

REPORT DOCUMENTATION PAGE

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6. AUTHOR(s) Professor Singh				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Dept of Electrical Engineering and Computer Science University of Michigan Ann Arbor, MI 48109-2122			8. PERFORMING ORGANIZATION REPORT NUMBER	
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ATTACHMENT
AUGMENTATION AWARDS FOR SCIENCE & ENGINEERING RESEARCH TRAINING (AASERT)
REPORTING FORM

The Department of Defense (DoD) requires certain information to evaluate the effectiveness of the AASERT Program. By accepting this Grant which bestows the AASERT funds, the Grantee agrees to provide 1) a brief (not to exceed one page) narrative technical report of the research training activities of the AASERT-funded student(s) and 2) the information requested below. This information should be provided to the Government's technical point of contact by each annual anniversary of the AASERT award date.

1. Grantee identification data: (R&T and Grant numbers found on Page 1 of Grant)

- a. University of Michigan
University Name
- b. F49620-92-J-0304 - DEF c. none
Grant Number R&T Number
- d. _____ e. June 1, 1992 - May 31, 1995
From: J. Singh To: Dr. C. Woods AASERT Reporting Period
P.I. Name

NOTE: Grant to which AASERT award is attached is referred to hereafter as "Parent Agreement".

2. Total funding of the Parent Agreement and the number of full-time equivalent graduate students (FTEGS) supported by the Parent Agreement during the 12-month period prior to the AASERT award date.

- a. Funding: \$ 408,929
- b. Number FTEGS: .5

3. Total funding of the Parent Agreement and the number of FTEGS supported by the Parent Agreement during the current 12-month reporting period.

- a. Funding: \$ 58,360
- b. Number FTEGS .25

4. Total AASERT funding and the number of FTEGS and undergraduate students (UGS) supported by AASERT funds during the current 12-month reporting period.

- a. Funding: \$ 185,832
- b. Number FTEGS: .50
- c. Number UGS: 0

VERIFICATION STATEMENT: I hereby verify that all students supported by the AASERT award are U.S. Citizens.

J. Singh
Principal Investigator

9/19/95
Date

University of Michigan
Grant F49620-94-1-0404, DEF

Final Report: "III-V Modulation and Switching Devices for Optical Systems Applications"

F49620-92-J-0304-DEF

6/1/92 - 5/31/95

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Professor Jasprit Singh**

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**Air Force Office of Scientific Research
Bolling Air Force Base**

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September, 1995

The thrust of this three-year program has been to exploit quantum confined Stark effect (QCSE) in multiquantum well (MQW) structures for novel optoelectronic devices. During the course of this program a number of device concepts were implemented. We will briefly summarize the key findings of these implementations:

i) Voltage Tunable MQW Filter Using Schottky Gratings:

In this device an electron beam written Schottky grating is used to create a high speed modification in the optical period in a distributed feedback filter. When an electric field is applied, QCSE causes a modification of the refractive index. This concept can be exploited for creating a tunable optical filter. We were successfully able to implement this concept and several devices were fabricated. Filter tunability was demonstrated.

The device structure is grown by MBE on an n^+ GaAs substrate. A Schottky metal consisting of 250Å titanium and 1000Å gold is deposited on the AlGaAs cap layer. This metal constitutes a 128 period grating with a 0.36 micron pitch and individual finger length of 5µm. It is formed by standard electron beam lithography and liftoff techniques. A 3µm wide ridge waveguide is optically defined to pass under and perpendicular to the Schottky grating. A 0.7µm thick plasma-enhanced chemical vapor deposition (PECVD) of SiO₂ is then done to both passivate the waveguide between grating fingers and protect the surface. Contact holes to the Schottky grating strips are then opened up using RIE and a thick interconnect layer of Ti/Al/Ti/Au makes the probing pad for the Schottky contact. The waveguide is then cleaved to 400µm length for optical measurements. The diode characteristics of the device were first measured and exhibit a forward turn on voltage of 1.5V and reverse break down voltage of -16V. Photoluminescence data showed the heavy-hole excitonic peak of the wells to be at 845 nm. By the application of -2V bias on this MQW-DBR waveguide, we were able to shift the Bragg resonance by 8Å, thus demonstrating an integrable tunable filter. Through more exacting optimization, lithography calibration and longer written grating fields, devices with greater tunability, narrower bandpassing, and stronger filtering may be obtained.

ii) Optical Header Recognition for Lightwave Networks:

QCSE is used in this architecture to provide a real time programmable transparency for header matching to a local address. The header contains the digital code for the node where a packet is to be routed. A simple optical comparison scheme was implemented to generate a signal which is a measure of the match between the header and the local address. A high speed circuitry is used to create the programmable transparency and the final decision. We have been able to show that this scheme has an excellent potential to provide header recognition up to 10 Gbps for headers containing 8 bits.

For the 1Gb/s implementation, the 8 bit word in a NRZ format was used. To generate a programmable optical data stream at that rate, an HP80000 data generator unit was used that could produce two independently programmable signals which could significantly drive two PIN MQW GaAs/AlGaAs modulators synchronously. Continuous wave light from a commercial diode laser was focused through the first modulator which created the test data streams, as in a transmitting station. The optical data were then collected and refocused through the second modulator whose time-varying transmittance represented the stored address of a receiving station. The light is then finally collected and focused into a picosecond detector for analysis.