

Contents

PART I LASER PHYSICS AND LASER CHEMISTRY

<i>High-Resolution Spectroscopy</i>	3
Recent Advances in Laser Spectroscopy <i>T. W. Hänsch, Stanford University, U.S.A.</i>	5
Tunable-Laser Stabilization Techniques for Ultrahigh-Resolution Spectroscopy <i>J. L. Hall, National Bureau of Standards and University of Colorado, U.S.A.</i>	15
High-Resolution Spectroscopy of Molecular Hydrogen at 83 nm. <i>M. Rothschild, H. Egger, R. T. Hawkins, J. Bokor, H. Pummer, and C. K. Rhodes, University of Illinois at Chicago Circle, U.S.A.</i>	35
Laser Spectroscopy of Hydrogen <i>T. W. Hänsch, Stanford University, U.S.A.</i>	41
Laser Spectroscopy in Solids <i>W. M. Yen, University of Wisconsin, U.S.A.</i>	43
Color-Center Laser Spectroscopy of Small Free Radicals <i>C. R. Pollock, P. F. Curl, Jr., and F. K. Tittel, Rice University, U.S.A., G. Litfin, Universität Hannover, F.R.G., and J. V. V. Kasper, University of California, U.S.A.</i>	51
Magic-Angle Line Narrowing in Optical Spectroscopy <i>S. C. Rand, A. Wokaun, R. G. DeVoe, and R. G. Brewer, IBM Research Laboratory, U.S.A.</i>	65

<i>Laser Chemistry</i>	71
Applications of Lasers in Chemistry <i>H. Walther, Universität München and Max-Planck-Gesellschaft, F.R.G.</i>	73
Infrared Multiphoton Chemistry: Some Recent Developments <i>H. van den Bergh, Institute of Physical Chemistry, ETH, Switzerland</i>	91
Theory of Multiphoton Dissociation of Polyatomic Molecules in an Intense Infrared Laser Field <i>Gan Zizhao, Beijing University, China, and Yang Guozhen, Huang Xiyi, and Feng Kean, Institute of Physics, Academia Sinica, China</i>	107
Infrared Multiphoton Dissociation of Methanol <i>Zhang Yunwu, Yu Shuqin, Zhang Jixiang, and Ma Xingxiao, Chinese University of Science and Technology, China</i>	113
The Chemical Specificity of Enzymes and the Possibility of Laser Catalysis <i>Li Kexue and Cai Shidong, Institute of Physics, Academia Sinica, China</i>	121
Anomalous Emission in Photosynthetic Systems <i>Sun Binrong and Zhao Shenduan, Shanghai Institute of Plant Physiology, Academia Sinica, China, and Lin Yixian, Li Fuming, and Zhao Yancheng, Fudan University, China</i>	129
<i>Lasing Process</i>	133
Measurement of Kinetics of Processes in Rare-Gas and Mercury Halide Lasers <i>R. W. Waynant and J. G. Eden, Naval Research Laboratory, U.S.A</i>	135
Chemiluminescence Studies of the Reaction of Na + CCl ₄ <i>Li Xuechu, Wang Xiuyan, and Lou Nanquan, Dalian Institute of Chemical Physics, Academia Sinica, China</i>	145
The Nonradiative Energy-Transfer Process in Nd-Doped Laser Glasses <i>Gan Fuxi, Chen Shuchun, and Hu Hefang, Shanghai Institute of Optics and Fine Mechanics, Academia Sinica, China</i>	157
Zeeman Effect and Mode-Competition Effect in Two-Frequency Lasers <i>Ba Enxu and Liu Yuzhao, Nankai University, China</i>	169
Laser Application Activities in China <i>Wang Daheng, Changchun Institute of Optics and Fine Mechanics, Academia Sinica, China, and Wo Xinneng, Shanghai Institute of Optics and Fine Mechanics, Academia Sinica, China</i>	171
Recent Advances in Laser-Triggered Switching <i>A. H. Guenther, Air Force Weapons Laboratory, U.S.A.</i>	187

CONTENTS	xi
<i>Interaction of Lasers with Matter</i>	201
Laser Scattering of Concentration and Temperature Determination in Turbulence and Combustion Studies	203
<i>R. K. Chang, M. B. Long, D. V. Murphy, and B. T. Chu, Yale University, U.S.A.</i>	
Near-Resonance Scattering of Collision-Perturbed Atoms with Double Excited States	217
<i>Zhang Yixiang, Han Quansheng, Luo Zhengji, and Cheng Wenqin, Institute of Physics, Academia Sinica, China</i>	
Four-Wave Mixing and Its Relaxation Effect in Liquid Crystals	225
<i>Ye Peixuan, Chu Guiyin, Zhang Zhiguo, Fu Panming, Ji Guoshu, and Lin Xi, Institute of Physics, Academia Sinica, China</i>	
Twofold Degenerate Four-Wave Mixing and Image Conversion	231
<i>Wu Cunkai, Fan Junyin, and Wang Zhiying, Shanghai Institute of Optics and Fine Mechanics, Academia Sinica, China</i>	
Laser Cooling of Gas Atoms by the AC Stark Effect	239
<i>Wang Yuzhu, Shanghai Institute of Optics and Fine Mechanics, Academia Sinica, China</i>	
Laser Kinetic Spectroscopy of Elementary Gas-Phase Processes (Abstract)	245
<i>C. Wittig, University of Southern California, U.S.A.</i>	
Giant Atoms Interacting with Radiation (Abstract)	245
<i>S. Haroche, Ecole Normale Supérieure, France</i>	
Time Development of Surface-Enhanced Raman Scattering from Molecules Absorbed on Metal Electrodes (Abstract)	246
<i>R. K. Chang, Yale University, U.S.A.</i>	
High-Resolution Spectroscopy of Atoms and Molecules in Monochromatic Fields (Listing)	247
<i>S. Ezekiel, Massachusetts Institute of Technology, U.S.A.</i>	
Applications in Laser Photochemistry (Listing)	247
<i>K. Boyer, Los Alamos Scientific Laboratory, U.S.A.</i>	
 PART II LASERS AND LASER COMPONENTS 	
<i>Components</i>	251
Laser-Induced Damage in Optical Thin Films	253
<i>A. H. Guenther, Air Force Weapons Laboratory, U.S.A.</i>	
Laser-Material Research in China	267
<i>Gan Fuxi, Shanghai Institute of Optics and Fine Mechanics, Academia Sinica, China</i>	

Enhancement of Second Harmonic Generation in LiNbO ₃ Crystals with Polysynthetic Domains	283
<i>Hong Jingfen, Ming Naiben, Yang Yongshun, Zhu Jinsong, Yang Zhen, Wang Yening, and Feng Duan, Nanking University, China</i>	
The Properties of Gradient Index Antireflection Layer on the Phase Separable Glass	289
<i>Y. Asahara and T. Izumitani, Hoya Corporation, Japan</i>	
The Growth of Large, Good-Quality (Nd, La)P ₅ O ₁₄ Laser Crystals	293
<i>Chen Fusheng, Chen Huanchu, Liu Yaogang, Lu Baosheng, and Han Jianru, Shandong University, China</i>	
The TEM ₀₀ -Thermoinsensitive Cavity with Several Thermoperturbing Centers	299
<i>Zhang Guangyin, Nankai University, China</i>	
	307
<i>Pumping Methods</i>	
Free-Electron Lasers	309
<i>C. A. Brau, Los Alamos Scientific Laboratory, U.S.A.</i>	
Problems of Energy Deposition in e-Beam-Pumped Gas Lasers	327
<i>Zhao Zhonghong, Wang Shaoying, and Wu Chengmu, Institute of Electronics, Academia Sinica, China</i>	
Discharge-Pumped UV and Visible Lasers	337
<i>Chen Jianwen, Fu Shufen, and Liu Miaohong, Shanghai Institute of Optics and Fine Mechanics, Academia Sinica, China</i>	
	343
<i>Chemical Lasers</i>	
Investigation of an Electron-Beam-Initiated Pulsed HF Chemical Laser	345
<i>Sha Guohe, Yin Houming, Zhou Dazheng, Yang Guansheng, Han Denglong, Shi Shuguo, Wang Xueling, Cai Peihua, Wang Zhengi, Li Xinhua, Wang Ruqing, and Zhang Cunhao, Dalian Institute of Chemical Physics, Academia Sinica, China</i>	
Generalized Kinetic Model of CW Flow Chemical Lasers	355
<i>Gao Zhi, Zhao Lie, and E. Xuequan, Institute of Mechanics, Academia Sinica, China</i>	
Blumlein-Discharge-Initiated HF Chemical Laser	371
<i>Fu Shufen, Chen Jianwen, and Liu Miaohong, Shanghai Institute of Optics and Fine Mechanics, Academia Sinica, China</i>	
Experimental Demonstration of a Potential High-Energy HCl Chemical-Laser System	377
<i>Hu Shiheng, Yang Boling, Ma Yueren, Wang Yang, and Zhang Cunhao, Dalian Institute of Chemical Physics, Academia Sinica, China</i>	

CONTENTS	xiii
<i>Excimer Lasers</i>	379
High-Repetition-Rate Rare-Gas Halide Lasers <i>C. P. Wang, Aerospace Corporation, U.S.A.</i>	381
Tunable Electron-Beam-Pumped Excimer Lasers <i>F. K. Tittel, W. L. Wilson, G. Marowsky, W. E. Ernst, and M. Smayling, Rice University, U.S.A.</i>	387
Investigations on Excimer Lasers with Various Pumping Schemes <i>Gu Zhiyu and Cao Quisheng, Institute of Electronics, Academia Sinica, China</i>	399
<i>Gas and Vapor Lasers</i>	413
A 2.5-kW Transverse-Flow CO ₂ Laser <i>Wang Zheen, Su Baorong, Hu Shaoyi, Chen Kexin, Wu Donglai, Xi Quanxin, Cui Jinsi, Yu Zhijiang, and Cheng Zhaogu, Shanghai Institute of Optics and Fine Mechanics, Academia Sinica</i>	415
Investigation of a Tunable High-Power CW CO ₂ Laser Using a Compound Cavity <i>He Maoqi, Gao Rufang, Zheng Jiabiao, and Zhao Youyuan, Fudan University, China</i>	421
A Near-Infrared, High-Power Gas Laser: The Iodine Laser <i>J. C. Guyot, Compagnie Générale d'Electricité, France</i>	431
Long-Lived, Sealed-Off Metal-Vapor Lasers <i>C. S. Liu and D. W. Feldman, Westinghouse R & D Center, U.S.A.</i>	433
<i>Solid Lasers</i>	435
Recent Advances in Transition-Metal-Doped Tunable Lasers <i>P. F. Moulton and A. Mooradian, Lincoln Laboratory, M.I.T., U.S.A.</i>	437
Stable Single-Axial-Mode Operation of a High-Power Nd-YAG Oscillator by Injection Locking <i>R. L. Byer, Stanford University, U.S.A.</i>	447
Acoustooptical Mode Locking of a CW Nd-YAG Laser <i>Zhang Zhengxiang and Zhao Renjun, North China Research Institute of Electro-Optics</i>	457
A Theoretical Analysis of Langmuir Flow Effects in Ring Lasers (Abstract) <i>Jiang Yanan, Quinghua University, and Liao Fuzhong, National Institute of Metrology, China</i>	459
Electron Beams for e-Beam Lasers (Abstract) <i>Gary K. Loda, Systems, Science & Software Co., U.S.A.</i>	459

Gas Lasers Preionized by Pulse or CW X-rays (Abstract)	460
<i>Tsunenori Arai, Minoru Obara, Tomoo Fujioka, Keio University, Japan</i>	
Rare-Gas and Mercury Halide Lasers (Abstract)	461
<i>Joel H. Parks, AVCO Everett Research Laboratory, U.S.A.</i>	
Discharge-Excited Metal Excimer Systems (Abstract)	461
<i>C. S. Liu and D. W. Feldman, Westinghouse R & D Center, U.S.A.</i>	
Discharge-Excited Rare-Gas Halide Lasers (Listing)	462
<i>N. Djeu, Naval Research Laboratory, U.S.A.</i>	
Tunable F-Center Lasers (Listing)	462
<i>William G. Clark, Burleigh Instruments Inc., U.S.A.</i>	

PART III LASER FUSION

<i>General Progress</i>	465
LLL Laser-Fusion-Program Overview and Future Directions in Laser Fusion Systems	467
<i>J. L. Emmett, Lawrence Livermore Laboratory, U.S.A.</i>	
Status of Fusion Implosion Experiments at LLL	471
<i>E. K. Storm, Lawrence Livermore Laboratory, U.S.A.</i>	
Progress in Inertial Fusion Research at the Los Alamos Scientific Laboratory	499
<i>Roger B. Perkins, Los Alamos Scientific Laboratory, U.S.A.</i>	
Laser Fusion Research at ILE Osaka	513
<i>C. Yamanaka, Institute of Laser Engineering, Osaka University, Japan</i>	
<i>High-Power Laser Systems</i>	527
Development of High-Power Laser Systems for Laser-Fusion Research	529
<i>Deng Ximing, Shanghai Institute of Optics and Fine Mechanics, Academia Sinica, China</i>	
Pulsed-Power Technology for Particle-Beam Fusion	537
<i>J. P. Van Devender, T. H. Martin, D. L. Johnson, E. L. Neau, J. T. Crow, and G. Yonas, Sandia National Laboratory, U.S.A.</i>	
<i>Topical Research</i>	547
CO ₂ -Laser-Target Interaction Experiments	549
<i>Tai Ho Tan, Los Alamos Scientific Laboratory, U.S.A.</i>	

CONTENTS	xv
Recent Laser-Plasma Interaction Experiments at the Lawrence Livermore National Laboratory	559
<i>Peter Hoong-Yee Lee, Lawrence Livermore Laboratory, U.S.A.</i>	
Investigation of Laser-Plasma Interaction and Target Compression	571
<i>Deng Ximing, Xu Zhizhan, Yu Wenyan, Shanghai Institute of Optics and Fine Mechanics, Academia Sinica, China</i>	
X-Ray Spectroscopic Diagnostics of Laser Plasma	585
<i>Lu Renxiang, Yin Guangyu, Fan Pinzhong, and Gong Weiyan, Shanghai Institute of Optics and Fine Mechanics, Academia Sinica, China</i>	
Spectroscopic Study of Laser-Supported Absorption Waves	593
<i>P. S. P. Wei, Boeing Aerospace Company, U.S.A.</i>	
Stimulated Scattering and Harmonic Generation in Homogeneous and Inhomogeneous Laser Plasma	603
<i>Tan Weihai, Wang Runwen, and Dung Liming, Shanghai Institute of Optics and Fine Mechanics, Academia Sinica, China</i>	
Solitary Waves in a Plasma	615
<i>Chen Yashen, Lin Dewen, Gao Fei, and Wang Daxian, Institute of Atomic Energy, Academia Sinica, China</i>	
Laser Drivers for Inertial-Fusion Reactors (Abstract)	625
<i>William F. Krupke, Lawrence Livermore Laboratory, U.S.A.</i>	
High-Density Implosion Experiments at Helios (Abstract)	625
<i>Tai Ho Tan and Gene H. McCall, Los Alamos Scientific Laboratory, U.S.A.</i>	
High-Efficiency CO ₂ Lasers for Inertial-Confinement Fusion (Listing)	626
<i>Sidney Singer, Los Alamos Scientific Laboratory, U.S.A.</i>	
Particle-Beam Diagnostics (Listing)	626
<i>J. Chang, Sandia National Laboratory, U.S.A.</i>	

PART IV LASERS IN MEDICINE

<i>Medical Use of Lasers</i>	631
Laser Diagnostic Medicine	631
<i>Leon Goldman, University of Cincinnati, U.S.A.</i>	
Some Aspects of Laser Medicine and Its Clinical Applications	645
<i>Qin Jianan and Liu Bingrong, Shanghai Second Medical College, China</i>	

Study of the Chromatin Functional State by Means of Laser Fluorescent Microirradiation: Preliminary Results on Human Lymphocytes	651
<i>G. Bottiroli, P. G. Cionini, F. Docchio, and C. A. Sacchi, C.N.R., Università di Pavia, Università di Pisa, and Politecnico di Milano, Italy</i>	
The Effects of He-Ne Laser Irradiation on the Regenerative Process of Wounded Skin of White Mice	661
<i>Ma Shuye and Xu Hao, Zhongshan University, China</i>	
<i>Laser Surgery</i>	663
Surgical Applications of Lasers	665
<i>Stanley Stellar, St. Barnabas Medical Center, U.S.A.</i>	
Fiber-Optic Laser Tunneling Device—the Laser Catheter	685
<i>Daniel S. J. Choy, Columbia Presbyterian Medical Center, U.S.A.</i>	
Combined Laser Therapy—a New Possibility	691
<i>Narong Nimsakul, Tokai University, Japan</i>	
<i>Laser Therapy on Tumors</i>	699
Laser Treatment of Vascular Tumors	701
<i>B. L. Aronoff, Baylor University Medical Center, U.S.A.</i>	
Surgical Applications of Carbon Dioxide Lasers in Gynecology	709
<i>Helmut F. Schellhas, University of Cincinnati College of Medicine, U.S.A.</i>	
Nd-YAG Lasers in the Treatment of Oral Hemangiomas	719
<i>Ma Paozhang, Zhou Hui, Xu Songling, and Shuo Ruipeng, Shanghai Second Medical College, China</i>	
Current Progress of Laser Therapy on Malignant Tumors in Head and Facial Regions	727
<i>Liu Demin, Yan Xuxia, Wei Xiubin, Shanghai First Medical College, China</i>	
<i>Laser Microsurgery</i>	735
Recent Advances in the Use of CO ₂ Laser in Neurosurgery	737
<i>P. W. Asher, University Clinic of Neurosurgery, Austria</i>	
Ruby- and Argon-Laser Treatment of Fundus Disease	743
<i>Zhang Chengfen and Zhu Xuanhe, Capital Hospital, Beijing, China</i>	
Animal Experiments and Clinical Applications of the Dye-Laser Ophthalmic Treatment Apparatus	749
<i>Wang Kangsun, Wei Yuehua, Zhang Mingheng, Shi Xianghe, and Shi Haiyun, Rui Jin Hospital and Shanghai Second Medical College, China</i>	

CONTENTS	xvii
Preliminary Observations on Laser Treatment of Chronic Bronchitis and Bronchial Asthma	755
<i>Liu Pingyi, Xing Simin, Pan Zunyin, and Fu Zhengkai, People's Hospital, Beijing Medical College, China</i>	
Control of Upper Gastrointestinal Hemorrhage by the Use of a Nd-YAG Laser Endoscopic System (Abstract)	759
<i>Richard M. Dwyer, Harbor General/UCLA Medical Center, U.S.A.</i>	
CO ₂ Laser Excision of Thermal Burns with Immediate Autograft Closure (Abstract)	759
<i>James P. Fidler, University of Cincinnati, U.S.A.</i>	
Laser in Head and Neck Surgery (Abstract)	760
<i>Billie L. Aronoff, Baylor University Medical Center, U.S.A.</i>	
Carbon Dioxide Laser Microsurgery—Clinical Applications in the Aerodigestive Tract (Abstract)	761
<i>Geza J. Jako, Boston University School of Medicine, U.S.A.</i>	
Structural Studies of Biological Molecules via Laser Fluorescent Micro-Irradiation (Listing)	761
<i>C. A. Sacchi, Centro Electronica Quantistica CNR, Italy</i>	
CO ₂ Laser in Plastic Surgery with Good Surface Wound Healing (Listing)	761
<i>Narong Nimsakul, Takai University, Japan</i>	

**PART V INTEGRATED OPTICS, OPTICAL COMMUNICATION,
AND INFORMATION PROCESSING**

<i>Active Integrated Optics and Semiconductor Lasers</i>	765
Devices for Optical Communication	767
<i>H. Kogelnik, Bell Telephone Laboratories, U.S.A.</i>	
A Theory of Coherent Propagation of Light Waves in Semiconductors	791
<i>Gan Zizhao, Peking University, and Yang Guozhen, Institute of Physics, Academia Sinica, China</i>	
A GaAs-GaAlAs PNP Negative-Resistance Laser with Low Threshold Current Density	799
<i>Wang Shouwu, Wu Ronghan, Zhu Qigao, Zhang Quansheng, Li Zhaoyin, and Tian Huliang, Semiconductor Institute, Academia Sinica, China</i>	
A Long-Lifetime CW DH AlGaAs-GaAs Laser Operated at Room Temperature	809
<i>Zhuang Wanru, Semiconductor Institute, Academia Sinica, China</i>	

Fabrication of GaAs Monolithically Integrated Optical Circuits <i>Pan Huizhen, Xiao Zongyao, Shen Pennian, and Chen Zongquan, Shanghai Institute of Metallurgy, Academia Sinica, China</i>	817
The Masked and Selective Thermal Oxidation of GaAs-Ga _{1-x} Al _x As Multilayer Structures—Technology for Stripe-Geometry DH Lasers and Integrated Optics <i>Liu Hongdu, Zhang Bei, Wang Dehuang, and Chen Weixi, Peking University, China</i>	825
Coupling Losses in a Square-Waveguide Laser Resonator <i>Cheng Tirong and Jian Chinlin, Chengdu Institute of Radio Engineering, China</i>	833
Highly Efficient Coupling between DH Laser and Fiber <i>Zhu Rusheng, Zhu Baisheng, and Zhang Lun, Semiconductor Institute, Academia Sinica, China</i>	839
<i>Passive Integrated Optics and Fibers</i>	847
Selection of Fiber-Optical Waveguide Materials <i>Douglas A. Pinnow, Time Fiber Communication Ltd., U.S.A.</i>	849
Study on Graded-Index Multimode Optical Fibers in the System P ₂ O ₅ -SiO ₂ <i>Li Jiazhi, Zhang Yinghua, Wang Jianguo, and Shi Qinglin, Shanghai Institute of Ceramics, Academia Sinica, China</i>	851
A Preliminary Report on Single-Mode Optical Fibers <i>Huang Hungchia, Nie Chaojiang, Zhang Yilong, Zhou Youwei, Soo Chengchang, Zhu Junhao, and Huang Zunhua, Shanghai University of Science and Technology, China</i>	859
Ti-Diffused LiNbO ₃ Optical Waveguides with Low Loss <i>Li Yushan, Liu Hongju, Ren Bingfu, and Yu Rongjin, Changchun Institute of Physics, Academia Sinica, China</i>	865
<i>Information Processing and Coherent Optics</i>	871
Walsh Transform by the Coherent Optical Method <i>Yang Guozhen, Pan Shaohua, Chen Yansong, Wang Yutang, and Li Xiuying, Institute of Physics, Academia Sinica, China</i>	873
A Simple Optical Information-Processing Method to Detect the Difference between Two Photographs <i>Huang Letian, Wang Tianji, and Lin Shiyong, Guangzhou Institute of Electronic Technology, Academia Sinica, China</i>	881

CONTENTS	xix
Framing High-Speed Interferography with Pulsed He-He Lasers	883
<i>Xia Shengjie, Wang Chunkui, Fu Yushou, and Wu Baogen, Institute of Mechanics, Academia Sinica, China</i>	
Separation of Absolute Retardation Fringes by Using Polarization Holography	899
<i>Wang Jizhong and Zhang Wenzhi, Shandong Engineering Institute, China</i>	
Optical Waveguide Devices (Abstract)	907
<i>I. R. Kaminow, Bell Telephone Laboratories, U.S.A.</i>	
Optical "Gyroscopes" (Abstract)	907
<i>S. Ezekiel, Massachusetts Institute of Technology, U.S.A.</i>	
Active Integrated Optics (Listing)	908
<i>Amnon Yariv, California Institute of Technology, U.S.A.</i>	
Optical-Fiber Communications (Listing)	908
<i>I. P. Kaminow, Bell Telephone Laboratories, U.S.A.</i>	
Optical Fiber Sensors (Listing)	908
<i>Shin-chun Lin, Naval Research Laboratory, U.S.A.</i>	
Coherent Optical Pattern Recognition (Listing)	908
<i>David Casasent, Carnegie-Mellon University, U.S.A.</i>	
A Laser Scanning System for Automated Inspection of Roller-Bearings (Listing)	909
<i>Charles C. K. Cheng, Xerox Corporation, U.S.A.</i>	