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13. ABSTRACT (Maximum 200 words)

The technical program has continued to emphasize the fundamentals of optical techniques and electronic materials. In the former area, Mal Teich has examined the quantum statistics of squeezed light and fractal noise. In addition, Sven Hartmann's group has continued to push the frontiers of coherent ultrashort-pulse spectroscopy by examining attosecond pulses in four-wave mixing experiments. Rick Osgood's and Ed Yang's research has focussed on studying interfacial phenomena in buried epitaxial insulator-semiconductor interfaces (with laser photoemission) and bimetal Schottky barriers on GaAs, respectively. Irving Herman's work on high pressure studies of II-VI superlattices has yielded information on stress and strain in these layered compounds. George Flynn has successfully implemented direct infrared laser probing of Cl atoms, a technique of considerable general use in following Cl atom concentrations in etching environments. Finally, a new program in packaging science has been formulated for next year's JSEP program.

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FINAL REPORT

FOR THE

COLUMBIA RADIATION LABORATORY

JOINT SERVICES ELECTRONICS PROGRAM

"RESEARCH INVESTIGATION DIRECTED TOWARD EXTENDING THE USEFUL RANGE OF THE ELECTROMAGNETIC SPECTRUM"

CONTRACT # DAAL03-88-C-0009

April 1, 1988 - March 31, 1991

SUBMITTED BY

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Co-Principal Investigators

COLUMBIA RADIATION LABORATORY

COLUMBIA UNIVERSITY in the City of New York

New York, New York 10027

May 31, 1991

A. OVERVIEW

The JSEP program at Columbia is a dynamic one in which the changing orientation of our research effort has been advanced further over the past three years. In particular we have brought into the program two younger members whose chief focus is on fundamental electronic packaging research. In addition, Sven Hartmann's program in ultrashort coherent optical spectroscopy has been transitioned to other agencies for support.

We note at this point Professor Hartmann's long record of distinguished and very creative research in coherent spectroscopy. This work has revolutionized our understanding of light interaction with matter. His elucidation of coherent optical effects has also been crucial in a very practical sense by laying the fundamental framework for applications as diverse as the propagation of high power laser pulses in the atmosphere, transient solid-state spectroscopy, and more recently nonlinear optical effects in communications. Recently he received the Optical Society's R. W. Wood award for this pioneering work. Finally, Sven also played a crucial role in guiding the CRL during the "post-Rabi" era to the beginning of research oriented toward solid state electronics.

Our technical program has continued to emphasize the fundamentals of optical techniques and electronic materials. In the former area, Mal Teich has examined the quantum statistics of squeezed light and fractal noise. In addition, Sven Hartmann's group has continued to push the frontiers of coherent ultrashort-pulse spectroscopy by examining attosecond pulses in four-wave mixing experiments. Rick Osgood's and Ed Yang's research has focussed on studying interfacial phenomena in buried epitaxial insulator-semiconductor interfaces (with laser photoemission) and bimetal Schottky barriers on GaAs, respectively. Irving Herman's work on high pressure studies of II-VI superlattices has yielded information on stress and strain in these layered compounds. George Flynn has successfully implemented direct infrared laser probing of Cl atoms, a technique of considerable general use in following Cl atom concentrations in etching environments. Finally, a new program in packaging science has been formulated for next year's JSEP program.

Our reseach thrust in the packaging area has been leveraged by other cooperative programs at Columbia. In particular, Dave Auston, Rob White, and Brian Bent recently have initiated a packaging program with IBM. In addition, there are separate, significant programs in packaging science with DARPA by Richard Osgood and Dave Auston.

The activities of the CRL members have been noted by honors awarded outside and inside Columbia. In particular, because of his continued, extraordinarily dedicated service to Columbia, George Flynn has been designated for two additional years as the holder of the Con-Edison Distinguished Thomas Alva Edison Professor Chair. In addition, Richard Osgood was designated as a Distinguished Keynote Speaker at the Japanese Optical Industry Technology Development Association (OITDA) annual meeting in Tokyo. This honor was previously given to Amon Yariv, Ted Maiman, and Dave Auston.

There have been some major changes in our experimental facilities. Recently Columbia committed itself by virtue of the IBM Materials Program to constructing a more advanced UHV facility for Schottky barrier measurements. This facility will provide samples and materials for research by Edward Yang and his group.

Finally, our administrative structure has evolved considerably. In particular, Ms. Karen Wingate who for five years enthusiastically managed our administrative section, including a period of rapid growth in the activities and scope of our office, has been promoted within the university. Her position has been filled by Laura Meizler, who has considerable outside experience in fiscal planning. In addition, Richard Osgood has stepped down as Co-Director of CRL; however, he will continue to play a major role in technical and administrative matters. Finally, a key administrative change for the Columbia JSEP program is the appointment of Dave Auston as the new Dean of the School of Engineering and Applied Science. Dave's long record of achievement and interest in electronics and optics based research will clearly provide a major boost for the CRL program at Columbia.

B. LISTING OF PRINCIPAL INVESTIGATORS

George W. Flynn
Sven R. Hartmann
Irving P. Herman
Richard M. Osgood
Malvin C. Teich
Edward S. Yang

C. DEGREES AWARDED

Ph.D.

T. Cacouris
L. Chen
J. Cressler
D. DeBeer
E. Goldstein
A. Hewitt
B. Jalali
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T. Licata
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F. Moshary
J. A. O'Neill
M. Schmidt
P. Shaw
C. Shu
T. Tanabe
G. V. Treyz
X. Wu

M. S.

C. Knapp

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