



AFRL-ML-WP-TP-2007-499

**HYBRIDIZED PHOTOVOLTAIC LIQUID CRYSTAL
CELLS AND LIGHT VALVES (PREPRINT)**

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**Hardened Materials Branch
Survivability and Sensor Materials Division**

JANUARY 2006

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Hybridized Photovoltaic Liquid Crystal Cells and Light Valves



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Outline



- Motivation
- Nonholographic Hybrid PV Cells
- Nonholographic Hybrid PV Light Valves
- Conclusions

Motivation

**To develop a self-activated LC cell
using the photovoltaic effect from
photorefractive substrates**

**Nonholographic Hybrid PV Cells
One Photorefractive Substrate**

Field from one $\text{LiNbO}_3:\text{Fe}$ substrate
activates LC

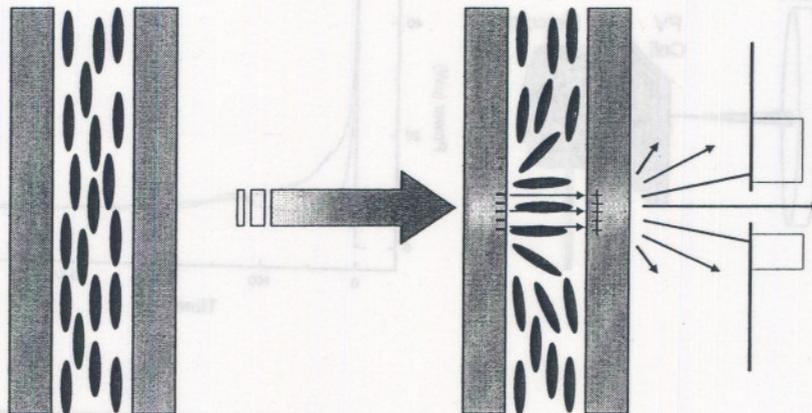
Very sensitive to focal position



Nonholographic Hybrid PV Cells Two Photorefractive Substrates



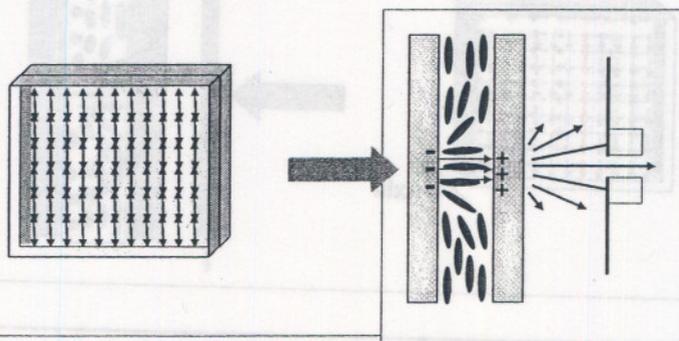
Field between two $\text{LiNbO}_3:\text{Fe}$ substrates
activates LC



Nonholographic Hybrid PV Cells Two Photorefractive Substrates

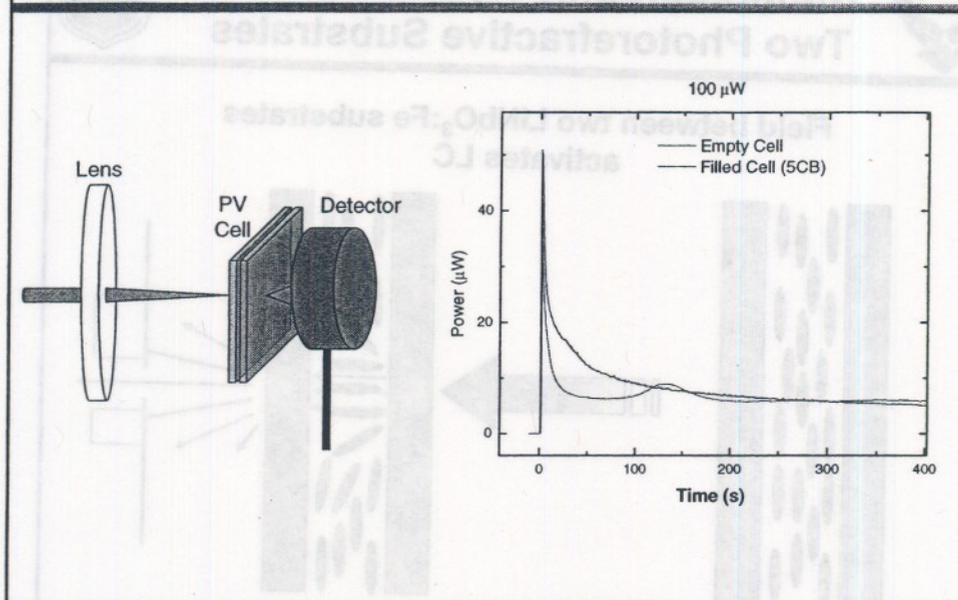


Substrates
0.05% $\text{LiNbO}_3:\text{Fe}$
25 x 25 x 1 mm
 $\alpha_{532} \approx 1.53 \text{ cm}^{-1}$





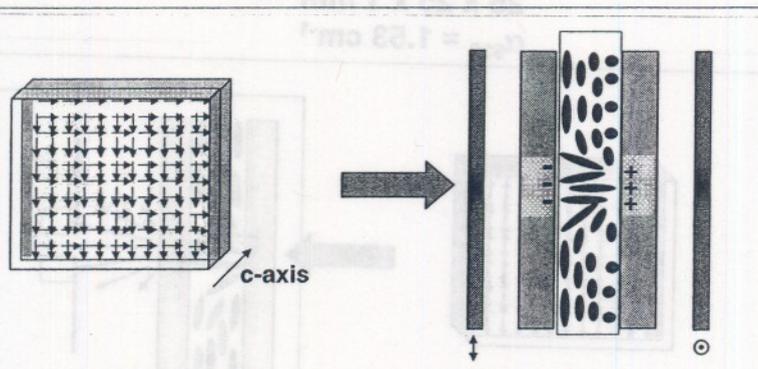
Nonholographic Hybrid PV Cells Two Photorefractive Substrates



Nonholographic Hybrid PV Light Valves Twisted Nematics

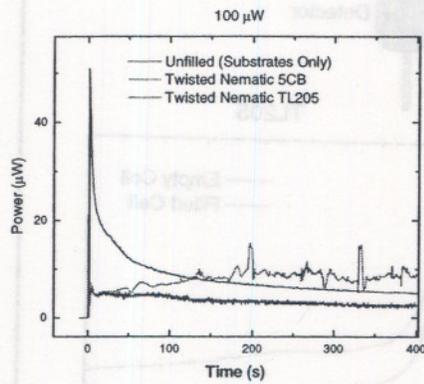


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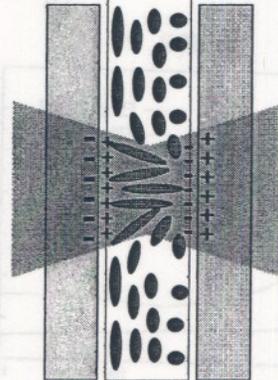




Nonholographic Hybrid PV Light Valves Twisted Nematics



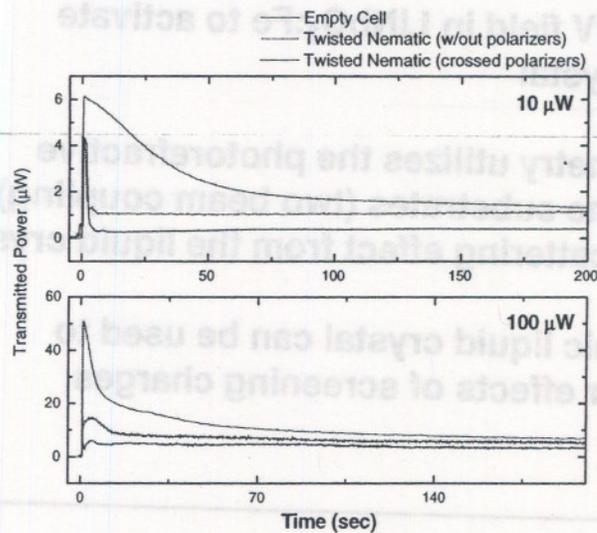
Screening Charges

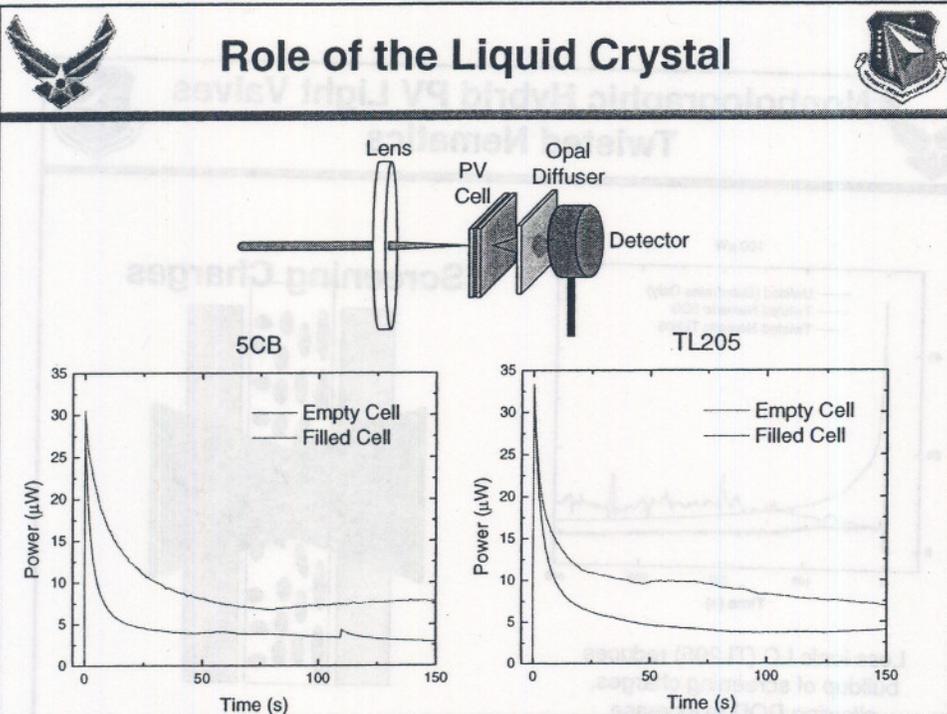


Less ionic LC (TL205) reduces
buildup of screening charges,
allowing DOD to increase



Nonholographic Hybrid PV Light Valves Twisted Nematics





- ## Conclusions
- Can use PV field in $\text{LiNbO}_3:\text{Fe}$ to activate a liquid crystal
 - This geometry utilizes the photorefractive effect in the substrates (two beam coupling) and the scattering effect from the liquid crystal
 - A less ionic liquid crystal can be used to correct for effects of screening charges