

# Contents

---

## Part I Ultrafast Optics and Electronics

---

Ultrafast Optical Electronics: From Femtoseconds to Terahertz By D.H. Auston, K.P. Cheung, J.A. Valdmanis, and P.R. Smith (With 3 Figures) .....	2
Prospects of High-Speed Semiconductor Devices By N. Chand and H. Morkoc (With 6 Figures) .....	9
The Role of Ultrashort Optical Pulses in High-Speed Electronics By C.V. Shank (With 2 Figures) .....	18
GaAs Integrated Circuit Technology for High Speed Analog and Digital Electronics. By R. Castagne and G. Nuzillat (With 7 Figures) .....	23
Heterojunction Bipolar Transistor Technology for High-Speed Integrated Circuits. By P.M. Asbeck (With 5 Figures) .....	32
Permeable Base Transistor. By R.A. Murphy (With 6 Figures) .....	38
Two Dimensional E-Field Mapping with Subpicosecond Resolution By K.E. Meyer and G.A. Mourou (With 4 Figures) .....	46
Picosecond Electrooptic Sampling and Harmonic Mixing in GaAs By B.H. Kolner, K.J. Weingarten, M.J.W. Rodwell, and D.M. Bloom (With 3 Figures) .....	50
Characterization of TEGFETs and MESFETs Using the Electrooptic Sampling Techniques. By K.E. Meyer, D.R. Dykaar, and G.A. Mourou (With 4 Figures) .....	54
Picosecond Electro-Electron Optic Oscilloscope By S. Williamson and G. Mourou (With 5 Figures) .....	58
Picosecond Optoelectronic Diagnostics of Field Effect Transistors By D.E. Cooper and S.C. Moss (With 4 Figures) .....	62
Time-Domain Measurements for Silicon Intergrated Circuit Testing Using Photoconductors. By W.R. Eisenstadt, R.B. Hammond, D.R. Bowman, and R.W. Dutton (With 3 Figures) .....	66
Modeling of Picosecond Pulse Propagation on Silicon Integrated Circuits By K.W. Gossen and R.B. Hammond (With 4 Figures) .....	70

---

## Part II High-Speed Phenomena in Bulk Semiconductors

---

Picosecond Processes in Carrier Transport Theory By D.K. Ferry (With 4 Figures) .....	76
Carrier-Carrier Interaction and Picosecond Phenomena in Polar Semiconductors. By P. Lugli and D.K. Ferry (With 4 Figures) .....	83
Subpicosecond Raman Spectroscopy of Electron-LO Phonon Dynamics in GaAs By J.A. Kash, J.C. Tsang, and J.M. Hvam (With 3 Figures) .....	87
Acoustic Phonon Generation in the Picosecond Dynamics of Dense Electron-Hole Plasmas in InGaAsP Films. By J.M. Wiesenfeld (With 3 Figures) .....	91
Picosecond Time-Resolved Photoemission Study of the InP (110) Surface By J. Bokor, R. Haight, J. Stark, R.H. Storz, R.R. Freeman, and P.H. Bucksbaum (With 2 Figures) .....	94
Monte Carlo Investigation of Hot Carriers Generated by Subpicosecond Laser Pulses in Schottky Barrier Diodes. By M.A. Osman, U. Ravaioli, and D.K. Ferry (With 2 Figures) .....	97

---

## Part III Quantum Structures and Applications

---

Properties of GaAlAs/GaAs Quantum Well Heterostructures Grown by Metalorganic Chemical Vapor Deposition. By R.D. Burnham, W. Streifer, T.L. Paoli, R.L. Thornton, and D.L. Smith .....	102
Molecular Beam Epitaxy Materials for High-Speed Digital Heterostructure Devices. By D.L. Miller (With 4 Figures) .....	105
New High-Speed Quantum Well and Variable Gap Superlattice Devices By F. Capasso (With 18 Figures) .....	112
Electric Field-Induced Decrease of Exciton Lifetimes in GaAs Quantum Wells. By J.A. Kash, E.E. Mendez, and H. Morkoc (With 2 Figures) .....	131
Reduction of Electron-Phonon Scattering Rates by Total Spatial Quantization. By M.A. Reed, R.T. Bate, W.M. Duncan, W.R. Frensley, and H.D. Shih (With 3 Figures) .....	135
Hot Electron Diffusion in Superlattices By J. Ho and R.O. Grondin (With 3 Figures) .....	139
Time-Resolved Photoluminescence of GaAs/Al <sub>x</sub> Ga <sub>1-x</sub> As Quantum Well Structures Grown by Metal-Organic Chemical Vapor Deposition By J.E. Fouquet, A.E. Siegman, R.D. Burnham, and T.L. Paoli (With 5 Figures) .....	143
A Study of Exciton and Carrier Dynamics and a Demonstration of One- Picosecond Optical NOR Gate Operation of a GaAs-AlGaAs Device By N. Peyghambarian, H.M. Gibbs, J.L. Jewell, A. Migus, A. Antonetti, D. Hulin, and A. Mysyrowicz (With 2 Figures) .....	148

Exciton-Exciton Interaction in GaAs-GaAlAs Superlattices By D. Hulin, A. Migus, A. Antonetti, A. Mysyrowicz, H.M. Gibbs, N. Peyghambarian, H. Morkoc, and W.T. Masselink (With 3 Figures) .....	151
---	-----

---

#### Part IV Picosecond Diode Lasers

---

An InGaAsP 1.55 $\mu\text{m}$ Mode-Locked Laser with a Single-Mode Fiber Output By G. Eisenstein, S.K. Korotky, R.S. Tucker, R.M. Jopson, L.W. Stulz, J.J. Veselka, and K.L. Hall (With 7 Figures) .....	156
Fast Multiple Quantum Well Absorber for Mode Locking of Semiconductor Lasers. By Y. Silberberg, P.W. Smith, D.A.B. Miller, B. Tell, A.C. Gossard, and W. Wiegmann (With 3 Figures) .....	159
Suppression of Timing and Energy Fluctuations in a Modelocked Semiconductor Laser by cw Injection. By F. Mengel, C. Lin, and N. Gade (With 5 Figures) .....	163
Parametric Oscillations in Semiconductor Lasers By D. Haas, J. McLean, J. Wurl, T.K. Gustafson, and C.L. Tang .....	167

---

#### Part V Optoelectronics and Photoconductive Switching

---

Ultrafast Traveling-Wave Light Modulators with Reduced Velocity Mismatch. By M. Izutsu, H. Haga, and T. Sueta (With 4 Figures) .....	172
Modulation of an Optical Beam by a Second Optical Beam in Biased Semi-Insulating GaAs. By L.M. Walpita, W.S.C. Chang, H.H. Wieder, and T.E. Van Eck (With 6 Figures) .....	176
22-GHz Bandwidth InGaAs/InP PIN Photodiodes By J.E. Bowers, C.A. Burrus, and R.S. Tucker (With 4 Figures) .....	180
An Ultrafast Diffusion-Driven Detector By A.G. Kostenbauder and A.E. Siegman (With 1 Figure) .....	184
Picosecond Photoconductivity in Polycrystalline CdTe Films Prepared by UV-Enhanced OMCVD. By A.M. Johnson, D.W. Kisker, W.M. Simpson, and R.D. Feldman (With 3 Figures) .....	188
High-Speed Internal Photoemission Detectors Enhanced by Grating Coupling to Surface Plasma Waves. By S.R.J. Brueck, V. Diadiuk, T. Jones, and W. Lenth (With 3 Figures) .....	193
Submicron-Gap Photoconductive Switching in Silicon By G.G. Shahidi, E.P. Ippen, and J. Melngailis (With 4 Figures) .....	197
Hertzian Dipole Measurements with InP Photoconductors By P.M. Downey and J.R. Karin (With 3 Figures) .....	201
Pulse Waveform Standards for Electro-Optics By R.A. Lawton .....	205

High-Speed Optoelectronic Track-and-Hold Circuits in Hybrid Signal Processors for Wideband Radar. By I. Yao, V. Diadiuk, E.M. Hauser, and C.A. Bouman (With 4 Figures) .....	207
Optoelectronic Modulation of Millimeter Waves in a Silicon-on-Sapphire Waveguide. By C.H. Lee, A.M. Yurek, M.G. Li, E.A. Chauchard, and R.P. Fischer (With 4 Figures) .....	212
Direct DC to RF Conversion by Impulse Excitation of a Resonant Cavity By M.G. Li, C.H. Lee, A. Caroglanian, E.A. Greene, C.Y. She, P. Polak-Dingels, and A. Rosen (With 4 Figures) .....	216
Kilovolt Sequential Waveform Generation by Picosecond Optoelectronic Switching in Silicon. By C.S. Chang, M.J. Rhee, C.H. Lee, A. Rosen, and H. Davis (With 4 Figures) .....	220
Femtosecond Nonlinearities of Standard Optical Glasses By J. Etchepare, I. Thomazeau, G. Grillon, A. Migus, and A. Antonetti (With 3 Figures) .....	224

---

## *Part VI Cryoelectronics*

---

High-Speed Analog Signal Processing with Superconductive Circuits By R.W. Ralston (With 7 Figures) .....	228
Picosecond Sampling with Josephson Junctions By P. Wolf (With 5 Figures) .....	236
Transmission Line Designs with a Measured Step Response of 3ps per Centimeter. By C.J. Kryzak, K.E. Meyer, and G.A. Mourou (With 5 Figures) .....	244
Development of a Picosecond Cryo-Sampler Using Electro-Optic Techniques By D.R. Dykaar, T.Y. Hsiang, and G.A. Mourou (With 4 Figures) .....	249
Picosecond Josephson Logic Gates for Digital LSIs By J. Sone, J.-S. Tsai, and H. Abe (With 5 Figures) .....	253
Index of Contributors .....	257