Internal electric field measurements in cadmium zinc telluride (CZT) using transmission two-modulator generalized ellipsometry (2-MGE)

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The two-modulator generalized ellipsometer (2-MGE) has been configured in the transmission mode (Jellison, et. al. *Appl. Opt* submitted for publication; *Appl. Phys. Lett.*, accepted for publication), where it can completely characterize a linear retarder and diattenuator, measuring the retardation δ, the direction of the principal axis ϕ, the diattenuation N, and the polarization factor β. Utilizing a lens mounted on an x-y translation stage, one can sequentially "map" a sample in all the measured parameters δ, ϕ, N, and β. If the sample under test is a properly oriented, transparent material with a non-zero linear electro-optic (Pockels) coefficient, then the retardation is given by $\delta \sim 2\pi drE/\lambda$, where d is the thickness of the sample, r is the Pockels coefficient, E is the electric field, and λ is the wavelength of light. The 2-MGE technique is contrasted to the linear polarizer technique of Yao and coworkers [SPIE **3768**, 330 (1999).], where the 2-MGE yields considerably more information.

Figure 1 shows several x-y maps taken at a bias of ±400 Volts. At the positive voltage, retardation is observed near the applied voltage contact, while a negative voltage results in enhanced retardation near the ground contact. These experiments show conclusively that the electric field does not penetrate the entire CZT crystal, but rather is limited by internal charge rearrangement in the top ~200 microns of the sample.

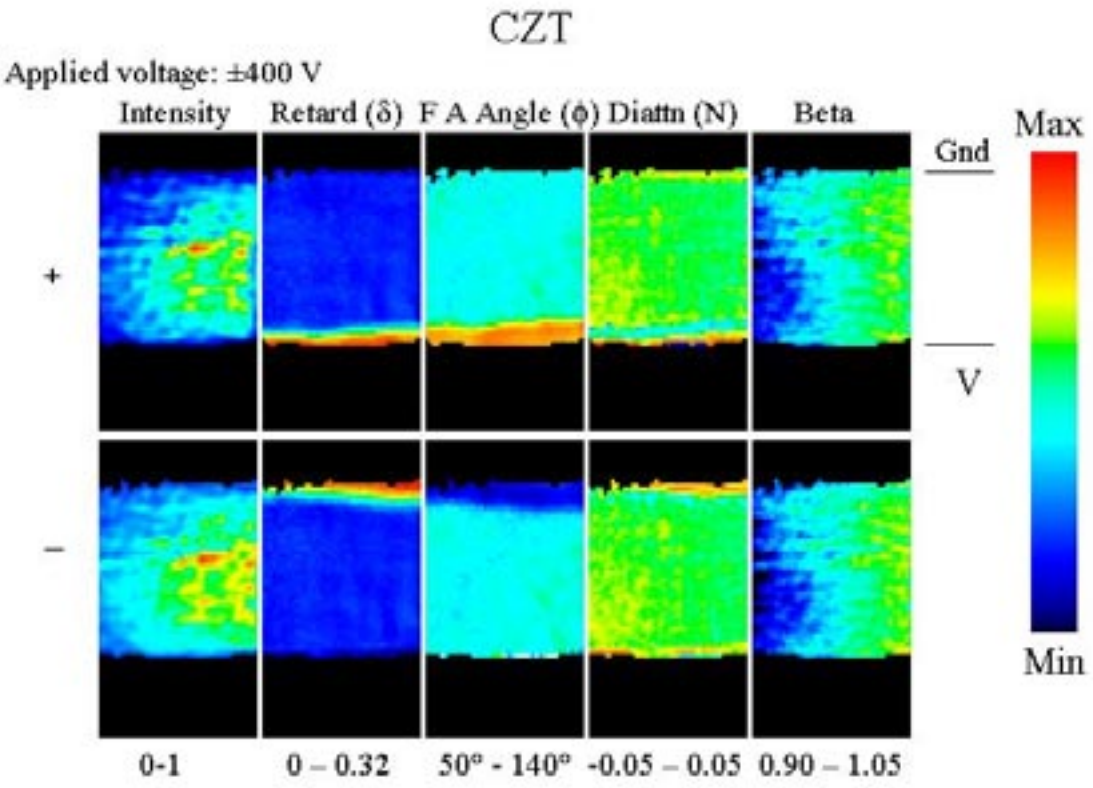

Figure 1: X-Y maps of a CZT sample under bias determined using the 2-MGE. The top set of maps was taken at +400 Volts, while the bottom set of maps was taken at –400V. The numbers at the bottom of the figures indicate the minimum and maximum ranges of the color scale, shown at the right