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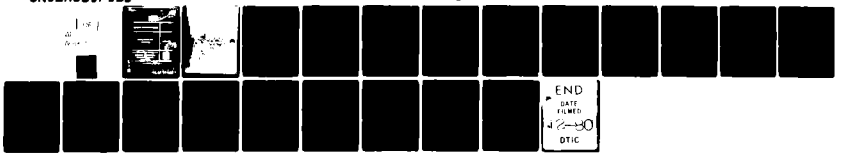

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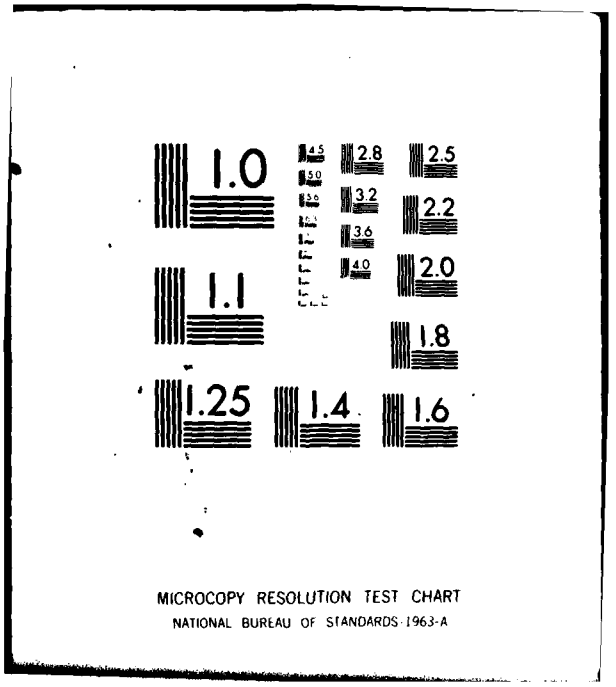
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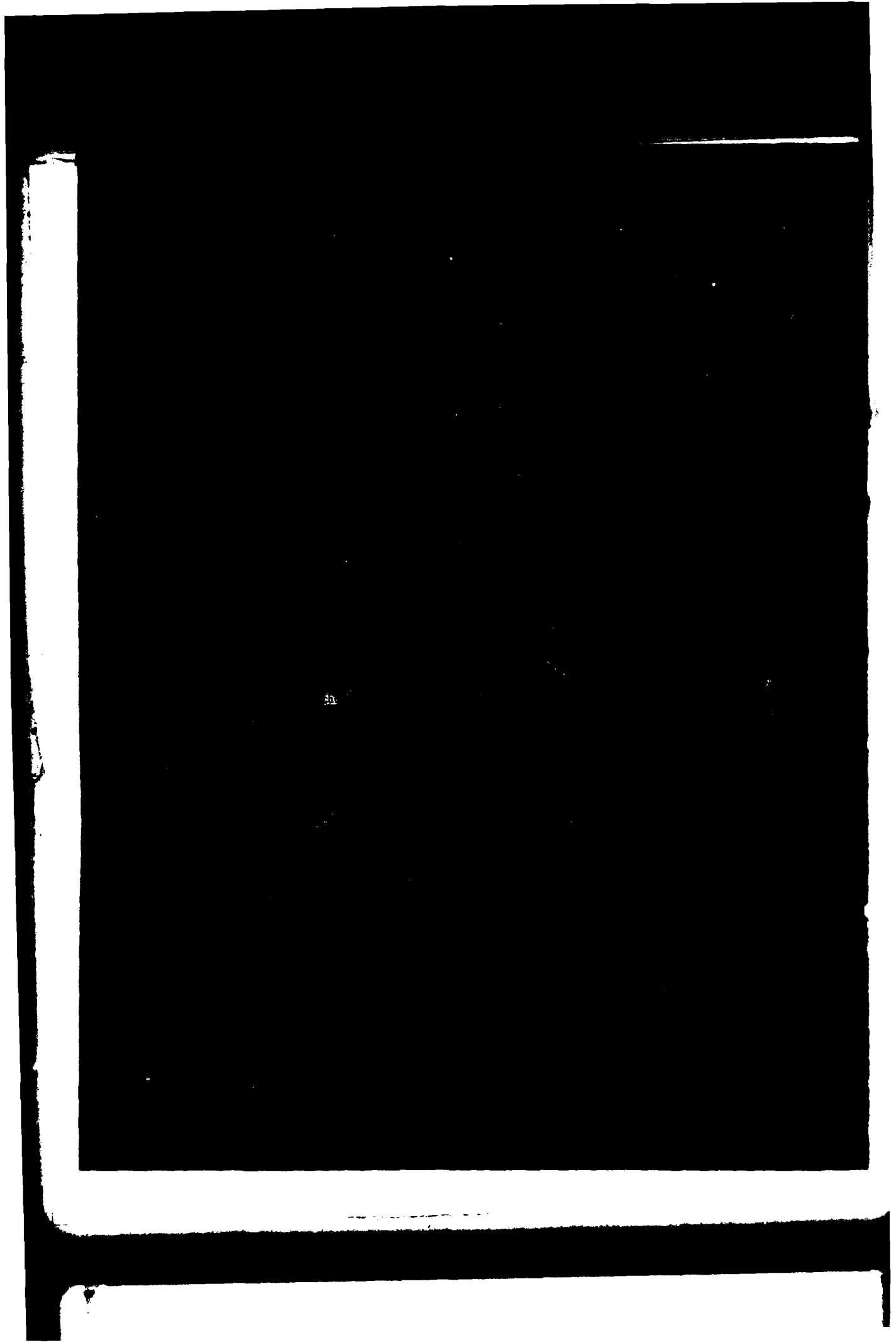

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MASSACHUSETTS INSTITUTE OF TECHNOLOGY

LINCOLN LABORATORY

ADVANCED ELECTRONIC TECHNOLOGY

QUARTERLY TECHNICAL SUMMARY REPORT
TO THE
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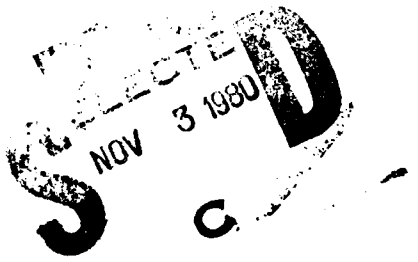


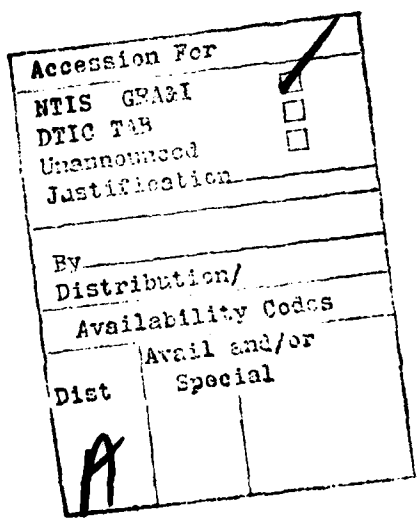
1 FEBRUARY – 30 APRIL 1980

ISSUED 4 AUGUST 1980

LEXINGTON MASSACHUSETTS

INTRODUCTION

This Quarterly Technical Summary covers the period 1 February through 30 April 1980. It consolidates the reports of Division 2 (Data Systems) and Division 8 (Solid State) on the Advanced Electronic Technology Program.



CONTENTS

DATA SYSTEMS
DIVISION 2

INTRODUCTION

This section of the report reviews progress during the period 1 February through 30 April 1980 on Data Systems. Separate reports describing other work of Division 2 are issued for the following programs:

Seismic Discrimination	DARPA/NMRO
Distributed Sensor Networks	DARPA/IPTO
Education Technology	Bureau of Mines
Network Speech Systems Technology	OSD-DCA
Digital Voice Processing	AF/ESD
JTIDS Speech Processing	AF/ESD
Packet Speech Systems Technology	DARPA/IPTO
Radar Signal Processing Technology	ARMY/BMDATC
Restructurable VLSI Technology	DARPA/IPTO
Multi-Dimensional Signal Processing	AF/RADC

A. J. McLaughlin
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DIGITAL INTEGRATED CIRCUITS
GROUP 23

I. INTRODUCTION

Scaling experiments, linking technologies and the development of CMOS design rules are all aimed at providing a capability for large-area VLSI. Incorporation of advances in polyimide technology, thermal nitridation, and e-beam fabrication have the potential for both high performance and radiation hardness.

II. MNOS MEMORY

A. 64-Kilobit Memory Arrays

64K chips with second-level on-chip digit decoding were operated satisfactorily.

Small residual parasitic contributions to the readout are still observed in the 64K chip. These are due to resistance in the Si digit line between the selected bit and the second metal digit shunt which allows coupling of the readout signal to a small portion of the unselected word lines. Active word line pulldowns are required to eliminate this parasitic as has been verified experimentally on 64K chips where the on-chip decoding is bypassed.

B. Megabit Design

The design of a 1-megabit memory chip has been initiated. Several key improvements over the 64K chip design will be: (1) CMOS word as well as digit decoding, (2) N-enhancement rather than depletion transistors to obtain better threshold control and eliminate level-shifting problems encountered when gate voltages are decoded on-chip, and (3) very compact transistors will be provided on the Si digit lines to allow switching in only a small segment of the digit line to the second metal digit shunt conductor during read and write operations. This latter improvement adds little to the chip area or complexity, but substantially reduces power dissipation and half selected bit disturbing during writing. Furthermore, this greatly reduces digit line capacitance during reading which directly improves readout speed and signal to noise. A preliminary layout resulted in a 1/4-in.-square megabit chip.

C. DSW Reticles

New reticles for use on the DSW wafer stepper have been produced for the 64K chip and a wafer run initiated. These reticles contain test devices which will be used to evaluate experimentally the improvements proposed above for the megabit chip. An alternative sense amplifier being studied for the MNOS capacitor memory is a charge-transfer amplifier of the type used in dynamic MOS memories. An on-chip version will be evaluated with the 3×3 decoded array.

D. Testing

A programmable controller for allowing dynamic testing of full 64K arrays at high bandwidth has been built.

III. RESTRUCTURABLE VLSI

A. CMOS Process

Bulk CMOS process sequences, design rules, and test structure are being completed to provide the fabrication technology for implementing large-area restructurable VLSI.

B. Scaled NMOS

Scaled NMOS test structures are in layout and will be used in experiments with short-channel devices having gate dielectrics formed from thermal nitride.

Preliminary discussions have been held on the use of Division 8's electron beam system for submicron scaling.

C. Link Devices

Test structures are being designed for demonstrating an additive process for linking in restructurable arrays. Deletion of links using a commercial laser zapper for mask trimming had previously been demonstrated.

D. Logic Design

Preliminary designs of CMOS cells are being laid out which would be components of a multiple-integrator chip for use with a SAW correlator. SPICE simulations to determine operating speeds are also under way.

IV. SILICON PROCESSING

A. Direct Nitridation

Direct nitridation is the growth of a silicon nitride film on a silicon wafer. It is accomplished by the reaction of the surface with a nitrogen-containing gas analogous to silicon oxidation. Films grown in this manner are generally less than 5 nm, but are more dense than comparable silicon dioxide and CVD nitride films and could be used as the gate dielectric in MNS (metal-nitride-semiconductor) transistors. The goals of this program are to develop a direct nitridation process for MNS devices and to investigate the properties of such devices.

Three sets of films were grown in an RF-heated horizontal reactor in ammonia for 60 min. at 1000°C. In each run the average film thickness was approximately 7 nm, the films were clear and quite dense – their buffered HF etch rate was less than 0.2 nm/min. Each wafer exhibited pits due to outgassing of the susceptor during the run. Four wafers from the first two runs have been fabricated into MNS capacitors and characterized in terms of an intrinsic maximum field strength and a defect density. The intrinsic field breakdown strength varied between 6.1 to 7.4×10^6 V/cm and the defect density varied between 0.13 to 0.17 defect/mil^2. Thus, MNS devices of realistic dimensions can be fabricated whose gates will withstand up to 4.5 V. While these results are encouraging, they do not meet our goal of $E_{max} \geq 1 \times 10^7$ V/cm and a defect density which is two orders of magnitude lower. Some of the defects are related to the outgassing problem; the dielectric strength could be related as well. It is clear that the reactor design is a key ingredient in obtaining thicker films since previous experiments in a diffusion furnace yielded films no thicker than 0.45 nm after 60 min. in ammonia at 1250°C. We believe that the RF field itself is responsible for the increased reaction rate and that the partial pressure of ammonia radicals is increased due to energy coupled into the ammonia molecule from the field.

We have begun to investigate the radiation hardness of the nitride films. Two of the above wafers were irradiated without an in situ bias applied to the capacitors. No measureable flat-band voltage shift has been observed after a total dose of 2×10^6 rad. Additional samples are being fabricated to determine the effects of an in situ bias and total dose on the films' properties.

B. Bipolar Transistors

Masks have been received and processing defined for the incorporation of polysilicon emitters into the poly-ox isolation process, the damaged-silicon isolation process, and a combined bipolar-MOS process. Test transistors have been fabricated in the poly-ox process and are being characterized.

C. Dielectric Isolation

Investigation of a higher selective oxidation temperature to realize the benefit of predicted steeper sidewall angles has revealed that for the same 1-μm sidewall oxide more of the silicon nitride selective oxidation mask is converted to silicon dioxide than in a 1000°C oxidation. This may require a thicker initial silicon nitride film which may induce additional stress into the silicon surface. This possibility should be explored before incorporation of a higher temperature oxidation into the poly-ox process.

D. Damaged-Silicon Resistors

Due to the lower density of free carriers for a given doping level, the resistivity of damaged-silicon material is higher than in the polysilicon used in the poly-ox process. Therefore, in using damaged silicon for a resistor material the present inactive base implant dose is no longer suitable for simultaneous predeposition of the resistor dopant. More suitable doping levels may be achieved concurrent with the phosphorous collector sinker or the arsenic emitter implant operations.

E. DSW Evaluation

Practical linewidth resolution on the GCA 4800 system appears to lie in the 1.0- to 1.25-μm range for oxide or aluminum on 2-in.-dia. wafers. A test PLA run is being exposed through all its processing steps to fully evaluate the DSW unit.

F. Polyimide

Polyimide implant masking is being assessed for practical resolution limits. Using a thin (~1000 Å) metal plasma etch mask, it appears that quite vertical-sided lines permitting resolution below 0.75 μm in 1.5-μm-thick polyimide are possible.

COMPUTER SYSTEMS
GROUP 28

An Amdahl 470V/7 replaced the IBM 370/168 during the quarter. As previously reported, the Lincoln V/7 consists of a central processor, 8 megabytes of main memory, 12 input/output channels, an operator's console, and a power distribution unit. These components replaced similar but less powerful units of the 370/168. All of the existing peripheral devices, such as magnetic tape drives, disk storage, and printers, have remained in place. The capacity of swapping disks used as a backing store for virtual memory was increased from 22 to 33 megabytes by the addition of a third unit and its controller.

The V/7 was turned over to the Laboratory on 28 March 1980. Because there was only one set of peripheral devices, and because of the very heavy user load on the IBM 370/168, only incremental testing of subsystems could be scheduled during the following week. At the end of the regular work day, Friday, 4 April, recabling and full system testing began. This was successfully completed over the weekend, and some of the batch production work was performed on the new system. On Monday, 7 April, users logged on to the 470V/7 with no software or procedure changes from the previous Friday. The only external appearance of change was an obvious improvement in performance.

The V/7 completed its 30-day acceptance test on schedule. User experience confirms the expected throughput of at least twice the 370/168 system. As soon as it became clear that the V/7 had successfully assumed the workload, the replaced 370/168 components were released to the Air Force for further use. The 370/168 had been in service at the Laboratory since 28 January 1974.

Although the installation of the new system necessarily dominated the software work of the past quarter, several new or updated facilities were also provided. Updated facilities include the PASCAL compiler, Release 6 of CMS, Release 6.7 of VS1, and on-line documentation of all Lincoln developed VM/370 commands. Newly provided facilities include the Statistical Analysis System (SAS) and an Eigen System package.

SOLID STATE
DIVISION 8

INTRODUCTION

This section of the report summarizes progress during the period 1 February through 30 April 1980. The Solid State Research Report for the same period describes the work of Division 8 in more detail. Funding is primarily provided by the Army, DARPA, Navy, NASA, NSF, and DOE.

A. L. McWhorter
Head, Division 8

I. Melngailis
Associate Head

DIVISION 8 REPORTS
ON ADVANCED ELECTRONIC TECHNOLOGY

15 February through 15 May 1980

PUBLISHED REPORTS

Journal Articles

JA No.			
5001	Effects of Narrow-Free-Spectral-Range Etalons of Mode-Locked Lasers	S. R. Chinn	Opt. Commun. 31, 359 (1979)
5014	Solid-Phase Growth of Large Aligned Grains During Scanned Laser Crystallization of Amorphous Ge Films on Fused Silica	J. C. C. Fan H. J. Zeiger R. P. Gale R. L. Chapman	Appl. Phys. Lett. 36, 158 (1980)
5017	Shallow-Homojunction GaAs Cells with High Resistance to 1-MeV Electron Radiation	J. C. C. Fan R. L. Chapman C. O. Bozler P. J. Drevinsky*	Appl. Phys. Lett. 36, 53 (1980)
5022	Metal-Atom Resonance-Line Lasers	D. J. Ehrlich R. M. Osgood, Jr.	IEEE J. Quantum Electron. QE-16, 257 (1980)
5027	Development of a High-Repetition-Rate Mini-TEA CO_2 Laser	N. Menyuk P. F. Moulton	Rev. Sci. Instrum. 51, 216 (1980)
5038	Self-Sustained Pulsations in GaInAsP Diode Lasers	J. N. Walpole T. A. Lind J. J. Hsieh A. G. Foyt	Appl. Phys. Lett. 36, 240 (1980)
5048	Nonvolatile Analog Memory in MNOS Capacitors	R. S. Withers R. W. Ralston E. Stern	IEEE Electron Devices Lett. EDL-1, 42 (1980)
5050	Remote Sensing of CO Using Frequency Doubled CO_2 Laser Radiation	D. K. Killinger N. Menyuk W. E. DeFeo	Appl. Phys. Lett. 36, 402 (1980)
5057	Observation of Stimulated Level Shifting in Inverted Atomic Thallium Populations	D. J. Ehrlich R. M. Osgood, Jr. A. Sanchez	Phys. Rev. Lett. 44, 871 (1980)
5060	Laser-Induced Microscopic Etching of GaAs and InP	D. J. Ehrlich R. M. Osgood, Jr. T. F. Deutsch	Appl. Phys. Lett. 36, 698 (1980)
5102	Ohmic Contacts to Silicon Devices Formed by Ion Implantation and Laser Annealing	D. J. Silversmith R. W. Mountain S. C. Munroe M. W. Geis	Solid State Technol. 23, 88 (1980)

*Author not at Lincoln Laboratory.

Meeting Speeches

MS No.			
4960A	Development and Applications of High-Speed InP Optoelectronic Switches	F. J. Leonberger P. F. Moulton	Topical Meeting on Integrated and Guided-Wave Optics, Incline Village, Nevada, 28-30 January 1980, Technical Digest, pp. WC5-1–WC5-4
5049	Wideband $LiNbO_3$ Elastic Convolver with Parabolic Horns	R. A. Becker D. H. Hurlburt	1979 Ultrasonics Symposium Proceedings (IEEE, New York, 1979), pp. 729-731
5058	Effects of Temperature-Dependent Anisotropy in RAC Devices and a Cut of Quartz for a Temperature-Compensated RAC	D. E. Oates R. C. Williamson	1979 Ultrasonics Symposium Proceedings (IEEE, New York, 1979), pp. 691-695
5059	Four-Wave Interactions in Acoustoelectric Integrating Correlators	R. W. Ralston E. Stern	1979 Ultrasonics Symposium Proceedings (IEEE, New York, 1979), pp. 761-766
5060	A SAW Accumulating Correlator with CCD Readout	R. W. Ralston D. L. Smythe E. Stern	1979 Ultrasonics Symposium Proceedings (IEEE, New York, 1979), pp. 771-775
5061	A CCD-Programmable SAW Matched Filter	D. L. Smythe R. W. Ralston E. Stern	1979 Ultrasonics Symposium Proceedings (IEEE, New York, 1979), pp. 767-770
5062	Wide Bandwidth Acoustoelectric Convolvers	I. Yao S. A. Reible	1979 Ultrasonics Symposium Proceedings (IEEE, New York, 1979), pp. 701-705
5081	Integrated Surface Acoustic Wave/Charge-Coupled Device (SAW/CCD) Signal Processing Devices	D. L. Smythe R. W. Ralston	Proc. SPIE Vol. 209: Optical Signal Processing for C^3I (Society of Photo-Optical Instrumentation Engineers, Bellingham, Washington, 1980), pp. 152-158
5082	A Satellite-Borne SAW Chirp-Transform System for Uplink Demodulation of FSK Communication Signals	R. C. Williamson V. S. Dolat R. R. Rhodes D. M. Boroson	1979 Ultrasonics Symposium Proceedings (IEEE, New York, 1979), pp. 741-747
5106	Comparison of Acousto-electric and Acousto-optic Signal Processing Devices	R. A. Becker S. A. Reible R. W. Ralston	Proc. SPIE Vol. 209: Optical Signal Processing for C^3I (Society of Photo-Optical Instrumentation Engineers, Bellingham, Washington, 1980), pp. 126-133
5133A	Laser Photochemical Techniques for Semiconductor Processing	T. F. Deutsch D. J. Ehrlich R. M. Osgood, Jr.	Conf. on Laser and Electro-optical Systems, OSA/IEEE, San Diego, California, 26-28 February 1980, Digest of Technical Papers, p. 108

MS No.			
5167	Device Requirements for Spread-Spectrum Communication	J. H. Cafarella	Proc. SPIE Vol. 209: Optical Signal Processing for C^3I (Society of Photo-Optical Instrumentation Engineers, Bellingham, Washington, 1980), pp. 53-56
5183	Advances in Transition-Metal-Doped Solid-State Lasers	P. F. Moulton A. Mooradian	Conf. on Laser and Electro-optical Systems, OSA/IEEE, San Diego, California, 26-28 February 1980, Digest of Technical Papers, p. 102
5186	Remote Sensing of NO Using a Differential Absorption LIDAR	N. Menyuk D. K. Killinger W. E. DeFeo	Conf. on Laser and Electro-optical Systems, OSA/IEEE, San Diego, California, 26-28 February 1980, Digest of Technical Papers, p. 94
5219	High-Speed Electro-Optical Signal Conversion Devices	F. J. Leonberger	Proc. SPIE Vol. 218: Devices and Systems for Optical Signal Processing (Society Photo-Optical Instrumentation Engineers, Bellingham, Washington, 1980) pp. 41-46
5248	Acoustoelectric Microcircuits: A New Technology for Signal Processing	R. W. Ralston	1980 IEEE International Symposium on Circuits and Systems Proceedings (IEEE, New York, 1980), pp. 1-9

* * * * *

UNPUBLISHED REPORTS

Journal Articles

JA No.			
5019	Doppler-Limited Spectroscopy of the $3\nu_3$ Band of SF_6	A. S. Pine A. G. Robiette*	Accepted by J. Mol. Spectrosc.
5040	The Effect of Implant Temperature on the Electrical Characteristics of Ion Implanted InP	J. P. Donnelly C. E. Hurwitz	Accepted by Solid-State Electron.
5043	Pump Depletion and Saturation of Two-Photon Resonant Third-Harmonic Generation Processes	H. Kildal S. R. J. Brueck	Accepted by IEEE J. Quantum Electron.
5049	Deconvolution of Infrared Spectra Beyond the Doppler Limit	J. Pliva* A. S. Pine P. D. Willson*	Accepted by Appl. Opt.
5051	The Electrical Characteristics of InP Implanted with the Column IV Elements	J. P. Donnelly G. A. Ferrante	Accepted by Solid-State Electron.

* Author not at Lincoln Laboratory.

JA No.			
5059	Stoichiometric Lasers	S. R. Chinn	Accepted for Handbook Series on Laser Science & Technology, Vol. I: Lasers in All Media (CRC Press, Inc., West Palm Beach, Florida)
5065	Ohmic Contact Formation on InP by Pulsed Laser Photochemical Doping	T. F. Deutsch D. J. Ehrlich R. M. Osgood, Jr. Z. L. Liau	Accepted by Appl. Phys. Lett.
5068	Direct Writing of Regions of High Doping on Semiconductors by UV-Laser Photodeposition	D. J. Ehrlich R. M. Osgood, Jr. T. F. Deutsch	Accepted by Appl. Phys. Lett.
5074	One-Step Repair of Transparent Defects in Hard-Surface Photolithographic Masks via Laser Photodeposition	D. J. Ehrlich T. F. Deutsch D. J. Silversmith R. M. Osgood, Jr.	Accepted by IEEE Electron Devices Lett.
5075	Picosecond Optical Sampling	H. A. Haus* S. T. Kirsch* K. Mathyssek* F. J. Leonberger	Accepted by IEEE J. Quantum Electron.
5082	Generation of Ultrashort Pulses in Synchronous Pumping of Near-Millimeter Wave Lasers	W. Lemley* A. V. Nurmikko* B. J. Clifton	Accepted by Intl. J. Infrared and Millimeter Waves
5084	Laser Sources and Detectors for Guided Wave Optical Signal Processing	I. Melngailis	Accepted by Opt. Eng.
5087	Far Infrared Heterodyne Detectors	P. E. Tannenwald	Accepted by Intl. J. Infrared and Millimeter Waves
5090	Long Wavelength Semiconductor Diode Lasers	I. Melngailis	Accepted in McGraw-Hill 1981 Yearbook of Science and Technology
5091	Convolver Technology for Spread Spectrum Communications	S. A. Reible	Accepted by IEEE Trans. Microwave Theory Tech.
5093	High-Temperature cw Operation of GaInAsP/InP Lasers Emitting at 1.5 μm	J. J. Hsieh	Accepted by Appl. Phys. Lett.
5096	Atomic Resonance-Line Lasers: New Sources for Analytical Atomic Spectrometry	D. J. Ehrlich R. M. Osgood, Jr. G. C. Turk* J. C. Travis*	Accepted by Anal. Chem.
5108	High-Speed Operation of $LiNbO_3$ Electrooptic Interferometric Waveguide Modulators	F. J. Leonberger	Accepted by Opt. Lett.

* Author not at Lincoln Laboratory.

JA No.			
5109	Crystallization Front Velocity During Scanned Laser Crystallization of Amorphous Ge Films	R. L. Chapman J. C. C. Fan H. J. Zeiger R. P. Gale	Accepted by Appl. Phys. Lett.

Meeting Speeches*

MS No.			
4530B, C	High-Resolution Molecular Spectroscopy Using a Tunable Difference-Frequency Laser Source	A. S. Pine	Seminars: Sandia Laboratory, Albuquerque, New Mexico, 23 April 1980; Los Alamos Scientific Laboratory, Los Alamos, New Mexico, 24 April 1980
4584C, D	Schottky Diodes and Their Application to Spectroscopy	H. R. Fetterman	Seminars: Raytheon, Waltham, Massachusetts, 6 February 1980; University of Massachusetts, Amherst, 10 March 1980
4878C	Liquid Phase Epitaxy of $Hg_{1-x}Cd_xTe$	T. C. Harman	2nd BACG Mtg. on "The Crystal Growth & Characterisation of II-VI Compounds," University of Lancaster, England, 14-16 April 1980
4894B	Efficient GaAs Shallow-Homojunction Solar Cells on Single-Crystal GaAs and Ge Substrates	J. C. C. Fan	Centro de Investigacion y de Estudios Avanzados del I.P.N., Mexico City, Mexico, 7 February 1980
4959A	Surface-Acoustic-Wave Devices for Processing Spread-Spectrum Signals	R. C. Williamson	Electrical Engineering Seminar, University of Pennsylvania, 6 March 1980
4960B	High-Speed InP Optoelectronic Sampling Device	F. J. Leonberger	Workshop on High-Speed A/D Conversion, Portland, Oregon, 11 February 1980
4967A	Graphoepitaxy of Silicon on Amorphous Substrates	H. I. Smith	American Physical Society Mtg., New York, New York, 24-28 March 1980
5223	A Precision Technique for Fabrication of Simple Metallic Microstructures with < 100 Å Dimensions	A. E. White† D. C. Flanders	
5225	Measurement of Spin-Orbit Splitting Δ_O in InP at 77 K Using Electroreflectance	K. Alavi† R. L. Aggarwal† S. H. Groves	
5000A	Magnetism and Chemical Reactions	H. J. Zeiger	Material Science Colloq. M.I.T., 8 February 1980

*Titles of Meeting Speeches are listed for information only. No copies are available for distribution.

† Author not at Lincoln Laboratory.

MS No.			
5152A	Laser Induced Photochemical Reactions for Electronic Device Fabrication	D. J. Ehrlich T. F. Deutsch R. M. Osgood, Jr.	Seminar, Xerox Corporation, Rochester, New York, 9 May 1980
5196	Electrode Band Structure and Interface States in Photoelectrochemical Cells	J. G. Mavroides J. C. C. Fan H. J. Zeiger	Photoeffects at Semiconductor-Electrolyte Interfaces Symp., Houston, Texas, 25 March 1980
5228	High-Temperature cw Operation of GaInAsP/InP Lasers Emitting at 1.5 μm	J. J. Hsieh	Topical Meeting on Integrated and Guided-Wave Optics, Incline Village, Nevada, 28-30 January 1980
5235A	Laser Photochemical Techniques for Semiconductor Processing	T. F. Deutsch	North Central Chapter of American Vacuum Society, Detroit, Michigan, 8 May 1980
5247A	Artificial Microstructures for Integrated Electronics	H. I. Smith	Applied Physics Seminar, California Institute of Technology, Pasadena, 1 February 1980
5250	Application of Artificial Microstructures to Chemistry	H. I. Smith	Chemistry Seminar, M.I.T., 12 February 1980
5250A, B	Submicrometer Structures Research & Applications	H. I. Smith	Seminars: Digital Equipment Corporation, Westboro, Massachusetts, 10 April 1980; College of the Holy Cross, Worcester, Massachusetts, 26 March 1980
5252	GaAs Monolithic Balanced Mixer and Monolithic MESFET Amplifier	A. Chu W. Courtney G. Lincoln L. Mahoney R. Sudbury	Workshop on Compound Semiconductors for Microwave Materials and Devices, San Francisco, California, 11-12 February 1980
5259	Charge-Coupled Devices for Signal Processing	B. E. Burke	Seminar, Iowa State University, Ames, 4 February 1980
5266	Laser Photochemistry and Its Application to Microelectronics	R. M. Osgood, Jr.	March Mtg., IEEE Quantum Electronics, Waltham, Massachusetts, 20 March 1980
5268	Wide Bandwidth CO_2 Laser Photomixers	D. L. Spears	SPIE Technical Symposium East '80, Washington, D.C., 7-11 April 1980
5345	Detectors for the 1.1 – 1.6 μm Spectral Region	C. E. Hurwitz	
5277	Far Infrared Heterodyne Systems	P. E. Tannenwald	Heterodyne Systems and Technology Conf., Williamsburg, Virginia, 25-27 March 1980
5293	Laser Sources for Heterodyne Detection	A. Mooradian	

MS No.			
5312	Extending the Operating Temperature, Wavelength and Frequency Response of HgCdTe Heterodyne Detectors	D. L. Spears	Heterodyne Systems and Technology Conf., Williamsburg, Virginia, 25-27 March 1980
5290, A, B	Millimeter and Submillimeter Wave Schottky Diode Receivers	B. J. Clifton	Seminars: U.S. Army Electronics Research and Development Command, Fort Monmouth, New Jersey, 28 February 1980; New Jersey Chapter IEEE, Monmouth College, New Jersey, 28 February 1980; Brown University, Providence, Rhode Island, 7 March 1980
5296	Recent Applications of Microstructure Fabrication Technology	D. C. Flanders	Seminar, Yale University, New Haven, Connecticut, 7 March 1980
5363	Progress in Microfabrication: Applications to 1-D Conduction Studies	A. E. White	Seminar, Middlebury College, Middlebury, Vermont, 23 April 1980

SOLID STATE
DIVISION 8

I. SOLID STATE DEVICE RESEARCH

High-speed operation of $LiNbO_3$ electrooptic interferometric waveguide modulators for use in optical A/D converters has been demonstrated. Modulation up to 1.4 GHz has been achieved and RF modulation of the 275-MHz pulse train from a CW mode-locked frequency-doubled Nd:YAG laser has been observed.

A systematic study of the LPE growth of $Ga_xIn_{1-x}As_yP_{1-y}$ has been carried out over the entire range of layer compositions which are nearly lattice-matched to InP substrates. The results of the investigation enable the LPE-grown layer thickness to be calculated for various values of step-cooling, growth time, and composition.

A terraced surface morphology is found to be characteristic of heavily Zn-doped InP layers grown by LPE on substrates nominally oriented to (100). Noticeably smoother growth results if the substrates are oriented to a critical angle, which other workers have determined to be 2.6° off (100) in a ⟨110⟩ direction. For not intentionally doped and Sn-doped growths, the terraced morphology is not evident and use of substrates oriented to the critical angle or those accurately oriented to (100) does not improve the morphology.

Liquidus measurements have been carried out in the Te-corner of the Hg-Cd-Te phase diagram by a modified direct observational method. The technique eliminates supercooling as a source of error and yields liquidus temperatures significantly higher than previous values for solution compositions of interest for the liquid phase epitaxial growth of $Hg_{1-x}Cd_xTe$ from Te-rich melts.

II. QUANTUM ELECTRONICS

Remote-sensing measurements of C_2H_4 have been made at ranges up to 2.7 km with a CO_2 laser differential-absorption LIDAR system, which has been significantly improved by the incorporation of a dual-computer high-speed digital data acquisition system. In addition, preliminary statistical analysis of the LIDAR returns has been used to study the effect of atmospheric turbulence.

Ultraviolet laser action has been obtained from a 5d-4f transition in Ce^{3+}-doped LaF_3. The 286-nm wavelength obtained is the shortest of any solid-state laser.

A technique for simple, one-step correction of transparent defects in hard-surface, photolithographic masks has been demonstrated. The correction process uses laser photodeposition of a metal film from a metal-alkyl parent gas.

A pulsed ArF excimer laser has been used to fabricate silicon solar cells. The laser causes localized photolysis of $Al(CH_3)_3$ or $B(CH_3)_3$, which combined with laser heating, produces p-doped regions on n-Si substrates.

III. MATERIALS RESEARCH

By using a new technique, the CLEFT process, multiple single-crystal GaAs films have been grown by vapor-phase epitaxy on reusable substrates and transferred without significant degradation to secondary glass substrates. Because it can greatly reduce the quantity of bulk

single-crystal material needed in the fabrication of semiconductor devices utilizing thin active regions, the CLEFT process should permit a drastic reduction in the cost of devices such as solar cells where wafer cost is currently a major factor; because it can be used to obtain high-quality single-crystal films on a variety of secondary substrates, the process can provide new approaches to the fabrication of integrated circuits on insulating substrates and of multilayer devices and circuits.

IV. MICROELECTRONICS

A SAW/MOSFET gap-coupled memory correlator which uses an array of MOSFETs to record an image of a SAW reference waveform from sampling fingers on a silicon chip has been demonstrated. The reference waveform is entered at the input of a SAW device, and a subsequent SAW signal is multiplied by the sampled reference and the products summed on an output electrode.

A 32-stage CCD transversal filter with taps programmable as 6-bit digital words has been built using a new architecture which allows more stages and more bits per tap to be achieved in a given chip area than was possible with earlier designs. The key to this design is the use of a multiplying D/A converter at the inputs to the filter. Matched filtering using a chirp waveform has been demonstrated with this device.

A new technique for fabricating high-contrast x-ray masks with precisely controlled linewidths smaller than 100 Å has been developed. The technique is based on the deposition at an oblique angle of x-ray absorber material onto relief structures of triangular and square section in a polyimide membrane.

A submicrometer gate-length GaAs FET has been fabricated as a test vehicle for the development of a device processing sequence which would not require alignment when writing or replicating the submicrometer patterns. Submicrometer alignment is eliminated by having the gate-processing step precede the ohmic contact step. A typical device with total gate dimensions of 0.45 μm by 104 μm exhibits a noise figure of 3.5 dB at 12 GHz, with an associated gain of 5 dB.

V. ANALOG DEVICE TECHNOLOGY

A surface-acoustic-wave (SAW) spectrum analyzer has been incorporated as the key signal-processing element in a prototype infrared airborne radar. The processor is designed to identify signals from moving targets while rejecting noise and ground clutter returns in order to provide automatic target acquisition. An analysis of the signal-processing trade-offs for various processors shows that the SAW equipment developed is well matched to the infrared radar application.

A novel method of maintaining accuracy in a chirp-Fourier-transform system has been demonstrated in which each port of the reflective-array expander device is sequentially impulsed. Use of this new technique permits controlled shifts in digitally timed impulses to generate the precise chirp waveforms required, and thereby greatly simplifies the task of automatically preserving system stability.

The effects of acoustic dispersion and attenuation on the performance of SAW convolvers are shown to be equivalent to an ideal SAW convolver in cascade with a linear time-invariant filter. Using this result, the implementation loss due to acoustic dispersion and attenuation, transducer band-pass response, and input/output matching networks has been calculated. Design criteria include the effects of phase and amplitude distortion which are representative of typical convolvers.

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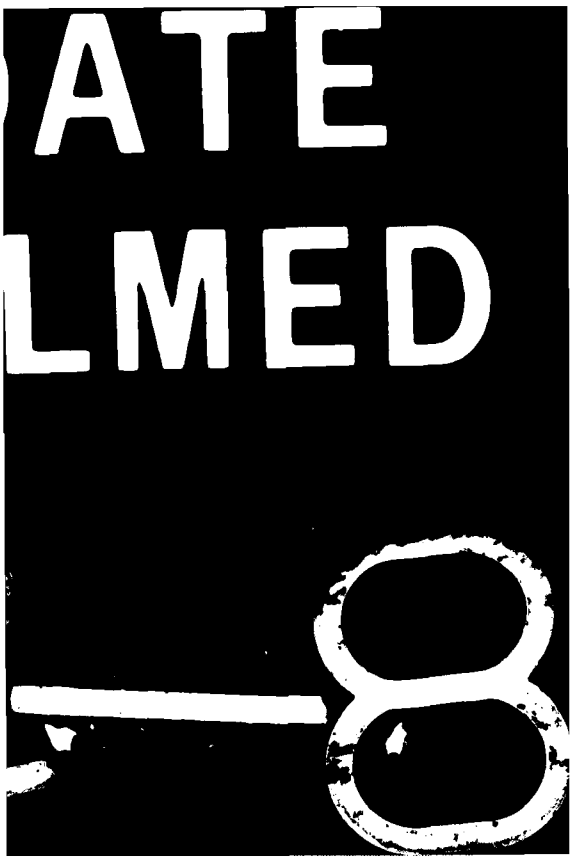
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