

AD-A266 562

DOCUMENTATION PAGE

Form Approved

OMB No. 0704-0188



Information is estimated to average 10 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and completing the information requested, and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this form, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

blank)

2. REPORT DATE

June 8, 1993

3. REPORT TYPE AND DATES COVERED

Final 1 Apr 90 - 31 Mar 93

4. TITLE AND SUBTITLE

Poling of thin polymer films in electro optic applications

5. FUNDING NUMBERS

DAA403-90-G-0081

6. AUTHOR(S)

Gerald G. Fuller

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

Stanford University
Department of Chemical Engineering
Stanford, CA 94305-5025

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING MONITORING AGENCY NAME(S) AND ADDRESS(ES)

U.S. Army Research Office
P.O. Box 12211
Research Triangle Park, NC 27709-2211

10. SPONSORING MONITORING AGENCY REPORT NUMBER

ARO 26883.2-M5

11. SUPPLEMENTARY NOTES

The views, opinions and/or findings contained in this report are those of the author(s) and should not be construed as an official Department of the Army position, policy, or decision, unless so designated by other documentation.

12a. DISTRIBUTION AVAILABILITY STATEMENT

Approved for public release; distribution unlimited

12b. DISTRIBUTION CODE

93-15717



13. ABSTRACT (Maximum 200 words)

Many polymeric glasses must be orientationally ordered for the materials to exhibit useful characteristics. The objective of this work was to understand the dynamics of the orientation and relaxation processes and to relate these behaviors to the structural characteristics of the polymeric material. In this study we considered materials suitable for nonlinear optical applications. In particular, thin polymer films, either doped with nonlinear optical chromophores or films with the chromophores covalently bonded to side groups were studied. Orientation of these chromophores was achieved by the birefringence resulting from chromophore concentration, spacer length, and molecular dominant factor determining the steady state and transient behaviors. The relationship between monomer and polymer structure and the resulting effect on the orientation dynamics is discussed. Qualitative agreement with theoretical predictions was obtained for the simpler guest/host system, but the model was shown to be inadequate to explain the behaviors of the more complex systems studied. The results reported here have provided valuable insight into the molecular processes that occur during the chromophore orientation and relaxation, and the effects of structural characteristics of the polymers on these mechanisms.

14. SUBJECT TERMS

15. NUMBER OF PAGES

1

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT

UNCLASSIFIED

18. SECURITY CLASSIFICATION OF THIS PAGE

UNCLASSIFIED

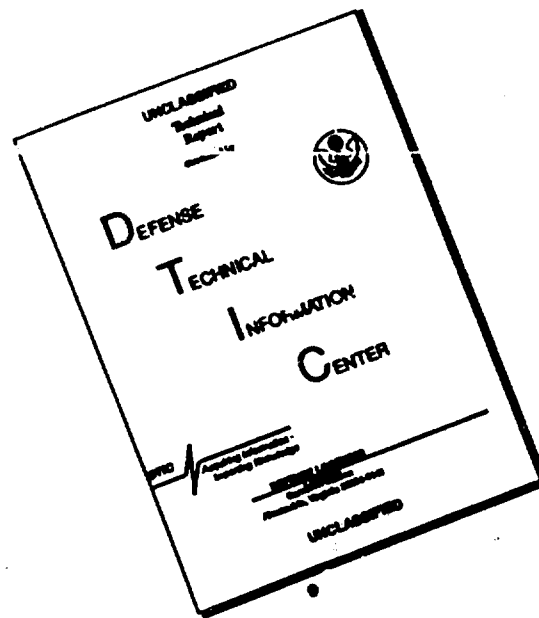
19. SECURITY CLASSIFICATION OF ABSTRACT

UNCLASSIFIED

20. LIMITATION OF ABSTRACT

UL

DISCLAIMER NOTICE



THIS DOCUMENT IS BEST QUALITY AVAILABLE. THE COPY FURNISHED TO DTIC CONTAINED A SIGNIFICANT NUMBER OF PAGES WHICH DO NOT REPRODUCE LEGIBLY.

FINAL REPORT

ARO Proposal Number 26883-MS

Contract Number: DAAL03-90-G-0081

Poling of Thin Polymer Films in Electro Optic Applications
Gerald G. Fuller, Stanford University

Many polymeric glasses must be orientationally ordered for the materials to exhibit useful characteristics. The objective of this work was to understand the dynamics of the orientation and relaxation processes and to relate these behaviors to the structural characteristics of the polymeric material. In this study we considered materials suitable for nonlinear optical applications. In particular, thin polymer films, either doped with nonlinear optical chromophores or films with the chromophores covalently bonded to side groups were studied. Orientation of these chromophores was achieved by the birefringence resulting from chromophore concentration, spacer length, and molecular dominant factor determining the steady state and transient behaviors. The relationship between monomer and polymer structure and the resulting effect on the orientation dynamics is discussed. Qualitative agreement with theoretical predictions was obtained for the simpler guest/host system, but the model was shown to be inadequate to explain the behaviors of the more complex systems studied. The results reported here have provided valuable insight into the molecular processes that occur during the chromophore orientation and relaxation, and the effects of structural characteristics of the polymers on these mechanisms.

In addition to orientation of thin polymer films by electric field poling, research was commenced on the problem of flow field orientation of polymer monolayers during Langmuir-Blodgett deposition. In this work, a stagnation point extensional flow was created by simultaneously immersing two identical glass substrates into a Langmuir trough supporting a monolayer of "hairy" rod-like macromolecules. The materials that were studied were polyglutamates with alkyl side chains distributed along the backbone. It was observed that very well characterized, homogeneous extensional flows could be generated between the two substrates as evidenced by tracking the trajectories of tracer particles residing on top of the polymer film. Consequently, very high degrees of planar polymer orientations could be achieved, which could potentially yield products with large nonlinear optical properties. Presently, optical probe experiments combining Brewster angle microscopy and polarimetry are being used to provide *real time, in situ* measurements of the orientational dynamics of the macromolecules contained within the thin polymer film.

MANUSCRIPTS PUBLISHED:

C.L. Hoffman (Valencia), H.-T. Man and G.G. Fuller, "Orientation Dynamics of Side Chain Polymers Subject to Electric Fields. Part I. Steady State", *Acta Polymer*, **44**, 39-49 (1993).

MANUSCRIPT IN PREPARATION:

C.L. Hoffman (Valencia), H.-T. Man and G.G. Fuller, "Orientation Dynamics of Side Chain Polymers Subject to Electric Fields. Part II. Transient Responses".

SCIENTIFIC PERSONNEL SUPPORTED BY THIS PROJECT AND DEGREES AWARDED:

Catherine Valencia - Ph.D. 1992
Jan van Egmond - Ph.D. expected July 1993
Jeffrey Zawada - Ph.D. expected July 1993
Eleanor L. Meyer

Dist	Special
A-1	

**END
FILMED**

DATE:

6-93

DTIC