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Microcrystalline Semiconductors: Materials Science & Devices

EDITORS

**Philippe M. Fauchet
Chuang Chuang Tsai
Leigh T. Canham
Isamu Shimizu
Yoshinobu Aoyagi**



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**Microcrystalline Semiconductors:
Materials Science & Devices**

Preface

This book contains the proceedings of the symposium on Microcrystalline Semiconductors: Materials Science & Devices, held during the 1992 Fall Meeting of the Materials Research Society in Boston. A similar symposium was held three years ago (MRS Symposium Proceedings Volume 164) and because significant progress had been made since 1989, the consensus of the community was that the symposium should be repeated. The present symposium was organized by P.M. Fauchet (University of Rochester) and C.C. Tsai (Xerox Palo Alto Research Center), who were both involved with the 1989 symposium, together with L.T. Canham (Defence Research Agency, Malvern, U.K.), I. Shimizu (Tokyo Institute of Technology, Japan), and Y. Aoyagi (RIKEN, Japan).

Microcrystals and nanocrystals form a class of materials that are neither amorphous nor single crystalline. Many of their properties are unusual; for example, the electronic and chemical properties are strongly influenced by the surfaces or interfaces and quantization affects the electronic states. As a result, micro- and nano-crystalline semiconductors display unique properties that may be exploited in novel devices. The four and one-half day long symposium brought together materials scientists, engineers, device physicists, chemists and solid state physicists who are active in various areas of growth, characterization, modelling and device applications of micro- and nano-crystalline semiconductors. Approximately 180 papers and posters were presented during the symposium, with a large contingent coming from Europe and Japan. All papers were refereed and 75% of them are included in this volume. For convenience, the papers are grouped in three sections although it was clear during the symposium that there were many issues in common between the three areas.

The first section deals with various aspects of light-emitting porous silicon and related nanostructural materials. Since the demonstration in 1990 that bright, visible light can be emitted by porous silicon, the field has expanded considerably. The symposium attracted numerous contributed papers in this new area. The invited papers are by J. Farr (University of Birmingham, U.K.), Y. Masumoto (University of Tsukuba, Japan), P. Badoz, (CNET, France), N. Koshida (Tokyo University of Agriculture and Technology, Japan), and W. Lang (Fraunhofer Institute, Germany). The field has progressed considerably since the post-deadline symposium held during the 1991 Fall MRS Meeting (MRS Symposium Proceedings Volume 256). Among the highlights are the demonstration of blue photoluminescence and electroluminescence, and the fabrication of relatively stable light-emitting diodes. Although there is still no general agreement on the mechanisms of the luminescence, many of the early hypotheses have been discredited and a comprehensive physical and chemical picture of light-emitting porous silicon is in sight. The papers in this section are grouped under five headings:

1. Silicon and germanium nanostructure fabrication
2. Porous silicon characterization
3. Porous silicon passivation/depassivation
4. Electroluminescent and other devices with porous silicon
5. Silicon nanostructure theory

The second section deals with microcrystalline and polycrystalline silicon film growth and device applications. This constitutes the historical core of the symposium. A large number of contributed papers were presented. The invited papers are by G. Lucovsky (North Carolina State University), B. Drevillon (Ecole Polytechnique, France), L. Yang (Solarex Corp.), T. Sameshima (Sony, Japan), and T. Dyer (University of Swansea, U.K.). Significant progress has occurred since 1989, in terms of understanding the chemistry of deposition, the electronic and optical properties of

microcrystalline films, the effect of various treatments, and the means of fabricating high quality devices. The papers in this section are grouped under three headings:

1. Microcrystalline silicon
2. Polysilicon
3. Laser and thermal processing

The third section deals mostly with quantum wires and quantum dots made of III-V and II-VI semiconductors. Major advances have been made in this area since 1989, and some of the most important of them were reported in the symposium. The number of contributed papers increased considerably compared to 1989, and the invited paper is by T. Fukui (Hokkaido University, Japan). Perhaps the most significant development is the ability to manufacture high quality nanostructures through sophisticated growth procedures and processing. The papers in this section are grouped under three headings:

1. III-V quantum dots and wires
2. II-VI quantum dots and wires
3. Other nano/micro-crystalline structures

The organizers wish to thank the numerous referees and all the authors for working under a very tight schedule, and all the invited speakers and session chairs for their essential contributions. Thanks also go to Ms. JoAnn D'Angelo for her help in preparing this volume. Finally, the following sponsors made this symposium possible:

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Contents

PREFACE	xvii
MATERIALS RESEARCH SOCIETY SYMPOSIUM PROCEEDINGS	xviii
PART I: SILICON AND GERMANIUM NANOSTRUCTURE FABRICATION	
*AN ELECTROCHEMICAL STUDY OF POROUS SILICON J.D. L'Ecuyer and J.P.G. Farr	3
*OPTICAL PROPERTIES AND NEW FUNCTIONALITY OF NANO- CRYSTALLINE CuCl AND Ge Yasuaki Masumoto	15
FORMATION MECHANISM OF MICROPOROUS SILICON: PREDICTIONS AND EXPERIMENTAL RESULTS V. Lehmann and U. Gösele	27
VISIBLE PHOTOLUMINESCENCE AND MICROSTRUCTURE OF ANNEALED AND CHEMICALLY ETCHED AMORPHOUS Si K.H. Jung, S. Shih, D.L. Kwong, C.C. Cho, and B.E. Gnade	33
INTENSE RT VISIBLE PHOTOLUMINESCENCE FROM ANODIZED AMORPHOUS AND NANOCRYSTALLINE SILICON FILMS E. Bustarret, J.C. Bruyere, F. Muller, and M. Ligeon	39
COMPOSITION AND STRUCTURE OF SPARK ERODED POROUS SILICON R.E. Hummel, S.-S. Chang, M. Ludwig, and A. Morrone	45
NANOCRYSTALLINE Ge SYNTHESIS BY REDUCTION OF $Si_{1-x}Ge_xO_2$ FORMED BY HIGH PRESSURE OXIDATION David C. Paine, Christine Caragianis, Tae Young Kim, and Yuzo Shigesato	51
SILICON QUANTUM WIRES OXIDATION AND TRANSPORT STUDIES H.I. Liu, D.K. Biegelsen, N.M. Johnson, F.A. Ponce, N.I. Maluf, and R.F.W. Pease	57
PHOTOLUMINESCENCE FROM MICROCRYSTALLINE SILICON AND RELATED MATERIALS M. Rückschloss, B. Landkammer, O. Ambacher, and S. Vepřek	65
NANOCRYSTALLITES OF Si EMBEDDED IN CaF_2 BY MOLECULAR BEAM EPITAXY (MBE) A.P. Taylor, K. Stokes, Z.C. Wu, P.D. Persans, L.J. Schowalter, and F.K. LeGoues	71
Si-CLUSTER LUMINESCENCE Winston A. Saunders, Harry A. Atwater, Kerry J. Vahala, Richard C. Flagan, and Peter C. Serceel	77
PREPARATION AND CHEMICAL INVESTIGATION OF POROUS SILICON S. Poulin, Y. Diawara, J.F. Currie, A. Yelon, S.C. Gujrathi, and V. Petrova-Koch	83

*Invited Paper

BLUE LIGHT EMISSION FROM POROUS SILICON X.Y. Hou, G. Shi, W. Wang, F.L. Zhang, P.H. Hao, D.M. Huang, X.F. Jin, and Xun Wang	89
PART II: POROUS SILICON CHARACTERIZATION	
*CHARACTERIZATION OF POROUS SILICON: STRUCTURAL, OPTICAL AND ELECTRICAL PROPERTIES P.A. Badoz, D. Bensahel, G. Bomchil, F. Ferrieu, A. Halimaoui, P. Perret, J.L. Regolini, I. Sagnes, and G. Vincent	97
PL AND FTIR ABSORPTION STUDY ON POROUS SILICON IN SITU DURING ETCHING, IN OXYGEN AMBIENT, AND AFTER CHEMICAL OXIDATION G. Mauckner, T. Walter, T. Baier, K. Thonk, and R. Sauer	109
VISIBLE LIGHT EMISSION FROM POROUS SILICON EXAMINED BY PHOTOLUMINESCENCE AND RAMAN SPECTROSCOPY Terry R. Guilinger, Michael J. Kelly, David R. Tallant, David A. Redman, and David M. Follstaedt	115
LUMINESCENCE PROPERTIES OF POROUS SILICON C. Peng, L. Tsybeskov, and P.M. Fauchet	121
STRAINED QUANTUM DOTS IN POROUS SILICON Xue-Shu Zhao, Peter D. Persans, John Schroeder, and Yeun-Jung Wu	127
SMALL-ANGLE X-RAY SCATTERING FROM LIGHT EMITTING POROUS SILICON AND SILOXENE H. Franz, V. Petrova-Koch, T. Muschik, V. Lehmann, and J. Peisl	133
Si ₂ p CORE LEVEL ABSORPTION AND PHOTOEMISSION SPECTRA OF POROUS Si Hisao Nakashima, Koichi Inoue, and Kenzo Maehashi	139
THE LUMINESCENCE MECHANISM OF POROUS SILICON P.D.J. Calcott, K.J. Nash, L.T. Canham, M.J. Kane, and D. Brumhead	143
PICOSECOND DECAY DYNAMICS IN POROUS SILICON T. Matsumoto, T. Futagi, H. Mimura, and Y. Kanemitsu	149
ESR STUDY OF POROUS SILICON W.Y. Cheung, S.P. Wong, I.H. Wilson, C.F. Kan, and S.K. Hark	155
STUDY OF PHOTOLUMINESCENT THIN FILM POROUS SILICON ON SAPPHIRE W.B. Dabbelday, D.M. Szaflarski, R.L. Shimabukuro, and S.D. Russell	161
OBSERVATION OF PARAMAGNETIC SILICON DANGLING ORBITALS IN LUMINESCENT POROUS SILICON F.C. Rong, E.H. Poindexter, J.F. Harvey, D.C. Morton, R.A. Lux, and G.J. Gerardi	167
HIGH SPATIAL RESOLUTION MAPPING OF POROUS SILICON E. Ettegui, C. Peng, L. Tsybeskov, Y. Gao, P.M. Fauchet, G.E. Carver, and H.A. Mizes	173

*Invited Paper

FAST PHOTOLUMINESCENCE FROM POROUS SILICON V. Petrova-Koch, T. Muschik, D.I. Kovalev, F. Koch, and V. Lehmann	179
FINE STRUCTURE OF VISIBLE LIGHT EMITTING POROUS SILICON Kiyokazu Nakagawa, Akio Nishida, and Toshikazu Shimada	185
POROUS SILICON PHOTOLUMINESCENCE VERSUS HF ETCHING: NO CORRELATION WITH SURFACE HYDROGEN SPECIES M.B. Robinson, A.C. Dillon, and S.M. George	191
SOME PERSPECTIVES ON THE LUMINESCENCE MECHANISM VIA SURFACE-CONFINED STATES OF POROUS Si F. Koch, V. Petrova-Koch, T. Muschik, A. Nikolov, and V. Gavrilenko	197
VISIBLE LUMINESCENCE FROM POROUS SILICON AND SILOXENE: RECENT RESULTS H.D. Fuchs, M. Rosenbauer, M.S. Brandt, S. Ernst, S. Finkbeiner, M. Stutzmann, K. Syassen, J. Weber, H.J. Queisser, and M. Cardona	203
STRUCTURAL INVESTIGATION OF ELECTROCHEMICALLY ETCHED SILICON B.J. Heuser, S. Spooner, C.J. Glinka, D.L. Gilliam, N.A. Winslow, and M.S. Boley	209
CHARACTERIZATION OF POROUS SILICON LAYERS BY REFLECTANCE SPECTROSCOPY W. Theiß, P. Grosse, H. Münder, H. Lüth, R. Herino, and M. Ligeon	215
PHOTOCHEMICAL ETCHING EFFECTS ON OPTICAL PROPERTIES OF POROUS SILICON Y. Kanemitsu, H. Uto, Y. Masumoto, T. Matsumoto, T. Futagi, and H. Mimura	221
INVESTIGATION OF POROUS SILICON FILMS STRUCTURE BY OPTICAL METHODS P. Basmaji, V. Grivickas, G.I. Surdutovich, R. Vitlina, and V.S. Bagnato	227
RAPID PHOTOLUMINESCENCE INTENSITY DEGRADATION IN POROUS SILICON P. Basmaji, A.A. Bernussi, J.C. Rossi, and B. Matvienko	232
 PART III: POROUS SILICON PASSIVATION/DEPASSIVATION	
RADIATIVE AND NON-RADIATIVE PROCESSES FOR THE LIGHT EMISSION FROM POROUS SILICON J.C. Vial, A. Bsiesy, G. Fishman, F. Gaspard, R. Herino, M. Ligeon, F. Muller, R. Romestain, and R.M. MacFarlane	241
MICROCRYSTALLITES IN OXIDIZED POROUS SILICON V. Lehmann, H. Cerva, B. Jobst, V. Petrova-Koch, A. Kux, and T. Muschik	247
ELECTRON SPIN RESONANCE INVESTIGATIONS OF RAPID THERMAL OXIDIZED POROUS SILICON H. Linke, P. Omling, B.K. Meyer, V. Petrova-Koch, T. Muschik, and V. Lehmann	251

LIGHT EMISSION FROM POROUS SILICON SUBJECTED TO RAPID THERMAL OXIDATION A.G. Cullis, L.T. Canham, G.M. Williams, P.W. Smith, and O.D. Dosser	257
LIGHT-EMITTING nm-SIZE SILICON USING ELECTROCHEMICAL ANODIZATION AND OXIDATION Toshimichi Ito, Toshimichi Ohta, Kenji Motoi, Osamu Arakaki, and Akio Hiraki	263
INTENSE VISIBLE LUMINESCENCE FROM THERMALLY-OXIDIZED POROUS SILICON S. Miyazaki, K. Shiba, K. Sakamoto, and M. Hirose	269
EFFECTS OF SURFACE TREATMENTS ON THE PHOTOLUMINESCENCE OF POROUS Si AND A SUGGESTED MECHANISM FOR THE PHOTO-LUMINESCENCE Masao Yamada, Kazuaki Kondo, Takae Sasaki, Akira Takazawa, and Tetsuro Tamura	275
DEGRADATION OF POROUS Si LAYERS CAUSED BY THERMAL TREATMENT H. Münder, M.G. Berger, S. Frohnhoff, H. Lüth, U. Rossow, U. Frotscher, and W. Richter	281
EFFECT OF LASER ILLUMINATION ON OXIDIZATION OF POROUS SILICON L.Z. Zhang, J.C. Mao, B.R. Zhang, W.X. Zhu, Y.L. He, H.Z. Song, J.Q. Duan, and G.G. Qin	287
THE ROLE OF Si-H, Si-H ₂ , AND OXYGEN IN THE PHOTO-LUMINESCENCE OF POROUS Si J.M. Lavine, A.J. Bellezza, S.P. Sawan, and Y-T. Shieh	293
METASTABILITY OF LUMINESCENT POROUS SILICON S. Miyazaki, K. Sakamoto, K. Shiba, and M. Hirose	299
THE EFFECT OF LEWIS BASE CHEMISORPTION ON THE LUMINESCENCE OF POROUS SILICON Jeffery L. Coffey, Sean C. Lilley, Rebecca A. Martin, and Leigh Ann Files-Sesler	305
LUMINESCENCE ACTIVATION OF POROUS SILICON BY POST-ANODIZATION TREATMENT A. Kux, F. Müller, and F. Koch	311
PROPERTIES OF POROUS SILICON WITH PHOTOLUMINESCENCE ENHANCED BY A REMOTE-PLASMA TREATMENT Y. Xiao, M.J. Heben, J.I. Pankove, and Y.S. Tsuo	317
MECHANISM OF IN-SITU PHOTOLUMINESCENCE DECAY IN POROUS SILICON AND ITS APPLICATION TO MASKLESS PATTERNING Mikio Takai, Sanae Indou, and Hisanori Murase	323
BRØNSTED AND LEWIS BASE QUENCHING OF PHOTOEMISSION FROM LUMINESCENT 'POROUS SILICON': SURFACE PROTONS IN THE LUMINESCENCE MECHANISM J.K.M. Chun, A.B. Bocarsly, T.R. Cottrell, J.B. Benziger, and J.C. Yee	329

PART IV: ELECTROLUMINESCENT AND OTHER DEVICES WITH POROUS SILICON

*OPTOELECTRONIC CHARACTERIZATIONS OF POROUS SILICON Nobuyoshi Koshida and Hideki Koyama	337
*NEW RESULTS ON ELECTROLUMINESCENCE FROM POROUS SILICON Peter Steiner, Frank Kozlowski, Hermann Sandmaier, and Walter Lang	343
PHOTOCONDUCTIVITY AND CARRIER TRANSPORT IN POROUS SILICON M.J. Heben and Y.S. Tsuo	353
MECHANISM OF ELECTRON INJECTION DURING THE ANODIC OXIDATION OF SILICON J.-N. Chazalviel and F. Ozanam	359
POROUS SILICON-BASED OPTOELECTRONIC DEVICES: PROCESSING AND CHARACTERIZATION Nader M. Kalkhoran	365
A UNITY QUANTUM EFFICIENCY PHOTODIODE USING POROUS SILICON FILM J.P. Zheng, K.L. Jiao, W.P. Shen, W.A. Anderson, and H.S. Kwok	371
THE DEPTH DEPENDENCE OF PHOTOLUMINESCENCE AND ELECTROLYTIC ELECTROLUMINESCENCE IN POROUS SILICON FILMS M.I.J. Beale, T.I. Cox, L.T. Canham, and D. Brumhead	377
THEORY OF POROUS SILICON INJECTION ELECTROLUMINESCENCE H. Paul Maruska, F. Namavar, and N.M. Kalkhoran	383
VISIBLE ELECTROLUMINESCENCE FROM PN JUNCTION TYPE μc-SiC/POROUS Si/c-Si STRUCTURES T. Futagi, T. Matsumoto, M. Katsuno, Y. Ohta, H. Mimura, and K. Kitamura	389
OPTICAL STUDIES OF ELECTROLUMINESCENT STRUCTURES FROM POROUS SILICON J.F. Harvey, R.A. Lux, D.C. Morton, G.F. McLane, and R. Tsu	395
STUDY ON THE PHOTOCONDUCTIVE EFFECT FROM A P/N JUNCTION STRUCTURE INCORPORATED WITH POROUS SILICON C.C. Yeh, Klaus Y.J. Hsu, P.C. Chen, and H.L. Hwang	401
PHOTOVOLTAIC DEVICE APPLICATIONS OF POROUS SILICON Y.S. Tsuo, M.J. Heben, X. Wu, Y. Xiao, C.A. Moore, P. Verlinden, and S.K. Deb	405
ORGANIC-INORGANIC JUNCTIONS FORMED ON POROUS SILICON: ISOLATION OF A SURFACE CONFIGURATION PRIMARY TO THE LUMINESCENCE MECHANISM T.R. Cottrell, J.B. Benziger, J.C. Yee, J.K.M. Chun, and A.B. Bocarsly	411

*Invited Paper

PART V: SILICON NANOSTRUCTURE THEORY

THEORY OF ELECTRONIC, OPTICAL AND TRANSPORT PROPERTIES IN SILICON QUANTUM WIRES G.D. Sanders, C.J. Stanton, and Y.C. Chang	419
ROLE OF HYDROGENATED SURFACE IN THE PHOTOLUMINESCENCE OF POROUS SILICON Masahiko Hirao, Tsuyoshi Uda, and Yoshimasa Murayama	425
CALCULATION OF THE ENERGY SPECTRUM OF NANO-METER- SIZED SILICON Vladimir Gavrilenko, Peter Vogl, and Frederick Koch	431
QUANTUM CONFINEMENT EFFECTS ON THE DIELECTRIC CONSTANT OF POROUS SILICON R. Tsu, L. Ioriatti, J.F. Harvey, H. Shen, and R.A. Lux	437

PART VI: MICROCRYSTALLINE SILICON

*TRANSPORT AND MICROSTRUCTURE OF MICROCRYSTALLINE SILICON ALLOYS G. Lucovsky, C. Wang, M.J. Williams, Y.L. Chen, and D.M. Maher	443
*THE PHYSICS OF PLASMA DEPOSITION OF MICROCRYSTALLINE SILICON B. Drevillon, I. Solomon, and M. Fang	455
*MICROCRYSTALLINE SILICON IN a-SI:H BASED MULTIJUNCTION SOLAR CELLS Liyu Yang, L. Chen, S. Wiedeman, and A. Catalano	463
MICROCRYSTALLINE SILICON PREPARED BY VHF-GD: STRUCTURE, TRANSPORT AND OPTICAL PROPERTIES F. Finger, R. Carius, P. Hapke, K. Prasad, and R. Flückiger	471
CRYSTALLINITY AND OPTOELECTRONIC PROPERTIES OF $\mu\text{c-SiC:H}$ F. Demichelis, G. Crovini, C. Osenga, C.F. Pirri, E. Tresso, and L. Boarino	477
CONDUCTANCE IN MICROCRYSTALLINE $\text{B}_{1-x}\text{C}_x/\text{Si}$ HETERO- JUNCTION DIODES Sunwoo Lee, Thuong Ton, D. Zych, and P.A. Dowben	483
HIGHLY TEXTURED MICROCRYSTALLINE Si-THIN FILM FABRICATED BY LAYER-BY-LAYER TECHNIQUE Shun-ichi Ishihara, Deyan He, Tetsuya Akasaka, Yuzoh Araki, Masami Nakata, and Isamu Shimizu	489
MICROSTRUCTURAL EVOLUTION AND SUBSTRATE SELECTIVITY IN PECVD $\mu\text{c-Si}$ Gregory N. Parsons, John J. Boland, and James C. Tsang	495
MICROCRYSTALLINE SILICON BY DC MAGNETRON SPUTTERING: GROWTH MECHANISMS G.F. Feng, M. Katiyar, Y.H. Yang, J.R. Abelson, and N. Maley	501
HIGH QUALITY P-DOPED $\mu\text{c-Si:H}$ FILMS AS OBTAINED BY LOW TEMPERATURE LPCVD OF DISILANE C. Manfredotti, F. Fizzotti, G. Amato, L. Boarino, and M. Abbas	507

*Invited Paper

CARRIER TRANSPORT THROUGH GRAIN BOUNDARIES IN HYDROGENATED MICROCRYSTALLINE SILICON S. Grebner, F. Wang, and R. Schwarz	513
SEPARATION OF NUCLEATION AND GROWTH PROCESSES OF NANOCRYSTALLINE SILICON BY HYDROGEN RADICAL TREATMENT OF HYDROGENATED AMORPHOUS SILICON Masanori Ootobe and Shunri Oda	519
XPS STUDIES OF HYDROGEN AND OXYGEN BONDING CONFIGURATIONS IN HYDROGENATED MICROCRYSTALLINE SILICON MATERIALS PRODUCED BY NEUTRON IRRADIATION Y.C. Koo, G.C. Weatherly, R. Sodhi, S.J. Thorpe, and K.T. Aust	525
HYDROGEN CONFIGURATIONS IN MICROCRYSTALLIZED SPUTTERED AMORPHOUS SILICON L. Lusson, P. Elkaim, M. Cuniot, D. Ballutaud, R. Rizk, and J. Dixmier	531
THE MICRO-STRUCTURE AND ELECTRON CONDUCTION MECHANISM OF HYDROGENATED NANO-CRYSTALLINE SILICON FILMS Yuliang He, Yiming Chu, Hongyi Lin, and Guoguang Qin	537
STRUCTURE AND MORPHOLOGY OF $\mu\text{c-SiC:H}$ FILMS PRODUCED BY PECVD F. Demichelis, G. Crovini, C.F. Pirri, E. Tresso, L. Battezzati, and P. Rava	543
SOLUTE BINDING AT VOID SURFACES IN SILICON AND GERMANIUM S.M. Myers, D.M. Bishop, D.M. Follstaedt, H.J. Stein, and W.R. Wampler	549
CRYSTALLINITY ANALYSIS OF AMORPHOUS-CRYSTALLINE MIXED PHASE SILICON FILMS USING EXAFS METHOD Masatoshi Wakagi, Toshiki Kaneko, Kiyoshi Ogata, and Asao Nakano	555
SPECTROSCOPIC ELLIPSOMETRY AND INTERFERENCE REFLECTOMETRY MEASUREMENTS OF CVD SILICON GROWN ON OXIDIZED SILICON G.E. Jellison, Jr., M. Keefer, and L. Thornquist	561
ELECTRICAL PROPERTIES OF BORON-DOPED $\mu\text{c-Si:H}$ PREPARED BY REACTIVE MAGNETRON SPUTTERING FROM c-Si TARGETS W.A. Turner, M.J. Williams, Y.L. Chen, D.M. Maher, and G. Lucovsky	567
A PARTICULAR STRUCTURE OF B-DOPED $\mu\text{c-Si/a-Si:H}$ LAYERS ON INSULATOR M. Le Berre, M. Lemiti, P. Pinard, E. Bustarret, W. Grieshaber, J.-C. Bruyère, and M. Brunel	573
PHOTOLUMINESCENCE IN B-DOPED $\mu\text{c-Si:H}$ S.Q. Gu, J.M. Viner, P.C. Taylor, M.J. Williams, W.A. Turner, and G. Lucovsky	579
ENHANCED CONDUCTIVITY IN n-TYPE MICROCRYSTALLINE SILICON E.A.T. Dirani, A.M. de Andrade, and I. Pereyra	585
TEM STUDY AND HALL MEASUREMENT OF nc-Si PREPARED BY CONTROLLED DEPOSITION Masami Nakata and Isamu Shimizu	591

ELECTROLUMINESCENCE AS A FUNCTION OF ELECTRIC FIELD AND TEMPERATURE IN AMORPHOUS SILICON-CARBIDE BASED p-i-n STRUCTURES	597
A.B. Pevtsov, A.G. Pilatov, N.A. Feoktistov, A.V. Zherzdev, S.M. Karabanov, T. Muschik, D. Zrenner, and R. Schwarz	
EFFECTS OF DILUTED-HYDROGEN AND HYDROGEN-ATOM- TREATMENT ON THE SILICON-HYDROGEN BONDING CONFIGURATIONS OF HYDROGENATED SILICON FILMS	603
K.C. Hsu, H. Chang, and H.L. Hwang	
MICRO-CRYSTALLINE SILICON IN IMAGE SENSOR	609
B.W. Park, J.I. Choi, C.W. Hur, T.K. Oh, and I.K. Kang	
A NEW THIN FILM GROWTH/REGROWTH PROCESS DESIGN AND EXPERIMENTAL COMPARISONS WITH MOLECULAR DYNAMIC ANALYSES	615
Takako K. Okada, Shigeru Kambayashi, Moto Yabuki, Yoshitaka Tsunashima, Yuichi Mikata, and Shinji Onga	
PART VII: POLYSILICON	
PROPERTIES AND PRODUCTION MECHANISM OF LOW-TEMPERATURE DEPOSITED CAT-CVD POLY-SILICON FILMS	623
Hideki Matsumura, Yoichi Hosoda, and Seiji Furukawa	
LOW TEMPERATURE FABRICATION OF POLY-Si TFTs USING <i>IN-SITU</i> CHEMICALLY CLEANING METHOD	629
Naoki Kono, Tatsuro Nagahara, Kenji Fujimoto, Yusaku Kashiwagi, and Hisashi Kakinoki	
GROWTH OF POLYCRYSTALLINE SILICON FILMS AT LOW TEMPERATURE BY REMOTE PLASMA CVD	635
Sung Chul Kim, Kyu Chang Park, Sung Ki Kim, Jung Mok Jun, and Jin Jang	
EARLY STAGE IN POLYCRYSTALLINE GROWTH OF Si BY FLUORO- OXIDATION OF SILANE	641
Kenji Endo, Masahiro Bunyo, Isamu Shimizu, and Jun-Ichi Hanna	
LAYERED POLY/AMORPHOUS SILICON DEPOSITION PROCESS FOR IMPROVED SILICIDE INTEGRITY	647
P.K. Roy, A.K. Nanda, and J.A. Taylor	
MODELING OF BORON DIFFUSION IN POLYSILICON-ON-SILICON LAYERS	653
Akif Sultan, Shubneesh Batra, Melvyn Lobo, Keunhyung Park, and Sanjay Banerjee	
DEPOSITION OF POLYCRYSTALLINE SILICON THIN FILMS BY PLASMA ENHANCED CVD	659
Russell E. Hollingsworth and Pawan K. Bhat	
RAMAN STUDIES OF HEAVILY DOPED POLYCRYSTALLINE Si FILMS PREPARED BY EXCIMER-LASER-ANNEALING OF DOPED a-Si:H	665
M.E. Savage, U. Jayamaha, A. Compaan, A. Aydinli, and Dashen Shen	
Si FILM GROWTH BY SUPERCOOLING OF A MOLTEN Si ALLOY FILM	671
R.L. Wallace, J. Yi, and W.A. Anderson	

PART VIII: LASER AND THERMAL PROCESSING

*PULSED-LASER ANNEALING OF SILICON FILMS T. Sameshima	679
*POLYSILICON THIN FILMS AND DEVICES PRODUCED BY LOW-TEMPERATURE (600°C) FURNACE CRYSTALLISATION OF HYDROGENATED AMORPHOUS SILICON (a-Si:H) T.E. Dyer, J.M. Marshall, W. Pickin, A.R. Hepburn, and J.F. Davies	691
EXCIMER LASER INDUCED CRYSTALLIZATION OF THIN AMORPHOUS Si FILMS ON SiO ₂ : IMPLICATIONS OF CRYSTALLIZED MICRO-STRUCTURES FOR PHASE TRANSFORMATION MECHANISMS H.J. Kim, James S. Im, and Michael O. Thompson	703
LARGE-GRAIN DOPED POLY-Si FILMS FABRICATED USING NEW EXCIMER LASER ANNEALING TECHNIQUE Hiroshi Iwata, Tomoyuki Nohda, Satoshi Ishida, Takashi Kuwahara, Keiichi Sano, Hiroyuki Kuriyama, Shigeru Noguchi, Hiroshi Hanafusa, Keiichi Kiyama, Shinya Tsuda, Shoichi Nakano, and Yukinori Kuwano	709
HIGH SUBSTRATE TEMPERATURE (420°C) EXCIMER LASER CRYSTALLIZATION OF HYDROGENATED AMORPHOUS SILICON R. Carluccio, A. Pecora, G. Fortunato, J. Stoemenos, and N. Economou	715
CONTROL OF POLYSILICON EMITTER BIPOLAR TRANSISTOR CHARACTERISTICS BY RAPID THERMAL OR FURNACE ANNEAL OF THE POLYSILICON/SILICON INTERFACE S. Bhattacharya, M. Lobo, L. Jung, S. Banerjee, R. Reuss, S. Batra, K. Park, and G. Hu	721
HIGH-QUALITY POLYCRYSTALLINE SILICON THIN FILMS PREPARED BY SOLID PHASE CRYSTALLIZATION (SPC) METHOD T. Matsuyama, T. Baba, M. Tanaka, S. Tsuda, H. Nishiwaki, S. Nakano, H. Hanafusa, and Y. Kuwano	727
I-V CHARACTERISTICS AND INTERFACE PROPERTIES OF Al-Si(P) CONTACTS BY THE KrF EXCIMER LASER INDUCED RECRYSTALLIZATION K. Sohn, H. Lee, and D.A. Hensley	733
PHOSPHORUS GLASS DOPING OF POLYCRYSTALLINE SILICON DURING RAPID THERMAL ANNEALING Bouchaib Hartiti, Abdelilah Slaoui, Roland Stuck, Jean-Claude Muller, and Paul Siffert	739
A NEW ANNEALING METHOD TO OBTAIN HIGH QUALITY POLY-Si Yoon-Ho Song, Jong-Tae Baek, Kee-Soo Nam, and Sang-Won Kang	745
CRYSTALLIZATION OF a-Si FILMS ON LOW-MELTING-POINT GLASS SUBSTRATES W.K. Park, G.S. Chae, E.I. Givargizov, A.B. Limanov, and A.N. Kiselev	751

PART IX: III-V QUANTUM WIRES AND DOTS

*GaAs QUANTUM DOTS BY MOCVD Takashi Fukui and Seigo Ando	759
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*Invited Paper