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1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE 31MAR93		3. REPORT TYPE AND DATES COVERED Monthly R&D Status 15MAR93-31MAR93	
4. TITLE AND SUBTITLE A New Class of High Strength Molding Resins				5. FUNDING NUMBER: C MDA972-93-C-0029 PE 65502E	
6. AUTHOR(S) Mark Trimmer, Ph.D				DTIC ELECTE S C D APR 7 1993	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Maxdem Incorporated 140 E. Arrow Hwy. San Dimas, CA 91773					
8. PERFORMING ORGANIZATION REPORT NUMBER NA				9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) Advanced Research Projects Agency A New Class of High Strength Molding Resins ATTN: Dr. Richard T. Loda 3701 N. Fairfax Drive Arlington, VA 22203-1714	
10. SPONSORING/MONITORING AGENCY REPORT NUMBER				11. SUPPLEMENTARY NOTES Statement A: Approved for public release; distribution is unlimited.	
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13. ABSTRACT (Maximum 200 words) Maxdem has developed a novel family of thermoplastic resins, designated Poly-X(TM), which demonstrate exceptional strength and modulus. PolyX(TM) is based on a new type of rigid-rod polymer structure which combines good mechanical properties with facile processibility. Therefore, parts can be molded from Poly-X(TM) resins by a variety of common molding techniques and are projected to possess ultra-high mechanical strength and stiffness. Composites fabricated with Poly-X(TM) resins are expected to have unprecedented compressive strengths due to the high modulus of the Poly-X(TM) matrix resin. During the proposed Phase I work, initial experiments will be performed to demonstrate suitable fibermatrix adhesion for composite applications and that high strength parts can be molded. Work has begun to prepare the quantities of polymer required to perform these tasks and to fabricate test samples to allow evaluation of the fiber-resin interfacial properties. During the Phase II work, new composites will be fabricated which are projected to possess significantly enhanced compressive strength compared to the current state-of-the-art.					
14. SUBJECT TERMS Composites, Compressive Strength, High-Strength, Matrix Resin, Molding Resin, Molecular Composite, Rigid-Rod Polymers, Self-Reinforced Polymers, Thermoplastic.				15. NUMBER OF PAGES	
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San Dimas, CA 91773
909-394-0644

A NEW CLASS OF HIGH STRENGTH MOLDING RESINS
PHASE I
Monthly R&D Status Report

SPONSORED BY
Advanced Research Projects Agency
Defense Sciences Office
ARPA Order No. 7755
Program Code No. 3S10
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Effective Dt.: March 15, 1993
Expiration Dt.: May 15, 1993
Report Period: 03/15/93 - 03/31/93
Principal Inv.: Mark Trimmer, Ph.D.
909-394-0644
Author: Mark Trimmer
909-394-0644

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Contract No.: MDA972-93-C-0029
Contract Start Date: March 15, 1993
Monthly R&D Status Report

Technical Progress

Initial work under this Phase I program has begun and has proceeded as planned. Maxdem researchers have begun efforts to prepare the polymers required during the course of the Phase I research. Thus far, sufficient quantities of Poly-X™ resins have been produced to begin to examine wetting and adhesion with carbon fibers. Within the next month, we project that the bulk of the materials required to complete both the processing and fiber adhesion studies will have been prepared. We anticipate no problems in preparing the required Poly-X™ derivatives.

Initial fiber-resin test samples have been prepared by combining various types of carbon and glass fiber tows with powdered Poly-X™ resin and consolidating (compression molding) into a small panel. Modifications which can be examined include fiber type, surface treatments, sizings and coupling agents, and processing conditions combined with different Poly-X™ derivatives (either different resins or resins modified by various types of additives such as plasticizers, thermosetting components, adhesion promoters, etc.). During the Phase I effort, studies will be limited to a series of basic fiber types (AS4, IM7, T300, and T650/42 carbon and S-2 Glass® fibers) and a single Poly-X™ resin which, however, will be modified by various types of additives.

The fracture surfaces of the consolidated fiber-resin test panels are examined by microscopy (optical and SEM) for qualitative evaluation of the fiber-matrix interfacial characteristics. Preliminary results obtained with the S-2 Glass® fibers appears to be very promising, and a Poly-X™/S-2 Glass® composite will likely be one of the first to be prepared. Samples prepared with the various types of carbon fibers will be sent for SEM analysis within the next two weeks, and results are expected within the next month. Considering the early success with glass, we anticipate no problem in identifying at least three promising combinations for composite fabrication during the Phase II effort.

Efforts are proceeding to coalesce a team of collaborators experienced in composite components, fabrication, and testing to aid in the Phase II efforts. Preliminary discussions have been held with researchers at Hercules, Amoco Performance Products, Hexcel, BASF Structural Materials, Quadrax, Custom Composites Materials Inc. (CCMI), Georgia Institute of Technology, Michigan State University, and Wright-Patterson Air Force Base. The makeup of the Phase II research team should be decided within the next few weeks.

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No processing of test coupons aimed at optimizing mechanical strength has been attempted yet, awaiting synthesis of the appropriate polymers. Most of these processing studies should be completed within the next month, including the compression molding and an initial attempt to prepare an extruded sample. Mechanical properties of initial samples will have been obtained by the end of the next month, but those of second-generation optimized samples may require somewhat more time. We anticipate no problems in fabricating the samples, obtaining the measurements, or meeting the stated goal of 325-375 MPa flexural strength.

DATE PREPARED: 04/01/93
 CONTRACT NO: MDA972-93-C-0029
 CONTRACTOR: MAXDEM INCORPORATED

FUNDS AND MAN HOUR EXPENDITURE
 SUMMARY

WORK PACKAGE TITLE SUMMARY
 REPORTING PERIOD: MARCH93
 EST. COMPLETION: 31APRIL93

	A		B		C		D		E	F
	ORIGINAL NEGOTIATED CONTRACT		LATEST NEGOTIATED CHANGES		REPORT PERIOD EXPENDITURES		CUMULATIVE EXPENDITURES		ESTIMATED COST TO COMPLETE	LATEST COST ESTIMATE
	A1	A2	B1	B2	C1	C2	D1	D2	D3	
	MAN HRS	\$ VALUE	MAN HRS	\$ VALUE	MAN HRS	\$ VALUE	MAN HRS	\$ VALUE	\$ VALUE	
1. DIRECT LABOR										
PRINCIPAL INVESTIGATORS	120	\$3,806			64	\$1,933	64.0	\$1,933	50.80%	\$1,351
RESEARCH ASSOCIATES	82	2,256			84	2,148	84.0	2,148	95.22%	\$120
RESEARCH ASSISTANTS	142	2,835			8	155	8.0	155	5.47%	\$2,752
MAXDEM COST SHARING										
PRINCIPAL INVESTIGATORS						0	0	0	0.00%	0
RESEARCH ASSOCIATES					(36)	(922)	(36)	(922)		\$20
RESEARCH ASSISTANTS						0.0				
TOTAL LABOR	344	\$8,897			118.0	\$3,317	118.0	\$3,317	37.27%	\$5,632
OVERHEAD + FRINGE BENEFITS	//////	22,242	//////		//////	10,591	//////	10,591	47.54%	11,780
2. TOTAL LABOR AND OVRHD	//////	31,139	//////		//////	13,908	//////	13,908	44.41%	17,412
3. SPECIAL TESTING	//////	3,500	//////		//////	0	//////	0	0.00%	3,500
4. TRAVEL EXPENSES	//////	500	//////		//////	0	//////	0	0.00%	500
5. OTHER DIRECT COSTS	//////	0	//////		//////	0	//////	0	0.00%	0
6. SUB-TOTAL COSTS	//////	35,139	//////		//////	13,908	//////	13,908	39.58%	21,412
(SUM OF 2 THRU 5)	//////		//////		//////		//////			
7. G&A COSTS	//////	9,965	//////		//////	4,745	//////	4,745	47.35%	5,277
8. TOTAL COST	//////	45,104	//////		//////	18,653	//////	18,653	41.14%	26,689
(SUM OF 6 & 7)	//////		//////		//////		//////			
9. FEE (OR PROFIT)+ FCC MONEY	//////	4,863	//////		//////	2,044	//////	2,044	44.19%	2,581
TOTAL CONTRACT AMOUNT	//////	49,967	//////		//////	20,697	//////	20,697	41.42%	29,270
(SUM OF 8 & 9)	//////		//////		//////		//////			
OUTSTANDING COMMITMENTS	//////		//////		//////		//////			
TOTAL COMMITMENTS	//////	49,967	//////		//////	\$20,697	//////	\$20,697	//////	49,967
AND EXPENDITURES	//////	49,967	//////		//////	20,697	//////	20,697	//////	49,967