
Low Temperature Alpha Measurement

David J. Gallant

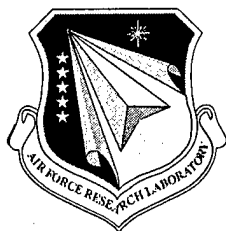
Boeing/ Rocketdyne Technical Services
PO Box 5670
Albuquerque, NM 87185

July 2001

Final Report

APPROVED FOR PUBLIC RELEASE, DISTRIBUTION IS UNLIMITED.

20040218 077



AIR FORCE RESEARCH LABORATORY
Directed Energy Directorate
3550 Aberdeen Ave SE
AIR FORCE MATERIEL COMMAND
KIRTLAND AIR FORCE BASE, NM 87117-5776


Using Government drawings, specifications, or other data included in this document for any purpose other than Government procurement does not in any way obligate the U.S. Government. The fact that the Government formulated or supplied the drawings, specifications, or other data, does not license the holder or any other person or corporation; or convey any rights or permission to manufacture, use, or sell any patented invention that may relate to them.

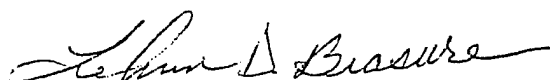
This report has been reviewed by the Public Affairs Office and is releasable to the National Technical Information Service (NTIS). At NTIS, it will be available to the general public, including foreign nationals.

If you change your address, wish to be removed from this mailing list, or your organization no longer employs the addressee, please notify AFRL/DELO, 3550 Aberdeen Ave SE, Kirtland AFB, NM 87117-5776.


Do not return copies of this report unless contractual obligations or notice on a specific document requires its return.

This report has been approved for publication.


Richard W. Berdine, DR-II
Project Manager


LeAnn D. Brasure, Lt Col, USAF
Chief, High Power Solid-State Lasers
Branch

FOR THE COMMANDER


DR. EARL GOOD, SES
Director, Directed Energy

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 074-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing this collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, 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

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE 25-07-2001	3. REPORT TYPE AND DATES COVERED FINAL; 22-03-2000 - 22-03-2001	
4. TITLE AND SUBTITLE Low Temperature Alpha Measurement		5. FUNDING NUMBERS F29601-00-D-0169 Order No. 0004	
6. AUTHOR(S) David J. Gallant		Program Element: 62601F Project: 3326 Task: LR Work Unit: AA	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) The Boeing Company Rocketdyne Technical Services PO Box 5670 Kirtland AFB, NM 87185		8. PERFORMING ORGANIZATION REPORT NUMBER 01RTS067	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) Air Force Research Laboratory/DELO 3550 Aberdeen Ave SE Kirtland AFB, NM 87117-5776		10. SPONSORING / MONITORING AGENCY REPORT NUMBER AFRL-DE-TR-2001-1065	
11. SUPPLEMENTARY NOTES			
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release, distribution is unlimited.			12b. DISTRIBUTION CODE
13. ABSTRACT (<i>Maximum 200 Words</i>) The objective of this task was to provide for the setup, measurement and data analysis of an experiment to measure the alpha parameter of diode lasers. The alpha parameter characterized the degree of coupling between the diode laser carriers and the material index of refraction. This parameter has been measured extensively at room temperature and this task extended the measurement regime to low temperatures.			
14. SUBJECT TERMS alpha parameter, diode lasers, low temperatures, alpha measurement			15. NUMBER OF PAGES 10
			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 Unlimited

This page intentionally left blank.

Table of Contents

Section	Page
I. Introduction	1
II. Low Temperature Alpha Measurements	2
III. Conclusion	3

I. INTRODUCTION

The SLIDERS contract encompassed several research efforts within the Semiconductor Laser Branch of the Laser Division, Directed Energy Directorate of the Air Force Research Laboratory. The scope of this contract included development, design, fabrication, procurement, management, operations and maintenance of optical, electronic, and mechanical systems, subsystems, and components. Principal efforts included theory and concept development, design analysis, laboratory operations, and semiconductor laser and diode-pumped laser development, operation and maintenance. Efforts also included the development, procurement, and operation of instrumentation to evaluate and characterize laser systems.

II. LOW TEMPERATURE ALPHA MEASUREMENT

The objective of this task was to provide for the setup, measurement and data analysis of an experiment to measure the alpha parameter of diode lasers. This work was a continuation of previous work on alpha parameter measurements, and was to extend measurement capabilities to other operating temperatures. The alpha parameter is a measure of the coupling between the diode laser carriers (electron current) and the material index of refraction. A lower coupling parameter is required to reduce nonlinear effects and filamentation, leading to improved beam quality and higher facet powers.

At the initiation of the task recent efforts on this experiment were reviewed and the optical layout was examined. Some of the optics were realigned, and changes to the vacuum chamber and laser mount were incorporated to facilitate an alignment laser through the vacuum chamber. Other vacuum chambers and cryogenic systems were looked into in order to vary the operating temperature of the test samples.

Additional parts were designed and machined to allow for the alignment laser and to better support the electrical current probe used to run the diode laser. The availability of diode laser samples and material on hand was reviewed.

Discussions were held with DOF personnel concerning anti-reflective optical coatings on the laser diodes. DOF typically builds a two layer AR coating so our coating model will have to be modified to account for the two layers and fixed material indices. Getting good quality optical coatings is critical. The coatings must withstand cryogenic temperatures and provide sufficient suppression of lasing for high carrier density alpha measurements.

We continued to pursue obtaining optical AR coating from the DOF. DOF contractual changes that were ongoing made it difficult to establish a new task with DOF. Computer models were run for coating specifications to be deposited.

Machining of parts for optical and electronic mounting was completed. L/I data was taken on several samples of quantum dot material received from Wright-Patterson AFB. Initial L/I curves indicated poor laser efficiencies, subsequent measurements on different bars showed better characteristics.

Subsequent to this activity the Air Force branch decided to move the laboratory to a new facility. Equipment from the lab was boxed and tables were cleared in preparation for moving. All of the remaining lab equipment was moved into the hanger lab including the Argon-ion laser, the Ti-sapphire laser, spectrometers and the alpha measurement setup. Organization of the new lab was started but was slowed due to changing space requirements within the Air Force branch.

III. CONCLUSION

Alpha measurements made prior to this task suggest that low temperature operation of diode lasers may decrease the alpha parameter leading to improved laser performance. Due to laboratory reorganization and consolidation, technical activity on this task was curtailed, and lowered alpha parameters could not be verified. Continued work in this area is appropriate, and may lead to higher power, higher brightness diode lasers.

DISTRIBUTION LIST

DTIC/OCP 8725 John J. Kingman Rd, Suite 0944 Ft Belvoir, VA 22060-6218	1 cy
AFRL/VSIL Kirtland AFB, NM 87117-5776	2 cys
AFRL/VSIH Kirtland AFB, NM 87117-5776	1 cy
Boeing/Rocketdyne Technical Services PO Box 5670 Albuquerque, NM 87185	1cy
Official Record Copy AFRL/DELO/Richard Berdine	2cys