

**Electro-optical Properties of Ultra Thin Organic films**

Ping Yang Hodges

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APPROVED:

Ravi F. Saraf, Chair

David F. Cox

William B. Spillman, Jr.

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### ABSTRACT

Electro-optical properties of thin film are of great interest owing to the perpetual demand for miniaturization and higher speed devices for communication, electronic, and biomedical applications. The thickness of polymer films developed for these applications has decreased dramatically making interfacial effects significant. It is well documented that, in submicron thickness range, both film/substrate & film/air interface are critical. In this study, we probe the dynamics of electro-optical polymer thin films in the sub-micron thickness regime to understand interfacial effects. The polymer chain dynamics of Polypropylene oxide (PPO) under electric field are investigated in this study. The effects of electric field strength, frequency, and polymer molecular weight on the polymer chain dynamics under electric field are studied. Experimental results show that PPO exhibits both piezoelectric and electrorestrictive effects at significantly high frequencies ( $10^1$  kHz range). Conventional organic materials are responsive only at frequencies in  $<1$  kHz range. A high signal-to-noise ratio differential interferometry is designed to quantitatively study the effects of film thickness, electric field frequency and amplitude on the dynamic properties of PPO thin films ranging from 30 nm to 400 nm. The interferometer can concurrently monitor the index of refraction, thickness change of polymer films, and birefringence due to the applied electrical field.

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