

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

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1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE Nov 30, 1983		3. REPORT TYPE AND DATES COVERED	
4. TITLE AND SUBTITLE THREE-DIMENSIONAL PHOTOCHEMICAL MACHINING WITH LASERS				5. FUNDING NUMBERS	
6. AUTHOR(S) Dr. Robert E. Schwerzel					
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Columbus Battello Laboratories 505 King Ave Columbus, Ohio 43201				8. PERFORMING ORGANIZATION REPORT NUMBER F49620-82-C-0077	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) AFOSR BLDG 410 BAFB DC 20332-6448				10. SPONSORING / MONITORING AGENCY REPORT NUMBER APOSR-TR- 90-0026	
11. SUPPLEMENTARY NOTES					
12a. DISTRIBUTION / AVAILABILITY STATEMENT unlimited				12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) DTIC ELECTE FEB 08 1990 S D D					
14. SUBJECT TERMS				15. NUMBER OF PAGES 4	
				16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT unclassified		18. SECURITY CLASSIFICATION OF THIS PAGE unclassified		19. SECURITY CLASSIFICATION OF ABSTRACT	
20. LIMITATION OF ABSTRACT					

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AD-A217 788

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FIFTH QUARTERLY R AND D STATUS REPORT

on

THREE-DIMENSIONAL PHOTOCHEMICAL
MACHINING WITH LASERS

to

AIR FORCE OFFICE OF SCIENTIFIC RESEARCH

from

BATTELLE
Columbus Laboratories
505 King Avenue
Columbus, Ohio 43201

November 30, 1983

Sponsored by

Advanced Research Projects Agency (DOD)
ARPA Order No. 4522, Program Code 2D10

Monitored by AFOSR Under Contract No. F49620-82-C-0077

Effective Date of contract: June 1, 1982
Contract Expiration Date: May 31, 1984
Amount of Contract Dollars: \$270,048, including fee
(\$196,298 obligated to date)

Principal Investigator/Program Manager: Dr. Robert E. Schwerzel
(614) 424-5637

Approved for public release;
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AIR FORCE
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distribution is unlimited.
MATTHEW J. KEFFER
Chief, Technical Information Division
AFSC

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INTRODUCTION

This document represents Battelle's Fifth Quarterly R and D Status Report to the Air Force Office of Scientific Research on Three-Dimensional Photochemical Machining With Lasers, under Contract No. F49620-82-C-0077, for the period August 1, 1983 through October 31, 1983. (Please note that, although the contract effective date is June 1, 1982, delays in the receipt of a signed contract resulted in an actual start date of August 1, 1982 for the research effort; thus, this report covers the fifth quarter of the actual research effort, as provided in the description of reporting periods in the subject contract.)

Our research efforts during this reporting period have focused on (a) continuing to investigate and characterize the brominated porphyrin photoinitiator system we discovered during the second quarter's research, (b) continuing our search for other candidate materials which offer the promise of providing selective photopolymerization when irradiated simultaneously with two laser beams of different colors, but of being inert to the presence of either beam alone, and (c) conducting a detailed

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MATTHEW J. KESNER
CHIEF, RESEARCH DIVISION

study of several porphyrin-based photoinitiator molecules in a different monomer system which has been selected because of its ability to crosslink readily. In particular, we have been studying the behavior of our porphyrin initiators and sensitizers in the monomer, trimethylolpropane-triacrylate (TMPTA). This polymer system crosslinks and hardens very efficiently upon two-beam irradiation using several of our novel brominated porphyrin photoinitiators, as well as with a two-component photoinitiator system consisting of tetraphenylporphyrin and naphthalene sulfonyl chloride. We have observed, however, that single-beam photopolymerization also occurs with this polymer under our irradiation conditions, such that polymer tends to form along one or both beam paths in addition to the intersection point, depending on the specific conditions used. This is clearly not desirable, and efforts are now underway to identify conditions that will minimize or eliminate this effect. We anticipate that this problem will be resolved in the context of investigating other polymer systems during the coming months. Our work on the program is continuing to progress well.

Three new motorized translation stages were purchased for this project during the past quarter, as was a new flashlamp for one of our tunable dye lasers (to replace the original, which had broken during an experiment). The translation stages will be programmed into our existing Apple IItm computer system to permit precise movement and positioning of the sample in the beam paths under computer control. This construction should be completed within the next few weeks. No travel or visits were made during this reporting period. No major problems or deviations from the program plan have been encountered to date. One new staff member has been added to the project team during this quarter; he is Mr. Dean R. Johnson, who is conducting the research for his Master's Degree thesis (Ohio State University) at Battelle on this project, under the supervision of Dr. Robert E. Schwerzel, the Principal Investigator for this project.

Fiscal Status:

Amount currently provided for the contract: \$196,298

Expenditures and commitments to date (10/31/83): \$159,542

Estimated funds required to complete the work: \$270,048

Estimated date of completion of work: June 30, 1984