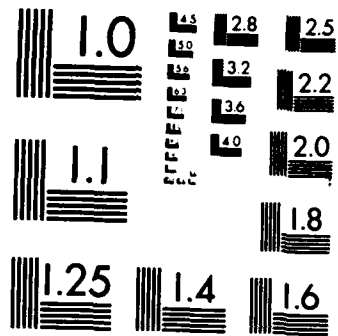
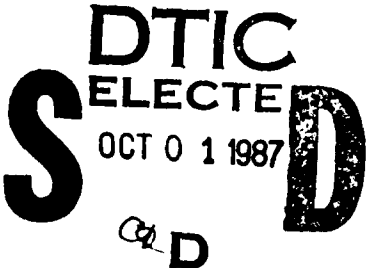


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CALIFORNIA LOS ANGELES A MADHUKAR 29 OCT 86  
UNCLASSIFIED AFOSR-TR-87-1177 \$AFOSR-84-0279 F/G 20/7 NL





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FINAL SCIENTIFIC REPORT

AFOSR GRANT NO. 84-0279

TITLE: MOLECULAR BEAM EPITAXIAL GROWTH AND  
CHARACTERIZATION OF III-V COMPOUND SEMICONDUCTOR  
SINGLE AND MULTIPLE INTERFACE STRUCTURES

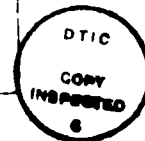
PERIOD: JULY 30, 1984 TO OCTOBER 29, 1986

PRINCIPAL INVESTIGATOR: ANUPAM MADHUKAR  
UNIVERSITY OF SOUTHERN CALIFORNIA  
LOS ANGELES, CA 90089-0241

ABSTRACT

A brief description of equipment acquired under the present grant is provided, along with a list of equipment. The equipment has enhanced molecular beam epitaxial growth and characterization capabilities in the principal investigator's laboratory.

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The AFOSR grant number 84-0279 provided funds under the University Research Instrumentation Program (URIP) to acquire equipment for (1) repair/upgrading of our Perkin-Elmer  $\Phi$ -400 molecular beam epitaxial (MBE) machine (2) establishing substrate preparation and characterization facility (3) thinning of electron microscopy samples (4) C-V and I-V measurements on quantum well samples, (5) ultra high vacuum system for ellipsometry studies, and (6) photoluminescence studies. As such, in the following we provide a brief description of each of these facilities established through equipment acquired for each of these objectives. A complete list of all equipment acquired is provided at the end.

(A) THE  $\Phi$ -400 MBE MACHINE:

To prevent down-time of the MBE machine due to aging instruments etc., we acquired such things as a new quadruple mass analyzer (UTI, model 100-C), a 10 KV DC power supply for routine cleaning of ceramic rods etc. on the mass analyzer, source oven components, cryopump, etc. Equipment acquired for such purposes is noted under the "List of Equipment" provided at the end of this report.

(B) SUBSTRATE PREPARATION AND SAMPLE STORAGE:

Equipment such as Dry N<sub>2</sub> dessicator cabinets, refrigerator for storage of sensitive chemicals, Nomarski optical microscope for examining surface morphology of prepared substrates, etc., was acquired. Items acquired are

noted in the "List of Equipment".

(C) PREPARATION OF ELECTRON MICROSCOPY SPECIMENS:

A "Dimpler" system (VCR, model D500) was acquired for mechanical thinning of the MBE grown samples in order to prepare specimens for transmission electron microscopy. The Dimpler was tested and found to be not quite up to the specifications of the manufacturer. However, being the state-of-the-art equipment at the time, there was little relief to be found by returning it. We retained the equipment for it is nevertheless useful for the intended purpose.

(D) C-V AND I-V MEASUREMENTS SYSTEM:

Equipment, such as a multi-frequency LCR-meter (HP, model PH4274A), was acquired to enlarge the Hall mobility measurements facility to include capacitance-voltage and current-voltage measurement capabilities. The system was set-up and performs as expected.

(E) UHV SYSTEM FOR ELLIPSOMETRY AND SURFACE DIAGNOSTICS:

An earlier DOD-URIP grant provided funds to partially cover establishment of an ultra high vacuum (UHV) system with some surface diagnostic capability (such as X-ray photoemission) to allow reliable and unambiguous spectroscopic ellipsometry studies of the dielectric function of MBE grown quantum well structures. This process

was brought to a completion by acquiring an UHV pumping system with appropriate vacuum gauges for the custom designed UHV chamber acquired earlier, a sample introduction system consisting of fast entry box, transfer rod, wobble stick, sample manipulator, a turbomolecular pump, etc. The vendor (MicroScience) had difficulties and delays in meeting the special requirements which led to nearly a year's delay in final approval of design and subsequent delivery of system. This, in fact, is the sole reason for delay in writing this report. The system was delivered some two months ago and is presently undergoing tests.

(F) PHOTOLUMINESCENCE MEASUREMENT FACILITY:

An integrated detection and data acquisition system (SPEX Industries, DATAMATE) was acquired to enhance the capabilities of a photoluminescence measurements system set up earlier. The system was tested and found to perform to specification.

LIST OF EQUIPMENT PURCHASED

AFOSR Grant #84-0279

<u>Equipment</u>	<u>Vendor</u>
1. UTI-100C-12 RGA Unit	UTI Instruments
2. Integrated Detection and Counting System; DMIB-2 Spectroscopic Lab Coordinator	Spex Industries
3. High Voltage Power Supply	Spellman High Voltage Electronics
4. CT-72 High Vacuum System	CTI Cryogenics
5. SBV-2. 53 Gate Valve Kit	Innotech Group Inc.
6. Nikon Optiphot M	A.G. Heinz Co. Inc.
7. 179A Digital Multimeter	EIL Instruments
8. EM Thickness Measuring Device	Quality Control Co.
9. 623 Precision Disc Grinder	Gatan Inc.
10. Dimpler D500	VCR Group
11. 197/1972 Microvolt DMM	Keithley Instruments
12. Houston 4523 Microscibe Recorder	VWR Scientific Inc.
13. HP4274A Multi Frequency LCR Meter	Hewlett Packard Co.
14. Surface Science System (A)	Microscience
15. Programmable Voltage Source	Keithley Instruments
16. Temperature Detection and Control System	Lake Shore Cryotronics Inc.
17. 02-400 Sample Introduction Rod, Cable & Support	Perkin Elmer

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