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Electro-optic solid state beam deflection: Resolution considerations and 2-D implementation

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A simpler, alternative to 'prism type' electro-optic (EO) solid state deflectors[1] has been recently demonstrated[2]. This device[2] is essentially a single interface version of a conventional deflector, but significant deflection is achieved by setting the input beam at grazing incidence to the interface (where, additionally, it can act as an EO switch). The increased deflection seen near TIR is, however, made at the expense of increased divergence of the output beam. Overall deflection can be a misleading quantity to determine the performance of a deflector as this could always be increased with suitable lenses. A more reliable figure of merit is the number of separate resolvable spots that can be imaged from the deflector output. Here we analyze the achievable resolution for a single interface deflector. It can be seen that with a suitably sized device, significant resolution can be attained from a single interface deflector as shown in Fig. 1. The resolution is shown here as a function of temperature since if the deflector were to be working at visible wavelengths if would necessarily be heated to avoid photo-refractive effects. Additionally heating has a secondary role in increasing resolution due to the intrinsic n_e^3 term in the EO equation. Although there are still issues to overcome in terms of the output beam quality of a single interface deflector, it does possess one major advantage over the previous, multiple interface deflectors. Due to its simplicity it can be fashioned to function in 2 dimensions (Fig. 2). This would be the first ever report to our knowledge of a 2D EO solid state beam deflector.

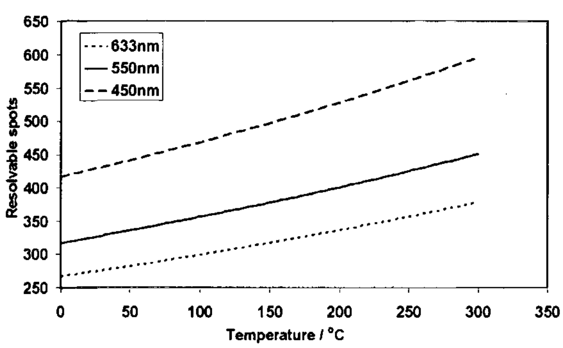

Figure 1: **Resolution of deflector as a function of temperature at three different wavelengths. In this case the device length is 50mm and the Maximum applied field is ~3330V/mm**

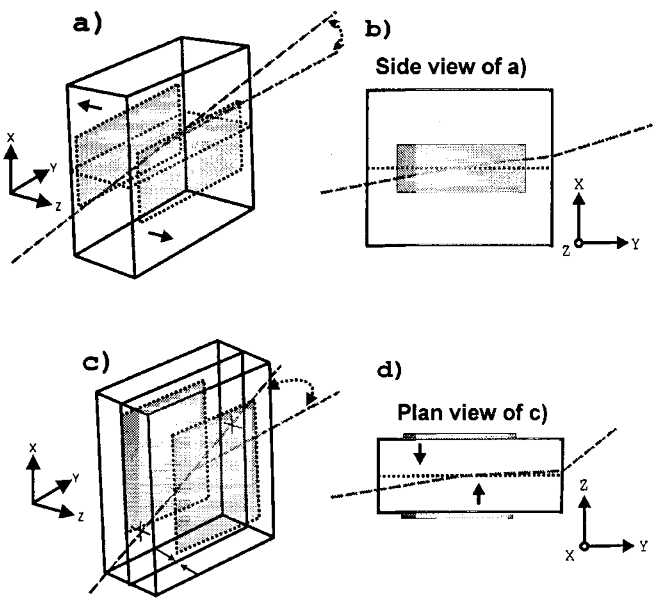

Figure 2: **Components of a 2D deflector, shaded areas represent electrodes**

The first part of the deflector (Fig.2 a & b) is as described in ref [2]. The second section of the deflector (Fig.2 c & d) consists of 2 single-domain, lithium niobate wafers that are directly bonded together with the domain directions of each crystal opposite to each other and normal to the interface. This allows for a much larger interface over which the laser beam can move (deflected by the previous deflector) without changing its angle with respect to the second interface normal.

These two deflectors can be combined into one single device to achieve 2D deflections. We will report on the performance of this device and its resolution in both planes.

1. D. A. Scrymgeour, Y. Barad, V. Gopalan, K. T. Gahagan, Q. X. Jia, T. E. Mitchell, and J. M. Robinson, Applied Optics **40**(34), 6236-6241, (2001)
2. R. W. Eason, A. J. Boyland, S. Mailis, J. M. Hendricks and P. G. R. Smith, Opt. Commun. **197**, 201-207, (2001)