

13:14:03

OCA PAD INITIATION - PROJECT HEADER INFORMATION

11/07/88

Project #: E-27-636
Center # : R6616-0A0

Cost share #:
Center shr #:

Rev #: 0
OCA file #:
Work type : RES
Document : SUBCONT
Contract entity: GTRC

Contract#: SUBCONT DTD 880926
Prime #: N00014-88-K-0535

Mod #:

Subprojects ? : N
Main project #:

Project unit:
Project director(s):
POLK M B

TE
TE

Unit code: 02.010.130
(404)894-2535

Sponsor/division names: ATLANTA UNIV CENTER
Sponsor/division codes: 400

/ ATLANTA, GA
/ 007

Award period: 880701 to 890630 (performance) 890830 (reports)

Sponsor amount	New this change	Total to date
Contract value	40,000.00	40,000.00
Funded	40,000.00	40,000.00
Cost sharing amount:		0.00

Does subcontracting plan apply?: N

Title: STUDIES OF LIQUID CRYSTALLINE & PRECERAMIC POLYMERS

PROJECT ADMINISTRATION DATA

OCA contact: Ina R. Lashley

894-4820

Sponsor technical contact

Sponsor issuing office

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Security class (U,C,S,TS) : U
Defense priority rating : N/A
Equipment title vests with: Sponsor
NONE PROPOSED.

ONR resident rep. is ACO (Y/N) ☐ Y ☐ N
N/A supplemental sheet
GIT

Administrative comments -

INITIATION OF A COST-REIMBURSEMENT SUBCONTRACT UNDER A NAVY PRIME SFRC. NO
SUBCONTRACTS ARE AUTHORIZED (P.2). GENERAL PROVISIONS OF THE PRIME PREVAIL.



GEORGIA INSTITUTE OF TECHNOLOGY
OFFICE OF CONTRACT ADMINISTRATION

NOTICE OF PROJECT CLOSEOUT

Closeout Notice Date 02/21/91

Project No. E-27-636 _____ Center No. R6616-OA0 _____
Project Director POLK M B _____ School/Lab TEXT ENGR _____
Sponsor ATLANTA UNIVERSITY/ATLANTA, GA _____
Contract/Grant No. SUBCONT DTD 880926 _____ Contract Entity GTRC
Prime Contract No. N00014-88-K-0535 _____
Title STUDIES OF LIQUID CRYSTALLINE & PRECERAMIC POLYMERS _____
Effective Completion Date 890630 (Performance) 890830 (Reports)

Closeout Actions Required:	Y/N	Date Submitted
Final Invoice or Copy of Final Invoice	Y	_____
Final Report of Inventions and/or Subcontracts	Y	_____
Government Property Inventory & Related Certificate	Y	_____
Classified Material Certificate	N	_____
Release and Assignment	Y	_____
Other _____	N	_____
Comments _____		

Subproject Under Main Project No. _____

Continues Project No. _____

Distribution Required:

Project Director	Y
Administrative Network Representative	Y
GTRI Accounting/Grants and Contracts	Y
Procurement/Supply Services	Y
Research Property Management	Y
Research Security Services	N
Reports Coordinator (OCA)	Y
GTRC	Y
Project File	Y
Other _____	N
_____	N

NOTE: Final Patent Questionnaire sent to PDPI.

OFFICE OF NAVAL RESEARCH
END-OF-THE-YEAR REPORT
PUBLICATIONS/PATENTS/PRESENTATIONS/HONORS/STUDENTS REPORT

for

Grant or Contract N0001488 K0535

R & T Code 4135023---01

Title of Grant or contract

Studies of Liquid Crystalline and Preceramic Polymers

Name(s) of Principal Investigators

Dr. Yitbarek Mariam
Dr. Malcolm Polk

Name of Organization

Georgia Institute of Technology

Address of Organization

School of Textile Engineering
Atlanta, Georgia 30332

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Part I

a. Papers Submitted to Refereed Journals

Nandu, M. and Polk, M. B. "Thermotropic Copolyesters. IV. Synthesis and Characterization of Liquid Crystal Copolyesters Containing the Bicyclo[2.2.2]Octane Ring System". Submitted to the Journal of Polymer Science, Polymer Chemistry Edition.

Harruna, I. and Polk, M. B. "Thermotropic Copolyesters.3. Synthesis and Characterization of Liquid Crystal Copolyesters Containing the Bicyclo[2.2.2]Octane Mesogenic Unit". Submitted to the Journal of Polymer Science, Polymer Chemistry Edition.

Harruna, I. and Polk, M. B. "Thermotropic Copolyesters1. Synthesis and Characterization of Homopolyesters Containing the Mesogenic Unit, Bicyclo[2.2.2]Oct-2-ene. Accepted by the Journal of Polymer Science, Polymer Chemistry Edition.

Venkatasubramanian, N., Lavala, D., Balakrishnan, P., Polk, M. B., and Banks, H. D., "Cycloadditions of 1,4-Bis-Trimethylsiloxy-1,3-Cyclohexadiene". Accepted by Synthetic Communications.

b. Papers Published in Refereed Journals

Lenz, R. W., Rao, A. K., Bhattacharya, S., Polk, M. B., and Venkatasubramanian, N., "Properties of a Liquid Crystalline Polyester With a Mesogen Containing the Bicyclooctylene Ring", Liquid Crystals, 4 (3), 317-323 (1989). Other support N00014-84-K-0308 for R.W.L.

Balakrishnan, P., Harruna, I. I., and Polk, M. B., "Two-Dimensional NMR and Proton Spin-Lattice Relaxation Studies of Thermotropic Homopolyesters Containing a Bicyclo[2.2.2]Oct-2-ene Ring System", Macromolecules, 21, 1538-1541 (1988).

Harruna, I. I. and Polk, M. B., "Thermotropic Copolyesters.2. Synthesis and Characterization of Copolyesters Containing the Bicyclo[2.2.2]Oct-2-ene Mesogenic Unit", Journal of Polymer Science, Polymer Chemistry Edition, 26, 2171-2182 (1988).

Polk, M. B., Banks, H. D., Onwumere, F., Venkatasubramanian, N., Nandu, M. and Phinbodhipakkiya, M., "Thermotropic Copolyesters III. Synthesis and Characterization of Liquid Crystal Copolyesters Containing the Bicyclo[2.2.2]Octane Ring System", Journal of Polymer Science, Polymer Chemistry Edition, 26, 2405-2422 (1988).

k. Ms. Agnes Thuo of Atlanta University is the only graduate student receiving support on the ONR grant.

Part II

- a. Principal Investigator: Malcolm B. Polk
- b. ONR Scientific Officer: Harold E. Guard
- c. (404) 894-2535 or (404) 894-2490
- d. Our objectives were to prepare random and alternating liquid crystal copolyesters which contain the p-phenylenedimethylene spacer. It was thought that the relatively stiff nature of the p-phenylenedimethylene spacer would lead to readily processible fibers with relatively high levels of mechanical properties. Therefore we proposed to produce fibers and/or films of the resulting polymers and determine the mechanical properties (including tensile strength and modulus) and the thermal properties (including DSC and TGA).

Furthermore we proposed to study the effect of the helical nature of cholesteric polymers on the mechanical properties of polymer films by preparing poly [oxy-2-(2-hydroxyethyl)-1,4-phenyleneoxyterephthaloyl]. We proposed to compression mold films of the polymer and determine the biaxial mechanical properties (including tensile strength and modulus) of the resulting films.

e. We have prepared the following polymers: random poly[oxy(2-methyl-1,4-phenylene)oxyterephthaloyl-co-oxy(2-methyl-1,4-phenylene)oxy-1,4-phenylenediacetoyl]I; alternating poly[oxy(2-chloro-1,4-phenylene)oxyterephthaloyl-alt-oxy(2-chloro-1,4-phenylene)oxy-1,4-phenylenediacetoyl]IIA; random poly[oxy(2-chloro-1,4-phenylene)oxyterephthaloyl-co-oxy(2-chloro-1,4-phenylene)oxy-1,4-phenylene diacetoyl]IIB; random poly [oxy(2-phenyl-1,4-phenylene)oxyterephthaloyl-co-oxy(2-phenyl-1,4-phenylene)oxy-1,4-phenylenediacetoyl]III; and poly[oxy(2-acetyl-1,4-phenylene)oxyterephthaloyl]IV. The routine characterization of the polymers included infrared spectroscopy, nuclear magnetic resonance spectroscopy, viscometry, differential scanning calorimetry, and polarizing optical microscopy. Polarizing optical microscopy studies showed that polymers I, IIA, IIB and IV formed birefringent fluid states in the melt.

f. Because the microtensile test results were disappointing for polymer IIA fibers, we have chosen to use the acidolysis polymerization technique to prepare high molecular weight random copolymer IIB for microtensile testing. We have prepared and purified the acetylated chlorohydroquinone monomer and completed one synthetic run on the corresponding mixture of terephthalic acid and 1,4-phenylenediacetic acid.

We have prepared poly[oxy-2-acetyl-1,4-phenylene)oxyterephthaloyl]IV and we are currently developing procedures for converting this starting material to poly[oxy-2-(2-hydroxyethyl)-1,4-phenyleneoxyterephthaloyl] by asymmetric reduction. After preparing the optically active polyester, we plan

to prepare films by compression molding for biaxial mechanical property tests.

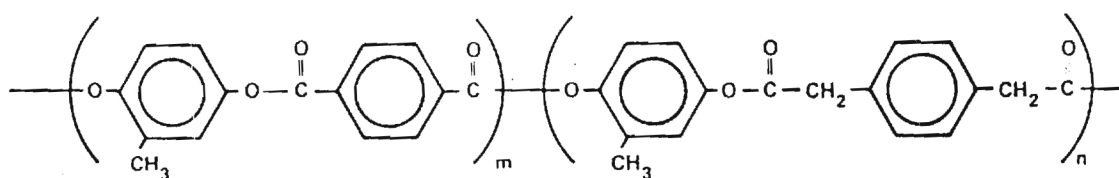
g. Ms. Agnes Thuo

Part III

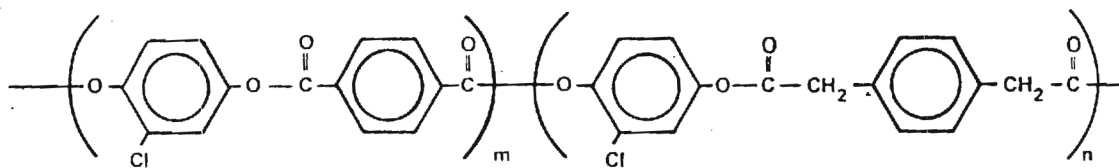
SYNTHESIS AND CHARACTERIZATION
OF LIQUID CRYSTALLINE COPOLYESTERS
CONTAINING THE SEMIRIGID
PHENYLENEDIMETHYLENE SPACER

Sonya Farrow, Shirley Johnson, and Agnes Thuo
Chemistry Department
Clark Atlanta University

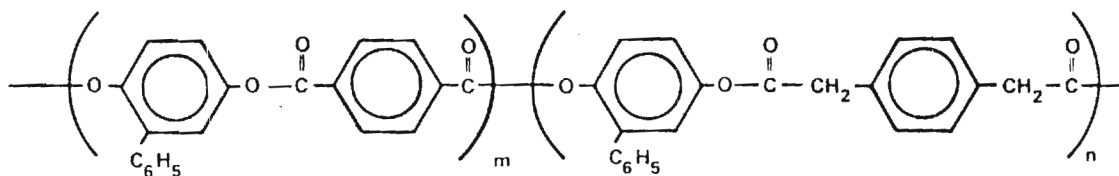
Martin Wusik and Malcolm Polk
School of Textile Engineering
Georgia Institute of Technology



I



II



III

STRUCTURES OF THE POLYESTERS SYNTHESIZED



POLARIZING OPTICAL MICROGRAMS OF I ABOVE THE MELTING POINT

As part of our studies of the mechanical and thermal properties of liquid crystal polymers, we have prepared the copolyesters shown in the figure. Copolyester I was particularly interesting because polarized optical micrograms of that polymer above the melting point of 270°C showed clearly the nematic schlieren texture. Copolyester II melted at approximately 250°C into the liquid crystal state and copolyester III melted into the isotropic state.