

Northeast Semiconductor, Inc.

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June 30, 1992

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Dr. Erhard Schimitschek, Scientific Officer
ATTN: Code 808
REF: N00014-91-C-0222
Naval Ocean Systems Center
271 Catalina Boulevard
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Re: Contractor : Northeast Semiconductor, Inc.
Address : 767 Warren Road, Ithaca, NY 14850
Req. No. : s405811srv02/17 APR
Contract No. : N00014-91-C-0222
Report Date : June 30, 1992
Report Title : 6th Monthly Technical Report
Period Covered : 06/01/92 through 06/30/92

Dear Dr. Schimitschek:

Northeast Semiconductor, Inc. encloses its Sixth Monthly Technical Report (Line Item #0002) pursuant to the provisions of contract Section B entitled, "Supplies or Services and Prices/Costs" for the period of June 1, 1992 through June 30, 1992.

**Innovative Techniques for the Production of Low
Cost 2D Laser Diode Arrays**

1.0 OBJECTIVE

The primary objective of this program is to develop a low cost, high yielding methodology for processing, packaging and characterization of MBE grown two dimensional high power laser diode arrays. Projected increases in overall yield of AlGaAs diode lasers would reduce manufacturing cost from the current \$10 to \$20 per peak watt to below \$3 per peak watt. Emphasis will be placed on innovative packaging techniques that will utilize recent advances in diamond heat sinking technology.

DESCRIPTION STATEMENT A

Approved for public release;
Distribution Unlimited

92-17582



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2.0 PROGRAM METHOD AND SCHEDULE

This program consists of four phases which will demonstrate reduced manufacturing cost and improved device performance of NSI's MBE laser diode arrays. The four phases listed below will result in milestones in processing, packaging, and testing along with delivery of the specified number of 5-bar laser arrays.

(i) Concept phase: Conceptual design and organization of this phase II program. NSI will utilize the current side cooled strained relief package to manufacture 5-bar laser diode arrays for base line evaluation. (Deliverables: 3 5-bar arrays.)

(ii) Backplane phase: Development of a copper backplane cooling technology that incorporates CVD diamond submounts. This phase will also include the completion of room temperature photoluminescence development. (Deliverables: 5 5-bar arrays.)

(iii) Diamond Backplane phase: Develop a CVD diamond backplane cooling scheme that will utilize smaller CVD submounts. The reduction in submount size is to decrease the thermal resistance from the laser bar to the backplane. (Deliverables: 5 5-bar arrays.)

(iv) Liquid Cooled Submount phase: An innovative liquid cooled package will be developed. The CVD diamond submounts will be hermetically sealed, electrically isolated and liquid cooled. (Deliverables: 5 5-bar arrays.)

The following global issues not mentioned above will be investigated continuously throughout all four phases of this program:

- (1) design and development of a mask set to increase processing and packaging yields,
- (2) development and updating of MBE growth software,
- (3) design and development of an in-house facet coating station,
- (4) evaluation of different facet coating materials,
- (5) development of automated tests,
- (6) life test and burn-in development.

The master schedule for this program is shown in Table 1. Each phase will require wafer growth, processing, assembly and test. The schedule shows the estimated number of sample fabrications and tests, as well as the time of hardware deliverables and reports.

3.0 PROGRESS THIS PERIOD

3.1 Wafer Growths

NSI has grown nine laser wafers this past month at the new MBE facility. This series of wafer represents NSI's first attempts at calibrating and qualifying the laser material at the facility. Initial results are encouraging with PL wavelength uniformity of approximately ± 1 nm across the 3" wafers. A sampling of these wafers will be processed in July to accurately characterize the quality of the material and adjust growth parameters to optimize laser performance.

3.2 Processing

Difficulties were experienced in processing of the individual metalized material to investigate side wall passivation leakage. As mentioned in May's monthly report, material utilized for the first set of deliverables experienced infant life time mortalities. One possible cause for this failure was identified as side wall passivation break through. Therefore, it was decided to process the remaining half wafer (of this material) with individually metalized diodes. This would reduce the chance of current leakage through the side walls. Upon testing these arrays, it was discovered that the p-side metalization "stretched" during cleaving and encroached on the optical output regions. This contributed to poor device performance and resulted in unusable material. The fully metalized processed batch did not suffer from this condition. Efforts in the future will be focused on early detection of this process anomaly and investigation into possible corrective action.

3.3 Testing

Photoluminescence (PL) evaluation of the MBE laser wafers grown this period were performed. Improvements were made for increasing the sensitivity of NSI's current PL facility. These improvements involved reconstruction of the PL optical arena and focusing down the HeNe laser beam to a spot size of approximately 100 μ m. Additional reduction in the spot size is planned to increase the photon density and the stations overall sensitivity.

3.4 Assembly and Packaging

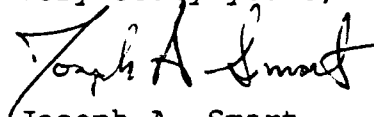
Efforts this period were focused on evaluation of CVD diamond. Progress has been hindered by a plaque of unreliable p-side solder joints. Initial InPb solder depositions ranged between 4.5 μ m to 5.5 μ m which is approximately 1.5 μ m to 2 μ m less than that utilized on Cu submounts. The decreased amount was attempted to reduce thickness and thermal resistance of the p-side solder joint and was believed possible with the improved surface conditions of the diamond. However, this resulted in inferior solder joints. Deposition was then done to the standard 7 μ m - 8 μ m

InPb solder. This also produced poor quality solder joints. Investigation is currently being performed to verify the purity of the evaporated solders and the integrity of the vacuum furnace utilized in this bonding operation. The possibility that the metalization provided by the diamond vendor is flawed is also being explored.

4.0 PLANS FOR JULY

The month of July will involve growing MBE laser material at NSI's new crystal facility. Investigation will continue into the CVD diamond heat sink difficulties described above. Fabrication of NSI's first backplane cooled package will begin.

Very truly yours,



Joseph A. Smart,
Co-Principal Investigator
Northeast Semiconductor, Inc.

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Encl: 1 Copy of 6th Monthly Technical Report

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DEPARTMENT : LASER PRODUCT LINE		KEY		DATE : NOVEMBER 20, 1991	
PROJECT(S) : ONR PHASE II		: Start Task		PREPARED BY : GEOFFREY T. BURNHAM	
N00014-91-C-0222		: Milestone		APPROVED BY :	
		: Completion Date 1			
		: Completion Date 2			

PAGE 1 of 2 MILESTONES	1991												1992												1993											
	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A											
HIGH YIELD EPITAXIAL GROWTH																																				
SYSTEM QUALIFICATION																																				
WAFER STARTS					4	4	4	4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3											
REVIEW INCOMING INSPECTION																																				
UPDATE GROWTH SOFTWARE																																				
WAFER PROCESSING																																				
PROCESSING STARTS					2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2												
DEVELOP ROOM TEMP PL TEST																																				
DEVELOP FACET COATING																																				
PACKAGING																																				
1-BAR SUBMOUNTS				15	30	30	10	10	10	10	30	30	10	10	10	10	30	30	10	10	10	10	30	30												
5-BAR ARRAYS																																				
CURRENT																																				
Cu BACKPLANE																																				
CVD DIAMOND																																				
EG ₁ /V COOLED																																				
TESTING																																				
DEVELOP AUTOMATED TESTS																																				
LIFE TESTS/BURN-IN																																				

TABLE 1. MASTER SCHEDULE FOR SBIR PHASE I
CONTRACT NO. N00014-91-C-0222

DEPARTMENT : LASER PRODUCT LINE		DATE : NOVEMBER 20, 1991	
PROJECT(S) : ONR PHASE II		PREPARED BY : GEOFFREY T. BURNHAM	
N00014-91-C-0222		APPROVED BY :	
PAGE 2 of 2		1991	
MILESTONES (CONTINUED)		1992	
TESTING (CONTINUED)		1993	
5-BAR ARRAYS			
DELIVERABLES			
REPORTS			
MONTHLY			
QUARTERLY			
FINAL			
5-BAR ARRAYS			
CURRENT			
Cu BACKPLANE			
CVD DIAMOND			
EGW COOLED			