 0.633$ µm, free space Rayleigh range of $z_R \sim 25$ mm, which is linearly polarized along the *z*-axis, is propagating through the crystal parallel to the strip electrode. Electrical pulses of ~ 35 V and 100 nsec duration are applied between the electrodes and the 1st order diffraction efficiency is monitored, see Fig. (2). For this driving voltage a diffraction efficiency of more than 80 % has been achieved. The fall times for both the electrical driving pulse and the optical response are ~ 5 nsec and no effects due to excitation of spurious acoustic waves was observed. Such effects are known to limit the performance of electro-optic modulators generally [2] and we believe that acoustic damping produced by the thin bonding layer of gallium between the wafer and circuit board is responsible. This performance represents considerable improvement on current commercially available switches based on acousto-optic techniques, and by improving the driver circuit we expect to reduce the rise and fall times to the order of 1 ns or less.

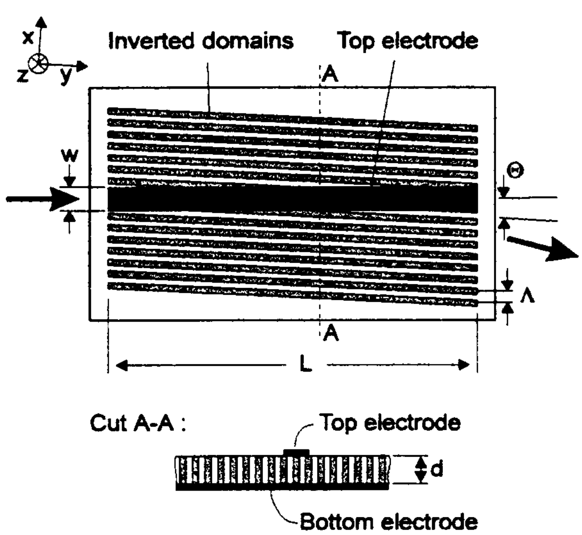

Fig. 1: Arrangement of light deflector

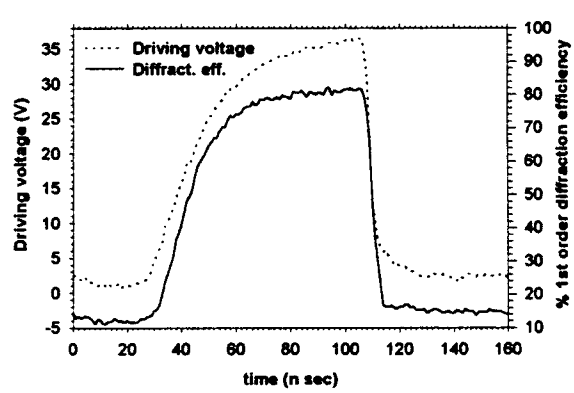

Fig. 2 : Time response of driving voltage and 1st order diffraction efficiency

References :
[1] M. Yamada et al, Appl. Phys. Lett. **69**, 3659 (1996).
[2] P. Basseras et al, J. Appl. Phys. **69**, 7774 (1991).