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Amorphous and Heterogeneous Silicon-Based Films—2001

Editors: Martin Stutzmann, James B. Boyce, J. David Cohen, Robert W. Collins

and Jun-ichi Hanna

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# **Amorphous and Heterogeneous Silicon-Based Films—2001**

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and Jun-ichi Hanna  
Frontmatter  
[More information](#)

CONTENTS

Preface ..... xxi

Materials Research Society Symposium Proceedings..... xxiii

NUCLEATION AND GROWTH

\* *In Situ* Probing and Atomistic Simulation of a-Si:H Plasma  
Deposition ..... A1.1  
Eray S. Aydil, Dimitrios Maroudas, Denise C. Marra,  
W.M.M. Kessels, Sumit Agarwal, Shyam Ramalingam,  
Saravanapriyan Sriraman, M.C.M. Van de Sanden, and Akihiro Takano

Effect of Strained Si-Si Bonds in Amorphous Silicon Incubation  
Layer on Microcrystalline Silicon Nucleation ..... A1.2  
Hiroyuki Fujiwara, Michio Kondo, and Akihisa Matsuda

Quantitative Modeling of Nucleation Kinetics in Experiments for  
Poly-Si Growth on SiO<sub>2</sub> by Hot-Wire Chemical Vapor Deposition..... A1.3  
Maribeth Swiatek, Jason K. Holt, and Harry A. Atwater

Thermodynamic Model of the Role of Hydrogen Dilution in  
Plasma Deposition of Microcrystalline Silicon ..... A1.5  
J. Robertson

NOVEL CONCEPTS

Photovoltaics on Wire..... A2.1  
M. Rojahn, M. Rakhlin, and M.B. Schubert

HOT WIRE CVD I

Identification of Growth Precursors in Hot Wire CVD of  
Amorphous Silicon Films ..... A3.1  
H.L. Duan, G.A. Zaharias, and Stacey F. Bent

Radical Species Distributions in Hot-Wire Chemical Vapor  
Deposition Probed Via Threshold Ionization Mass Spectrometry  
and Direct Simulation Monte Carlo Techniques..... A3.2  
Jason K. Holt, Maribeth Swiatek, David G. Goodwin,  
Harry A. Atwater, R.P. Muller, and W.A. Goddard III

\*Invited Paper

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Frontmatter  
[More information](#)

|                                                                                                                                                                     |             |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| <b>Films and Devices Deposited by HWCVD at Ultra High Deposition Rates .....</b>                                                                                    | <b>A3.3</b> |
| A.H. Mahan, Y. Xu, E. Iwaniczko, D.L. Williamson, W. Beyer,<br>J.D. Perkins, M. Vanecek, L.M. Gedvilas, and B.P. Nelson                                             |             |
| <b>Structural Characterization of SiF<sub>4</sub>, SiH<sub>4</sub>, and H<sub>2</sub> Hot-Wire-Grown Microcrystalline Silicon Thin Films With Large Grains.....</b> | <b>A3.4</b> |
| J.J. Gutierrez, C.E. Inglefield, C.P. An, M.C. DeLong,<br>P.C. Taylor, S. Morrison, and A. Madan                                                                    |             |
| <b>T-Site Trapped Molecular Hydrogen in Hot Wire a-Si:H .....</b>                                                                                                   | <b>A3.5</b> |
| J. Herberg, P.A. Fedders, D.J. Leopold, R.E. Norberg, and R.E. Schropp                                                                                              |             |
| <b>p-Type Window Layers for pin Solar Cells Entirely Fabricated by Hot-Wire CVD.....</b>                                                                            | <b>A3.6</b> |
| Urban Weber, Markus Koob, Chandrachur Mukherjee,<br>D. Chandrashekar, Rajiv O. Dusane, and Bernd Schroeder                                                          |             |

*HIGH RATE DEPOSITION*

|                                                                                                                       |             |
|-----------------------------------------------------------------------------------------------------------------------|-------------|
| <b>Material Properties and Growth Process of Microcrystalline Silicon With Growth Rates in Excess of 1 nm/s .....</b> | <b>A4.2</b> |
| E.A.G. Hamers, A.H.M. Smets, C. Smit, J.P.M. Hoefnagels,<br>W.M.M. Kessels, and M.C.M. van de Sanden                  |             |
| <b>* High Rate Growth of Device Grade Silicon Thin Films for Solar Cells.....</b>                                     | <b>A4.3</b> |
| M. Kondo, S. Suzuki, Y. Nasuno, and A. Matsuda                                                                        |             |
| <b>Evaluation of Microcrystalline Silicon Films Deposited by Ultrafast Thermal Plasma CVD .....</b>                   | <b>A4.4</b> |
| Yongkee Chae, Hiromasa Ohno, Keisuke Eguchi,<br>and Toyonobu Yoshida                                                  |             |
| <b>Properties of Large Grain-Size Poly-Si Films by Catalytic Chemical Sputtering.....</b>                             | <b>A4.5</b> |
| Atsushi Masuda, Koji Kamesaki, Akira Izumi,<br>and Hideki Matsumura                                                   |             |

*GROWTH OF SILICON AND SILICON-ALLOY THIN FILMS*

|                                                                                        |             |
|----------------------------------------------------------------------------------------|-------------|
| <b>Optical Emission Spectroscopy of Germane Plasma Produced in an ECR Reactor.....</b> | <b>A5.2</b> |
| Matt deFreese, Vikram L. Dalal, and Julie Falter                                       |             |

\*Invited Paper

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and Jun-ichi Hanna  
Frontmatter  
[More information](#)

|                                                                                                                                                                  |              |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| <b>Some Considerations Relating to Growth Chemistry of Amorphous Si and (Si,Ge) Films and Devices.....</b>                                                       | <b>A5.3</b>  |
| Vikram L. Dalal                                                                                                                                                  |              |
| <b>Phase Diagrams for the Optimization of rf Plasma Enhanced Chemical Vapor Deposition of a-Si:H: Variations in Plasma Power and Substrate Temperature .....</b> | <b>A5.4</b>  |
| Andre S. Ferlauto, Randy J. Koval, Christopher R. Wronski, and Robert W. Collins                                                                                 |              |
| <b>VHF Large Area Plasma Processing on Moving Substrates.....</b>                                                                                                | <b>A5.5</b>  |
| J. Kuske, U. Stephan, R. Terasa, H. Brechtel, and A. Kottwitz                                                                                                    |              |
| <b>Cluster-Less Plasma CVD Reactor and Its Application to a-Si:H Film Deposition .....</b>                                                                       | <b>A5.6</b>  |
| Masaharu Shiratani, Kazunori Koga, and Yukio Watanabe                                                                                                            |              |
| <b>Ion-Assisted Sputter Deposition of Microcrystalline Silicon Films With Pulsed-DC Plasma Excitation .....</b>                                                  | <b>A5.7</b>  |
| P. Reinig, F. Fenske, B. Selle, and W. Fuhs                                                                                                                      |              |
| <b>The Properties of Low Hydrogen Silicon Thin Films Deposited by Mesh-Type PECVD .....</b>                                                                      | <b>A5.8</b>  |
| Se-won Ryu, Do-Hyun Kwon, Sung-Gye Park, and Hyoung-June Kim                                                                                                     |              |
| <b>Low-Temperature (630°C) Epitaxy of Silicon on Seeded Glass by Ion-Assisted Deposition .....</b>                                                               | <b>A5.11</b> |
| Armin G. Aberle, Nils-Peter Harder, and Stefan Oelting                                                                                                           |              |

*CRYSTALLIZATION*

|                                                                                                        |             |
|--------------------------------------------------------------------------------------------------------|-------------|
| <b>Formation of Polycrystalline Silicon Films Using Electrical-Current-Induced Joule Heating .....</b> | <b>A6.2</b> |
| Nobuyuki Andoh, Hiroyuki Takahashi, and Toshiyuki Sameshima                                            |             |
| <b>Electrical Properties of Solid Phase Crystallized Silicon Films .....</b>                           | <b>A6.3</b> |
| Tadashi Watanabe, Hajime Watakabe, and Toshiyuki Sameshima                                             |             |
| <b>Super Poly-Si and Transistor Formed by Nickel-Induced-Lateral-Crystallization.....</b>              | <b>A6.4</b> |
| C.F. Cheng, T.C. Leung, and M.C. Poon                                                                  |             |
| <b>A Novel Back-Reflecting UV-Assisted Metal-Induced Crystallization of Silicon on Glass.....</b>      | <b>A6.5</b> |
| Leila Rezaee, Shamsoddin Mohajerzadeh, Ali Khakifirooz, Saber Haji, and Ebrahim Asl Soleimani          |             |

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Frontmatter  
[More information](#)

|                                                                                                                       |              |
|-----------------------------------------------------------------------------------------------------------------------|--------------|
| <b>A New Field-Aided Germanium-Induced Lateral Crystallization of Silicon .....</b>                                   | <b>A6.6</b>  |
| Kianoush Naeli, Shamsoddin Mohajerzadeh, Ali Khakifirooz, Saber Haji, and Ebrahim A. Soleimani                        |              |
| <b>Directional Field Aided Lateral Crystallization of Amorphous Silicon Thin Films .....</b>                          | <b>A6.7</b>  |
| Marek A.T. Izmajlowicz, Neil A. Morrison, Andrew J. Flewitt, and William I. Milne                                     |              |
| <b>The Effects of Cu on Field Aided Lateral Crystallization (FALC) of Amorphous Silicon (a-Si) Films.....</b>         | <b>A6.8</b>  |
| Jae-Bok Lee, Chul-Ho Kim, Se-Youl Kwon, and Duck-Kyun Choi                                                            |              |
| <b>CW Argon-Ion Laser Crystallization of a-Si:H Thin Films.....</b>                                                   | <b>A6.9</b>  |
| A. Sunda-Meya, D. Gracin, J. Dutta, B. Vlahovic, and R.J. Nemanich                                                    |              |
| <b>Electrical Properties and Defect States of Laser Crystallized Polycrystalline Silicon Films.....</b>               | <b>A6.10</b> |
| Tadashi Watanabe, Nobuyuki Andoh, and Toshiyuki Sameshima                                                             |              |
| <b>Excimer Laser Recrystallization of Selectively Floating a-Si Active Layer for Large-Grained Poly-Si Film .....</b> | <b>A6.11</b> |
| Cheon-Hong Kim, Juhn-Suk Yoo, In-Hyuk Song, and Min-Koo Han                                                           |              |

*HOT WIRE CVD II*

|                                                                                                                                                   |             |
|---------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| <b>The Effect of H<sub>2</sub> Dilution on Thin Film SiN Deposited by Hot Wire CVD Using SiH<sub>4</sub> and NH<sub>3</sub> Gas Mixtures.....</b> | <b>A7.2</b> |
| A.C. Dillon, L. Gedvillas, D.L. Williamson, J. Thiesen, J.D. Perkins, and A.H. Mahan                                                              |             |
| <b>The Effect of Moderate Hydrogen Dilution on Stability and Structure of Amorphous Silicon Deposited by Hot-Wire CVD .....</b>                   | <b>A7.3</b> |
| Urban Weber and Bernd Schroeder                                                                                                                   |             |
| <b>Large Red Shift of PL Peak Energy in High Growth Rate a-Si:H Prepared by Hot-Wire CVD.....</b>                                                 | <b>A7.4</b> |
| Daxing Han, Guozhen Yue, Jennifer Weinberg-Wolf, Jessica M. Owens, Yueqin Xu, and Qi Wang                                                         |             |
| <b>High Quality Amorphous Silicon Germanium Alloy Solar Cells Made by Hot-Wire CVD at 10 Å/s.....</b>                                             | <b>A7.5</b> |
| Qi Wang, Eugene Iwaniczko, Jeffrey Yang, Kenneth Lord, and Subhendu Guha                                                                          |             |

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Frontmatter  
[More information](#)

**Properties of Nanocrystalline n-Type Silicon Films Produced by  
Hot Wire Plasma Assisted Technique..... A7.6**  
I. Ferreira, F. Braz Fernandes, P. Vilarinho, E. Fortunato, and  
R. Martins

*SILICON-BASED ALLOYS*

**Stress Induced Lateral Concentration Profiles in SiGe Layers  
Grown on Si(001) Non-Planar Substrates ..... A8.3**  
Anat Eshed, Robert Beserman, and Klauss Dettmer

**Electronic and Optical Properties of High Quality Low Bandgap  
Amorphous (Ge, Si) Alloys..... A8.4**  
S.R. Sheng, R. Braunstein, and V.L. Dalal

**Hydrogen Concentration Analysis in PECVD and RTCVD Silicon  
Nitride Thin Films and Its Impact on Device Performance ..... A8.5**  
C.Y. Wang, E.H. Lim, H. Liu, J.L. Sudijono, T.C. Ang,  
V.Y. Vassiliev, and J.Z. Zheng

**High-Rate Deposition of a-SiN<sub>x</sub>:H Films for Photovoltaic  
Applications..... A8.6**  
W.M.M. Kessels, F.J.H. van Assche, J. Hong, J.D. Moschner,  
T. Lauinger, D.C. Schram, and M.C.M. van de Sanden

**Thermal Annealing Study of Variable Bandgap a-SiN:H Alloy Films ..... A8.7**  
N. Banerji, E. Faro, and J. Serra

**Ge Island Evolution During Growth, *In Situ* Anneal, and  
Si Capping in an Industrial CVD Reactor..... A8.8**  
Roger Loo, Philippe Meunier-Beillard, Didier Dentel,  
Michael Goryll, Danielle Vanhaeren, Lili Vescan, Hugo Bender,  
Matty Caymax, and Wilfried Vandervorst

*STRUCTURAL PROPERTIES OF  
HETEROGENEOUS SILICON FILMS*

**Microstructure Characterization of Hydrogenated Amorphous  
Silicon Films by Rare Gas Effusion Studies ..... A9.2**  
Wolfhard Beyer

**Stability and Nanostructure of Heterogeneous Amorphous Silicon  
Thin-Film Synthesized Under High Chamber Pressure (500 to  
2200 mTorr) Regime of RF PECVD ..... A9.5**  
A.R. Middy, S. Hamma, S. Hazra, S. Ray, and C. Longeaud

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and Jun-ichi Hanna  
Frontmatter  
[More information](#)

**Nanostructured Silicon Films Produced by PECVD ..... A9.6**  
R. Martins, H. Águas, V. Silva, I. Ferreira, A. Cabrita,  
and E. Fortunato

**Effects of Hydrogen Dilution on a-Si:H and Its Solar Cells Studied  
by Raman and Photoluminescence Spectroscopy ..... A9.7**  
Guozhen Yue, Jessica M. Owens, Jennifer Weinberg-Wolf,  
Daxing Han, Jeffrey Yang, Kenneth Lord, Baojie Yan,  
and Subhendu Guha

**Morphology, Phonon Confinement and Properties of a-Si:H Films ..... A9.8**  
Valeri Ligatchev

*DOPANTS AND IMPURITIES*

**Where Oxygen Donor Lives in Microcrystalline Silicon ..... A10.1**  
Toshihiro Kamei, Takehito Wada, and Akihisa Matsuda

**Relation Between Erbium Photoluminescence and Dangling-Bond  
Defects in a-Si:H ..... A10.4**  
Minoru Kumeda, Hiroshi Itoh, Norio Shitakata,  
and Tatsuo Shimizu

*AMORPHOUS SILICON  
SOLAR CELLS*

**\* Towards Stabilized 10% Efficiency of Large-Area (> 5000cm<sup>2</sup>)  
a-Si/a-SiGe Tandem Solar Cells Using High-Rate Deposition ..... A11.1**  
Shingo Okamoto, Akira Terakawa, Eiji Maruyama,  
Wataru Shinohara, Makoto Tanaka, and Seiichi Kiyama

**Higher Efficiency of n-i-p Solar Cells by Hot-Wire CVD at  
Moderate Temperatures ..... A11.2**  
Marieke K. van Veen and Ruud E.I. Schropp

**Amorphous Silicon and Silicon Germanium Alloy Solar Cells  
Deposited by VHF at High Rates..... A11.3**  
Jeffrey Yang, Baojie Yan, Jozef Smeets, and Subhendu Guha

**\* Technology Transfer Challenges in the Manufacturing of a-Si  
Tandem Solar Cells ..... A11.4**  
D.E. Carlson, G. Ganguly, G. Lin, M. Gleaton, M. Bennett,  
and R.R. Arya

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Frontmatter  
[More information](#)

*METASTABILITY I*

|                                                                                                                                                                        |              |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| <b>Photocarrier Capture Properties of Light-Induced Defects in a-Si:H .....</b>                                                                                        | <b>A12.1</b> |
| Paul Stradins, Satoshi Shimizu, Michio Kondo, and Akihisa Matsuda                                                                                                      |              |
| <b>New Experiments on the Relationship Between Light-Induced Defects and Photoconductivity Degradation .....</b>                                                       | <b>A12.2</b> |
| Stephan Heck and Howard M. Branz                                                                                                                                       |              |
| <b>Contributions of D<sup>0</sup> and Non-D<sup>0</sup> Gap States to the Kinetics of Light Induced Degradation of Amorphous Silicon Under 1 sun Illumination.....</b> | <b>A12.3</b> |
| J. Pearce, X. Niu, R. Koval, G. Ganguly, D. Carlson, R.W. Collins, and C.R. Wronski                                                                                    |              |
| <b>Light-Induced Creation of Defects and Lifetime Distribution of Photoluminescence in a-Si:H Based Films.....</b>                                                     | <b>A12.4</b> |
| Chisato Ogihara, Hitoshi Takemura, and Kazuo Morigaki                                                                                                                  |              |
| <b>Light-Induced Annealing of Deep Defects in Low Ge Fraction a-Si,Ge:H Alloys: Further Insights Into the Fundamentals of Light-Induced Degradation .....</b>          | <b>A12.5</b> |
| J. David Cohen, Jennifer Heath, Kimon C. Palinginis, Jeffrey C. Yang, and Subhendu Guha                                                                                |              |
| <b>Changes in Hydrogenated Amorphous Silicon Upon Extensive Light-Soaking at Elevated Temperature .....</b>                                                            | <b>A12.6</b> |
| N. Hata, C.M. Fortmann, and A. Matsuda                                                                                                                                 |              |

*HYDROGEN AND METASTABILITY*

|                                                                                                  |              |
|--------------------------------------------------------------------------------------------------|--------------|
| <b>* Diffusion and Solubility of Hydrogen in Amorphous and Microcrystalline Si:H Films .....</b> | <b>A13.1</b> |
| Wolfhard Beyer                                                                                   |              |
| <b>* Forms of Hydrogen and Hydrogen Diffusion in Realistic Models of a-Si:H.....</b>             | <b>A13.2</b> |
| P.A. Fedders                                                                                     |              |
| <b>* Hydrogen Equilibration and Metastability in Amorphous Silicon .....</b>                     | <b>A13.3</b> |
| Howard M. Branz and S.B. Zhang                                                                   |              |

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and Jun-ichi Hanna  
Frontmatter  
[More information](#)

*METASTABILITY II*

|                                                                                                                                  |              |
|----------------------------------------------------------------------------------------------------------------------------------|--------------|
| <b>Network Rebonding Model for Metastability in Amorphous Silicon .....</b>                                                      | <b>A14.1</b> |
| R. Biswas, B.C. Pan, and Y. Ye                                                                                                   |              |
| <b>Investigation of Light-Induced Defect Depth Profile in Hydrogenated Amorphous Silicon Films.....</b>                          | <b>A14.2</b> |
| S. Shimizu, P. Stradins, M. Kondo, and A. Matsuda                                                                                |              |
| <b>Illumination- and Annealing-Induced Changes in the Infrared and Raman Spectra of a-Si:H .....</b>                             | <b>A14.3</b> |
| L.-F. Arsenault, S. Lebib, E. Sacher, and A. Yelon                                                                               |              |
| <b>Is Interstitial Hydrogen Playing a Role in the Staebler-Wronski Effect? .....</b>                                             | <b>A14.4</b> |
| C. Longeaud and D. Roy                                                                                                           |              |
| <b>The Staebler-Wronski Effect and 1/f Noise in Amorphous Silicon .....</b>                                                      | <b>A14.5</b> |
| T.J. Belich and J. Kakalios                                                                                                      |              |
| <b>Defect Creation by Electron Beam Irradiation in Amorphous Silicon Nitride Films Compared With That by Light Soaking .....</b> | <b>A14.6</b> |
| Tatsuo Shimizu, Yuji Kawashima, and Minoru Kumeda                                                                                |              |

*MICROCRYSTALLINE SILICON  
SOLAR CELLS*

|                                                                                                                                                                   |              |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| <b>Assessment of the Use of Microcrystalline Silicon Materials Grown at Rates Near 15 Å/s as i-Layer Material for Single and Multi-Junction Solar Cells .....</b> | <b>A15.1</b> |
| S.J. Jones, R. Crucet, R. Capangpangan, M. Izu, and A. Banerjee                                                                                                   |              |
| <b>Structural Properties of Microcrystalline Si Solar Cells.....</b>                                                                                              | <b>A15.2</b> |
| M. Luysberg, C. Scholten, L. Houben, R. Carius, F. Finger, and O. Vetterl                                                                                         |              |
| <b>Improved Interface Between Front TCO and Microcrystalline Silicon p-i-n Solar Cells .....</b>                                                                  | <b>A15.3</b> |
| E. Vallat-Sauvain, S. Faÿ, S. Dubail, J. Meier, J. Bailat, U. Kroll, and A. Shah                                                                                  |              |
| <b>Tailoring the Structure of Low-Temperature-Deposited Microcrystalline Silicon Films by Biasing the Substrate.....</b>                                          | <b>A15.4</b> |
| Mario Birkholz, Burkhardt Selle, Walther Fuhs, and Don L. Williamson                                                                                              |              |

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and Jun-ichi Hanna  
Frontmatter  
[More information](#)

**\* Microcrystalline Silicon Thin-Film Solar Cells Prepared at Low Temperature..... A15.5**  
Y. Nasuno, M. Kondo, and A. Matsuda

**Thin Film a-Si/poly-Si Multibandgap Tandem Solar Cells With Both Absorber Layers Deposited by Hot Wire CVD..... A15.6**  
R.E.I. Schropp, C.H.M. Van Der Werf, M.K. Van Veen,  
P.A.T.T. Van Veenendaal, R. Jimenez Zambrano, Z. Hartman,  
J. Löffler, and J.K. Rath

*TRANSPORT IN  $\mu$ c-Si*

**\* Microscopic Aspects of Charge Transport in Hydrogenated Microcrystalline Silicon..... A16.1**  
Antonín Fejfar, Tomás Mates, Christian Koch, Bohuslav Rezek,  
Vladimír Svrcek, Petr Fojtík, Ha Stuchlíková, Jirí Stuchlík,  
and Jan Kocka

**Carrier Transport in Ultra-Thin Nano/Polycrystalline Silicon Films and Nanowires ..... A16.2**  
Toshio Kamiya, Yong T. Tan, Yoshikazu Furuta,  
Hiroshi Mizuta, Zahid A.K. Durrani, and Haroon Ahmed

**Improvement in Electrical Properties of Polycrystalline Silicon Films by the H<sub>2</sub>O Vapor Annealing Method ..... A16.3**  
Toshiyuki Sameshima, Katsumi Asada, Yoshiyuki Tsunoda,  
and Yoshiyasu Kaneko

**Evolution of the Mobility Gap With Thickness in Hydrogen-Diluted Intrinsic Si:H Materials in the Phase Transition Region and Its Effect on p-i-n Solar Cell Characteristics ..... A16.4**  
R.J. Koval, J.M. Pearce, A.S. Ferlauto, R.W. Collins,  
and C.R. Wronski

**Femtosecond Carrier Dynamics in Nanocrystalline Silicon Films: The Effect of the Degree of Crystallinity ..... A16.5**  
K.E. Myers, Q. Wang, and S.L. Dexheimer

*THIN FILM TRANSISTORS*

**P-Channel Polycrystalline Silicon Thin Film Transistors on Steel Foil Substrates..... A17.2**  
Ming Wu and Sigurd Wagner

\*Invited Paper

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978-1-107-41224-8 - Materials Research Society Symposium Proceedings: Volume 664:  
Amorphous and Heterogeneous Silicon-Based Films—2001  
Editors: Martin Stutzmann, James B. Boyce, J. David Cohen, Robert W. Collins  
and Jun-ichi Hanna  
Frontmatter  
[More information](#)

**Towards an All-Hot-Wire TFT: Silicon Nitride and Amorphous Silicon Deposited by Hot-Wire Chemical Vapor Deposition..... A17.3**  
B. Stannowski, M.K. van Veen, and R.E.I. Schropp

**Jet-Printed Fabrication of a-Si:H Thin-Film Transistors and Arrays ..... A17.4**  
W.S. Wong, S. Ready, R. Matusiak, S.D. White, J.-P. Lu, R. Lau, J. Ho, and R.A. Street

**Nanocrystalline Silicon TFTs With 50 nm Thick Deposited Channel Layer, 10 cm<sup>2</sup>/Vs Electron Mobility and 10<sup>8</sup> On/Off Current Ratio ..... A17.5**  
Robert B. Min and Sigurd Wagner

*SENSORS*

**Two-Dimensional Amorphous Silicon Color Sensor Array ..... A18.1**  
F. Lemmi, M. Mulato, J. Ho, R. Lau, J.P. Lu, and R.A. Street

**Design and Modeling of Optical Sensors in Multi-Channel Technology ..... A18.2**  
D. Knipp, H. Stiebig, and P.G. Herzog

**Mechanisms of Cross-Talk in Large Area a-Si:H Continuous Image Sensors ..... A18.4**  
M. Mulato, J.P. Lu, S.E. Ready, K. Van Schuylenbergh, J. Ho, R. Lau, J.B. Boyce, and R.A. Street

**Tailored Laser Scanned Photodiodes (LSP) for Image Recognition ..... A18.5**  
M. Vieira, M. Fernandes, P. Louro, Y. Vygranenko, R. Schwarz, and M. Schubert

**Piezoresistive Sensors on Plastic Substrates Using Doped Microcrystalline Silicon..... A18.6**  
P. Alpuim, V. Chu, and J.P. Conde

*METASTABILITY III*

**Model of Hydrogen-Mediated Metastable Changes in a Two-Domain Amorphous Silicon Network..... A19.1**  
Jonathan Baugh and Daxing Han

**Defect Density Profiling in Light-Soaked and Annealed Hydrogenated Amorphous Silicon Solar Cells..... A19.2**  
Richard S. Crandall, Jeffrey Yang, and Subhendu Guha

Cambridge University Press  
978-1-107-41224-8 - Materials Research Society Symposium Proceedings: Volume 664:  
Amorphous and Heterogeneous Silicon-Based Films—2001  
Editors: Martin Stutzmann, James B. Boyce, J. David Cohen, Robert W. Collins  
and Jun-ichi Hanna  
Frontmatter  
[More information](#)

|                                                                                                                                                                       |              |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| <b>Laplace-Transform Transient Photocurrent Spectroscopy as a Probe of Metastable Defect Distributions in Hydrogenated Amorphous Silicon .....</b>                    | <b>A19.3</b> |
| Mariana J. Gueorguieva, Charlie Main, and Steve Reynolds                                                                                                              |              |
| <b>Hydrogen Distributions and Model Lineshapes of ESR Signals of Dangling Bonds in a-Si:H.....</b>                                                                    | <b>A19.4</b> |
| P.A. Fedders                                                                                                                                                          |              |
| <b>Fast Light-Induced Change in Ellipsometry Spectra of Hydrogenated Amorphous Silicon Measured Through a Transparent Substrate Upon Bias Light Illumination.....</b> | <b>A19.5</b> |
| N. Hata, C.M. Fortmann, and A. Matsuda                                                                                                                                |              |
| <b>Illumination Dependence of Microcrystalline PIN Diodes.....</b>                                                                                                    | <b>A19.6</b> |
| Torsten Brammer, Franz Birmans, Mathias Krause, Helmut Stiebig, and Heribert Wagner                                                                                   |              |
| <b>Electrical Stability of a-Si:H TFTs Fabricated at 150°C .....</b>                                                                                                  | <b>A19.7</b> |
| H. Gleskova and S. Wagner                                                                                                                                             |              |
| <b>Structural Changes in Amorphous Silicon Annealed at Low Temperatures .....</b>                                                                                     | <b>A19.9</b> |
| Branko Pivac, Pavo Dubcek, Ognjen Milat, and Ivan Zulim                                                                                                               |              |

***HYDROGENATION AND  
OXIDATION***

|                                                                                                         |              |
|---------------------------------------------------------------------------------------------------------|--------------|
| <b>Surface Derivatization of Amorphous Silicon by Grignard Reagents .....</b>                           | <b>A20.4</b> |
| Takashi Ehara and Arata Maruyama                                                                        |              |
| <b>Photoluminescence Study of Self-Limiting Oxidation in Nanocrystalline Silicon Quantum Dots .....</b> | <b>A20.6</b> |
| Kenta Arai, Junichi Omachi, Katsuhiko Nishiguchi, and Shunri Oda                                        |              |

***THEORY AND COMPUTER  
MODELING***

|                                                                                                   |              |
|---------------------------------------------------------------------------------------------------|--------------|
| <b>Vibrational Stretching Modes of the Si-H and Si-D Bonds in Amorphous Silicon Nitride .....</b> | <b>A21.5</b> |
| Shu-Ya Lin                                                                                        |              |

Cambridge University Press  
978-1-107-41224-8 - Materials Research Society Symposium Proceedings: Volume 664:  
Amorphous and Heterogeneous Silicon-Based Films—2001  
Editors: Martin Stutzmann, James B. Boyce, J. David Cohen, Robert W. Collins  
and Jun-ichi Hanna  
Frontmatter  
[More information](#)

*DEFECTS AND  
DEFECT SPECTROSCOPY*

|                                                                                                                                                 |              |
|-------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| <b>Sensitization of the Holes Lifetime by the Addition of Dangling Bonds in a-Si:H .....</b>                                                    | <b>A22.2</b> |
| L.F. Fonseca, S.Z. Weisz, and I. Balberg                                                                                                        |              |
| <b>Orientation-Dependence of Low-Temperature Epitaxial Silicon Growth.....</b>                                                                  | <b>A22.3</b> |
| Thomas A. Wagner, Lars Oberbeck, Melanie Nerdling,<br>Horst P. Strunk, and Ralf B. Bergmann                                                     |              |
| <b>Ex Situ and In Situ Defect Density Measurements of a-Si:H by Means of the Cavity Ring Down Absorption Technique.....</b>                     | <b>A22.4</b> |
| A.H.M. Smets, J.H. van Helden, and M.C.M. van de Sanden                                                                                         |              |
| <b>Study of Defects in Hydrogenated Amorphous Silicon by Constant Photocurrent Method and Positron Annihilation .....</b>                       | <b>A22.5</b> |
| A. Amaral, G. Lavareda, C. Nunes de Carvalho, P. Brogueira,<br>P.M. Gordo, V.S. Subrahmanyam, C. Lopes Gil, M. Duarte Naia,<br>and A.P. de Lima |              |
| <b>Effect of Experimental Noise on Recovery of the Electronic Density of States From Transient Photocurrent Data .....</b>                      | <b>A22.6</b> |
| Steve Reynolds, Charlie Main, and Mariana J. Gueorguieva                                                                                        |              |

*STRUCTURAL AND ELECTRONIC  
PROPERTIES OF THIN SILICON FILMS*

|                                                                                                                                    |              |
|------------------------------------------------------------------------------------------------------------------------------------|--------------|
| <b>Properties of Silicon Films Deposited Under Argon Dilution .....</b>                                                            | <b>A23.1</b> |
| C. Longeaud, D. Roy, P. Chaudhuri, N. Dutta Gupta,<br>P. Pratim Ray, S. Vignoli, R. Meaudre, M. Meaudre,<br>and L. Saviot          |              |
| <b>The Determination of Optoelectronic Properties of Microcrystalline and Amorphous Silicon Films.....</b>                         | <b>A23.2</b> |
| Marinus Kunst, Susanne von Aichberger, Wilhelm Thom,<br>and Frank Wünsch                                                           |              |
| <b>Structural and Optical Features of Nanocrystalline Silicon Films Prepared by PECVD and rf Magnetron Sputter Techniques.....</b> | <b>A23.3</b> |
| M.-B. Park and N.-H. Cho                                                                                                           |              |
| <b>Electronic Transport Study of High Deposition Rate HWCVD a-Si:H by the Microwave Photomixing Technique .....</b>                | <b>A23.4</b> |
| S.R. Sheng, R. Braunstein, B.P. Nelson, and Y. Xu                                                                                  |              |

Cambridge University Press  
978-1-107-41224-8 - Materials Research Society Symposium Proceedings: Volume 664:  
Amorphous and Heterogeneous Silicon-Based Films—2001  
Editors: Martin Stutzmann, James B. Boyce, J. David Cohen, Robert W. Collins  
and Jun-ichi Hanna  
Frontmatter  
[More information](#)

**Study of Electrical Properties of Microcrystalline Silicon Films  
Using AC Measurements..... A23.5**  
Ely A.T. Dirani, Alexandre M. Nardes, Adnei M. Andrade,  
Fernando J. Fonseca, and Reginaldo Muccillo

**Increasing the Dark Conductivity Activation Energy in Undoped  
Microcrystalline Silicon by Post-Growth Anneals ..... A23.6**  
Jong-Hwan Yoon

**Generation-Recombination Noise in Amorphous Semiconductors ..... A23.7**  
Charlie Main, Steve Reynolds, and Rashad I. Badran

*HETEROJUNCTIONS*

**Charge Carrier Transport in a-Si:H/c-Si Heterojunctions ..... A24.1**  
Susanne von Aichberger, Frank Wünsch, and Marinus Kunst

**Importance of Defect Density Near the p-i Interface for a-Si:H  
Solar Cell Performance ..... A24.4**  
B.A. Korevaar, C. Smit, R.A.C.M.M. van Swaaij, D.C. Schram,  
and M.C.M. van de Sanden

**Silicon Thin Film Deposition on Nano-Structured ZnO Substrates..... A24.5**  
R. Könenkamp, V. Chu, J. Conde, and L. Dłoczik

**Optical Simulations of the Effects of Transparent Conducting  
Oxide Interface Layers on Amorphous Silicon Solar Cell  
Performance ..... A24.6**  
Gelio M. Ferreira, Andre S. Ferlauto, Pablo I. Rovira, Chi Chen,  
Hien V. Nguyen, Christopher R. Wronski, and Robert W. Collins

*AMORPHOUS AND  
MICROCRYSTALLINE SOLAR CELLS*

**Integrated Optical and Electrical Modeling of a-Si:H Based Solar  
Cells..... A25.1**  
Miro Zeman, René A.C.M.M. van Swaaij, Joost J.G. van den Heuvel,  
and Wim Metselaar

**Annealing Kinetics of Amorphous Silicon Alloy Solar Cells Made  
at Various Deposition Rates..... A25.2**  
Baojie Yan, Jeffrey Yang, Kenneth Lord, and Subhendu Guha

**Correlation Between Film and Cell Properties for DC Plasma  
Deposited Amorphous Silicon..... A25.3**  
Jennifer Heath, Suman B. Iyer, Yoram Lubianiker,  
J. David Cohen, and Gautam Ganguly

Cambridge University Press  
978-1-107-41224-8 - Materials Research Society Symposium Proceedings: Volume 664:  
Amorphous and Heterogeneous Silicon-Based Films—2001  
Editors: Martin Stutzmann, James B. Boyce, J. David Cohen, Robert W. Collins  
and Jun-ichi Hanna  
Frontmatter  
[More information](#)

|                                                                                                                                                               |               |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| <b>Effects of Low-Temperature Annealing on the Initial and Stabilized Performance of Amorphous Silicon Solar Cells .....</b>                                  | <b>A25.4</b>  |
| D. Carlson, G. Ganguly, and G. Lin                                                                                                                            |               |
| <b>Microcrystalline Silicon Solar Cells Prepared by 13.56 MHz PECVD at High Growth Rates: Solar Cell and Material Properties .....</b>                        | <b>A25.5</b>  |
| Tobias Roschek, Bernd Rech, Wolfhard Beyer, Peter Werner, Felix Edelman, Albert Chack, Raoul Weil, and Robert Beserman                                        |               |
| <b>Guiding Principle to Develop Intrinsic Microcrystalline Silicon Absorber Layer for Solar Cell by Hot Wire CVD .....</b>                                    | <b>A25.6</b>  |
| A.R. Middy, U. Weber, C. Mukherjee, and B. Schroeder                                                                                                          |               |
| <b>A Novel Poly-Si Solar Cell Using Grain Boundary Etching Treatment and Transparent Conducting Oxide .....</b>                                               | <b>A25.7</b>  |
| Dong Gun Lim, Wook Jae Lee, and Junsin Yi                                                                                                                     |               |
| <b>Preparation Temperature Effects in Microcrystalline Silicon Thin Film Solar Cells.....</b>                                                                 | <b>A25.8</b>  |
| O. Vetterl, A. Dasgupta, A. Lambert, H. Stiebig, F. Finger, and H. Wagner                                                                                     |               |
| <b>Solar Cell Performance Under Different Illumination Conditions .....</b>                                                                                   | <b>A25.9</b>  |
| Christian Gemmer and Markus B. Schubert                                                                                                                       |               |
| <b>Carrier Transport and Photogeneration in Large Area p-i-n Si/SiC Heterojunctions .....</b>                                                                 | <b>A25.10</b> |
| P. Louro, Yu. Vygranenko, R. Schwarz, M. Fernandes, M. Vieira, J. Gloeckner, and M. Schubert                                                                  |               |
| <b>Controlling the Lateral Photoeffect in a-Si:H Heterojunction Structures: The Influence of the Band Offset Analyzed Through a Numerical Simulation.....</b> | <b>A25.11</b> |
| A. Fantoni, M. Fernandes, P. Louro, R. Schwarz, and M. Vieira                                                                                                 |               |
| <b>Microcrystalline Germanium Carbide: A New, Almost Direct Gap, Thin Film Material for Photovoltaic Energy Conversion .....</b>                              | <b>A25.12</b> |
| Vikram L. Dalal and Jason T. Herrold                                                                                                                          |               |

*TFTs AND SENSORS*

|                                                                                                       |              |
|-------------------------------------------------------------------------------------------------------|--------------|
| <b>High Electron Mobility TFTs of Nanocrystalline Silicon Deposited at 150°C on Plastic Foil.....</b> | <b>A26.1</b> |
| I-Chun Cheng, Sigurd Wagner, Sanghoon Bae, and Stephen J. Fonash                                      |              |

Cambridge University Press  
978-1-107-41224-8 - Materials Research Society Symposium Proceedings: Volume 664:  
Amorphous and Heterogeneous Silicon-Based Films—2001  
Editors: Martin Stutzmann, James B. Boyce, J. David Cohen, Robert W. Collins  
and Jun-ichi Hanna  
Frontmatter  
[More information](#)

|                                                                                                             |              |
|-------------------------------------------------------------------------------------------------------------|--------------|
| <b>Density of States in a-Si:H From SCLC and Its Application in Modeling a Vertical TFT.....</b>            | <b>A26.2</b> |
| Naser Sedghi and Bill Eccleston                                                                             |              |
| <b>Photocapacitance of Hydrogenated Amorphous Silicon Phototransistors.....</b>                             | <b>A26.3</b> |
| D. Caputo, G. de Cesare, F. Lemmi, A. Nascetti, F. Palma, F. Roca, and M. Tucci                             |              |
| <b>Electromechanical Properties of Amorphous and Microcrystalline Silicon Micromachined Structures.....</b> | <b>A26.4</b> |
| J. Gaspar, M. Boucinha, V. Chu, and J.P. Conde                                                              |              |
| <b>Microcrystalline Germanium Photodetectors.....</b>                                                       | <b>A26.5</b> |
| M. Krause, H. Stiebig, R. Carius, and H. Wagner                                                             |              |
| <b>Hydrogenated Amorphous Silicon/ZnO Schottky Heterojunction for Position Sensitive Detectors.....</b>     | <b>A26.6</b> |
| H. Águas, P. Nunes, E. Fortunato, R. Silva, V. Silva, J. Figueiredo, F. Soares, and R. Martins              |              |
| <b>Porous Silicon Thin Film Gas Sensor.....</b>                                                             | <b>A26.7</b> |
| I. Ferreira, E. Fortunato, and R. Martins                                                                   |              |

*AMORPHOUS-TO-MICROCRYSTALLINE  
TRANSITION*

|                                                                                                                                  |              |
|----------------------------------------------------------------------------------------------------------------------------------|--------------|
| <b>Hydrogen Diffusion During Amorphous Silicon Growth and Its Consequences for the Transition to Nanocrystalline Growth.....</b> | <b>A27.2</b> |
| Richard S. Crandall and Jack Thiesen                                                                                             |              |
| <b>Control of Medium Range Order in Amorphous Silicon Via Ion and Neutral Bombardment.....</b>                                   | <b>A27.3</b> |
| Jennifer E. Gerbi, Paul M. Voyles, Michael M.J. Treacy, J. Murray Gibson, Wangchun Chen, Brent J. Heuser, and J.R. Abelson       |              |
| <b>* Proton NMR and Magnetic Susceptibility in a-Si:H .....</b>                                                                  | <b>A27.4</b> |
| Jonathan Baugh, Daxing Han, Alfred Kleinhammes, and Yue Wu                                                                       |              |

*STRUCTURAL RELAXATION AND DIFFUSION*

|                                                                                             |              |
|---------------------------------------------------------------------------------------------|--------------|
| <b>* Basic Mechanisms of Structural Relaxation and Diffusion in Amorphous Silicon .....</b> | <b>A28.1</b> |
| G.T. Barkema, Normand Mousseau, R.L.C. Vink, and Parthapratim Biswas                        |              |

\*Invited Paper

Cambridge University Press  
978-1-107-41224-8 - Materials Research Society Symposium Proceedings: Volume 664:  
Amorphous and Heterogeneous Silicon-Based Films—2001  
Editors: Martin Stutzmann, James B. Boyce, J. David Cohen, Robert W. Collins  
and Jun-ichi Hanna  
Frontmatter  
[More information](#)

**Determination of the Mobile-Hydrogen Charge State in  
Hydrogenated Amorphous Silicon ..... A28.2**  
Brent P. Nelson, Yueqin Xu, Robert C. Reedy,  
Richard S. Crandall, A. Harv Mahan, and Howard M. Branz

**Metastable Changes of the Electrical Conductivity in  
Microcrystalline Silicon..... A28.3**  
N.H. Nickel and M. Rakel

**Evidence for Long-Range Hydrogen Motion in a-Si:H Under  
Room-Temperature Illumination Using Raman Scattering of  
Amorphous Tungsten Oxide Overlayer ..... A28.5**  
Hyeonsik M. Cheong, Se-Hee Lee, Brent Nelson,  
Angelo Mascarenhas, and Sayten K. Deb

**Author Index**  
  
**Subject Index**

Cambridge University Press

978-1-107-41224-8 - Materials Research Society Symposium Proceedings: Volume 664:  
Amorphous and Heterogeneous Silicon-Based Films—2001

Editors: Martin Stutzmann, James B. Boyce, J. David Cohen, Robert W. Collins  
and Jun-ichi Hanna

Frontmatter

[More information](#)

## PREFACE

Once again, scientists and engineers from all over the world working on the physics and application of amorphous and microcrystalline silicon films met at Symposium A, "Amorphous and Heterogeneous Silicon-Based Films—2001," held April 16–20 at the 2001 MRS Spring Meeting in San Francisco, California. Continuing the long tradition of MRS symposia devoted to this particular field since 1982, this year's symposium attracted more than 250 participants from universities, industry laboratories, and other research institutions. Thus, Symposium A even after all these years remains one of the largest symposia of the MRS Spring Meeting and continues to provide an important international forum for the scientific exchange in this field. It was particularly encouraging to see so many young participants who contributed new ideas and interesting results to the presentations and discussions during the Meeting, showing that heterogeneous silicon-based films are still far from being a mature topic. The high scientific standard of their contributions was also "officially" recognized by two Graduate Students Awards and two Best Poster Awards.

The 2001 symposium program featured 175 oral and poster presentations in 28 scientific sessions, which covered all important new developments in the field. These contributions were selected from the more than 220 submitted abstracts by the symposium organizers together with five international advisors, who were asked to help in this task because of their internationally recognized scientific reputation. The organizers would like to use this occasion to express their sincere gratitude to the "2001" advisors: Pere Roca i Cabarrocas, Peter A. Fedders, Gregory N. Parsons, Kazunobu Tanaka, and Sigurd Wagner for their input and support!

These proceedings contain 143 scientific papers which were submitted by the participants and accepted after a careful reviewing process. Because of a general change in the publication procedure of MRS, the articles are not grouped in Chapters as in previous proceedings, but appear in the same order as in the symposium program and are also paginated individually by their program code, e.g. A25.4.1-6, etc. This does not necessarily improve the readability of the proceedings, but it is the price to pay for an increasingly automated publication process.

A large number of exciting new developments were presented during the Meeting. Thus, as discussed in the invited presentations of E.S. Aydil (UC Santa Barbara) and M. Kondo (ETL, Tsukuba), significant progress has been made in the high or even ultra-high rate deposition of device quality amorphous and microcrystalline silicon, in *in situ* growth characterization techniques, and in the state-of-the-art computer modeling of deposition processes. These issues are especially important for the successful future commercialization of silicon thin film devices. The latest results concerning silicon thin film solar cells were presented by S. Okamoto (Sanyo Electric Co., Osaka), D.E. Carlson (BP Solar, Toano), and Y. Nasuno (ETL, Tsukuba). a-Si:H tandem cells now approach stabilized conversion efficiencies of up to 10% even for large area modules. Similarly,  $\mu$ c-Si solar cells deposited on optimized TCO contacts by PECVD have reached conversion efficiencies of 9.4% on the laboratory scale. To achieve such high efficiencies in large-scale production is still a major challenge, but also here many improvements have been made.

Active matrix arrays for displays or sensors continue to be the second major application of thin silicon films, and again a lot of recent progress has been made. Thus, the status of low-temperature poly-Si TFTs was reviewed by A. Imaya (Sharp Co., Tenri). In addition, novel concepts for the use of amorphous or microcrystalline silicon in optical sensors and bio-implants were presented by M.B. Schubert (University of Stuttgart).

Experimental and theoretical tools for the investigation of the microstructure and structural processes in disordered silicon have become more and more sophisticated. This has led to new insights into the intricate role of hydrogen in amorphous silicon and has also

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Amorphous and Heterogeneous Silicon-Based Films—2001

Editors: Martin Stutzmann, James B. Boyce, J. David Cohen, Robert W. Collins  
and Jun-ichi Hanna

Frontmatter

[More information](#)

provided strong evidence for the so far elusive "paracrystalline" phase as a structural precursor of nanocrystalline silicon. Hydrogen and its role in metastability were the topic of a focused session with invited contributions from W. Beyer (Forschungszentrum Jülich), P.A. Fedders (Washington University, St. Louis), and H.M. Branz (NREL, Golden). In addition, important aspects of structural properties in heterogeneous silicon (medium range order, structural relaxation, hydrogen microstructure) were highlighted by P.M. Voyles (Bell Labs, Murray Hill), G. Barkema (Utrecht University), and Y. Wu (University of North Carolina, Chapel Hill).

A full-day tutorial on the physics and technology of amorphous and microcrystalline silicon held by R.A. Street (Xerox PARC, Palo Alto) and P. Mei (Hewlett Packard Labs., Palo Alto) preceded the symposium and was attended by more than 100 participants. This demonstrates the importance of silicon thin films for an increasing number of applications.

On behalf of all participants, we would like to thank the following companies and institutions for their financial support, which made the organization of the symposium a lot easier: Akzo Nobel nv, Asahi Glass Co., BP Solar, dpiX LLC, Energy Conversion Devices, EPRI, Fuji Electric Co., Hewlett Packard Laboratories, MVSystems Co., NREL, Pennsylvania State University, Sanyo Electric Co., United Solar Systems Co., Varian Medical Systems, Voltaix, and Xerox PARC. Last but not least, our very special thanks go to P. Craig Taylor and, in particular, to Mary Ann Woolf for their advice and immense help in organizing and running a symposium of this size! Without Mary Ann's long experience in handling, reviewing, and editing all those papers, these proceedings would never have existed.

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Amorphous and Heterogeneous Silicon-Based Films—2001

Editors: Martin Stutzmann, James B. Boyce, J. David Cohen, Robert W. Collins  
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Frontmatter

[More information](#)

## MATERIALS RESEARCH SOCIETY SYMPOSIUM PROCEEDINGS

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