

Cambridge University Press & Assessment

978-1-605-11298-5 — Amorphous and Polycrystalline Thin-Film Silicon Science and Technology —2011

Edited by Baojie Yan, Qi Wang, Helena Gleskova, Chuang Chuang Tsai, Seiichiro Higashi

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**Amorphous and Polycrystalline
Thin-Film Silicon Science
and Technology—2011**

**MATERIALS RESEARCH SOCIETY
SYMPOSIUM PROCEEDINGS VOLUME 1321**

Amorphous and Polycrystalline Thin-Film Silicon Science and Technology—2011

Symposium held April 25–29, 2011, San Francisco, California, U.S.A.

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University Printing House, Cambridge CB2 8BS, United Kingdom

One Liberty Plaza, 20th Floor, New York, NY 10006, USA

477 Williamstown Road, Port Melbourne, VIC 3207, Australia

314-321, 3rd Floor, Plot 3, Splendor Forum, Jasola District Centre, New Delhi - 110025, India

103 Penang Road, #05-06/07, Visioncrest Commercial, Singapore 238467

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www.cambridge.org

Information on this title: www.cambridge.org/9781605112985

Materials Research Society

506 Keystone Drive, Warrendale, PA 15086, USA

<http://www.mrs.org>

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First published 2012

CODEN: MRSPDH

A catalogue record for this publication is available from the British Library

ISBN 978-1-605-11298-5 Hardback

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CONTENTS

Preface xv

Materials Research Society Symposium Proceedings xvii

SOLAR CELLS

High Efficiency, Large Area, Nanocrystalline Silicon Based, Triple-junction Solar Cells3

A. Banerjee, T. Su, D. Beglau,
G. Pietka, F. Liu, B. Yan,
J. Yang, and S. Guha

Thin Film Silicon Solar Cells Under Moderate Concentration9

L.M. van Dam, W.G.J.H.M. van Sark,
and R.E.I. Schropp

Effect of Bandgap Grading on the Performance of a-Si_{1-x}Ge_x:H Single-junction Thin-film Solar Cells15

H.J. Hsu, C.M. Wang,
C.H. Hsu, and C.C. Tsai

* **High-efficiency Microcrystalline Silicon and Microcrystalline Silicon-germanium Alloy Solar Cells**21

Takuya Matsui and Michio Kondo

V_{oc} Saturation Effect in High-temperature Hydrogenated Polycrystalline Silicon Thin-film Solar Cells33

Hidayat Hidayat, Per I. Widenborg,
and Armin G. Aberle

Improvement of Single-junction a-Si:H Thin-film Solar Cells Toward 10% Efficiency39

P.H. Cheng, S.W. Liang, Y.P. Lin,
H.J. Hsu, C.H. Hsu, and C.C. Tsai

*Invited Paper

Semiconducting Polymer and Hydrogenated Amorphous Silicon Heterojunction Solar Cells	45
A.R. Middy and Eric A. Schiff	
Impact of a Finite Shunt Resistance on the Dark Spectral Response of a-Si:H/μc-Si Thin-film Multi-junction Photovoltaic Devices	51
Mauro Pravettoni and Alessandro Virtuani	
Investigation of Local Light Scattering Properties of Thin-film Silicon Solar Cells with Subwavelength Resolution	57
K. Bittkau, A. Hoffmann, J. Owen, and R. Carius	
Reflectance Improvement by Thermal Annealing of Sputtered Ag/ZnO Back Reflectors in a-Si:H Thin Film Silicon Solar Cells	63
Karin Söderström, Franz-Josef Haug, Céline Pahud, Rémi Biron, Jordi Escarré, Martial Duchamp, Rafal Dunin-Borkowski, and Christophe Ballif	
11.0% Stable Efficiency on Large Area, Encapsulated a-Si:H and a-SiGe:H Based Multijunction Solar Cells Using HF Technology	69
A. Banerjee, D. Beglau, T. Su, G. Pietka, G. Yue, B. Yan, J. Yang, and S. Guha	
Calibration of Multi-junction (Tandem) Thin Film Photovoltaic Modules Under Natural Sunlight	75
Georgios Tzamalis and Harald Müllejans	
* Flexible, Lightweight, Amorphous Silicon Based Solar Cells on Polymer Substrate for Space and Near-space Applications	81
K. Beernink, A. Banerjee, J. Yang, K. Lord, F. Liu, G. DeMaggio, G. Pietka, C. Worrel, and S. Guha	
Properties of Amorphous Silicon Passivation Layers for All Back Contact c-Si Heterojunction Solar Cells	93
Lulu Zhang, Ujjwal Das, Jesse Appel, Steve Hegedus, and Robert Birkmire	

*Invited Paper

Thin Film Si Photovoltaic Devices on Photonic Structures Fabricated on Steel and Polymer Substrates.....	99
S. Pattnaik, N. Chakravarty, J. Bhattacharya, R. Biswas, D. Slafer, and V.L. Dalal	
Performance of Hydrogenated a-Si:H Solar Cells with Downshifting Coating.....	105
Bill Nemeth, Yueqin Xu, Haorong Wang, Ted Sun, Benjamin G. Lee, Anna Duda, and Qi Wang	
Light-induced Open-circuit Voltage Increase in Amorphous Silicon/Microcrystalline Silicon Tandem Solar Cells.....	111
Xiaodan Zhang, Guanghong Wang, Shengzhi Xu, Shaozhen Xiong, Xinhua Geng, and Ying Zhao	
Modulated Surface-textured Substrates with High Haze for Thin-film Silicon Solar Cells.....	117
O. Isabella, P. Liu, B. Bolman, J. Krč, and M. Zeman	
Excitation of Guided-mode Resonances in Thin Film Silicon Solar Cells.....	123
F.-J. Haug, K. Söderström, A. Naqavi, and C. Ballif	
Effect of Buffer Structure on the Performance of a-Si:H/a-Si:H Tandem Solar Cells.....	129
C.H. Hsu, C.Y. Lee, P.H. Cheng, C.K. Chuang, and C.C. Tsai	
Annealing Effects of Microstructure in Thin-film Silicon Solar Cell Materials Measured by Effusion of Implanted Rare Gas Atoms.....	135
W. Beyer, D. Lennartz, P. Prunici, and H. Stiebig	

Room Temperature Fabricated ZnO:Al with Elevated and Unique Light-trapping Performance 141

E.V. Johnson, C. Charpentier,
T. Emeraud, J.F. Lerat, C. Boniface,
K. Huet, P. Prod'homme,
and P. Roca i Cabarrocas

n-Type Hydrogenated Microcrystalline Silicon Oxide Films and Their Applications in Micromorph Silicon Solar Cells. 147

Amornrat Limmanee, Songkiate Kittisontirak,
Channarong Piromjit, Jaran Sritharathikhun,
and Kobsak Sriprapha

Modeling of Advanced Light Trapping Approaches in Thin-film Silicon Solar Cells 153

Miro Zeman, Olindo Isabella,
Klaus Jäger, Pavel Babal,
Serge Solntsev, and Rudi Santbergen

*POLYCRYSTALLINE FILMS***Flash-lamp-induced Lateral Solidification of Thin Si Films 161**

K. Omori, G.S. Ganot, U.J. Chung,
A.M. Chitu, A.B. Limanov, and James S. Im

Poly-Si Thin Film Formation Using a Novel Low Thermal Budget Process. 167

Minghao Zhu, Yue Kuo,
Chen-Han Lin, and Qi Wang

Impact of Rapid Thermal Annealing and Hydrogenation on the Doping Concentration and Carrier Mobility in Solid Phase Crystallized Poly-Si Thin Films 173

A. Kumar, P.I. Widenborg, H. Hidayat,
Qiu Zixuan, and A.G. Aberle

Characterization of Green Laser Crystallized GeSi Thin Films 179

Balaji Rangarajan, Ihor Brunets,
Peter Oesterlin, Alexey Y. Kovalgin,
and Jurriaan Schmitz

A Study of the Post-hydrogenation Passivation Mechanism of Crystallized Poly-Si Films	185
Chong Luo, Juan Li, He Li, Zhiguo Meng, Chunya Wu, Qian Huang, Xu Shengzhi, Hoi Sing Kwok, and Shaozhen Xiong	
The Role of H-plasma in Aluminum Induced Crystallization of Amorphous Silicon	191
Chong Luo, Juan Li, He Li, Zhiguo Meng, Qian Huang, Shengzhi Xu, Hoi Sing Kwok, and Shaozhen Xiong	
Excimer-laser-induced Melting and Solidification of PECVD a-Si films Under Partial-melting Conditions	197
Q. Hu, Catherine S. Lee, T. Li, Y. Deng, U.J. Chung, A.B. Limanov, A.M. Chitu, M.O. Thompson, and James S. Im	
Growth of Large Grain Polycrystalline Silicon Thin Film on Soda-lime Glass at Low Temperature for Solar Cell Applications	203
K. Wang and K.H. Wong	
Non-melt Laser Thermal Annealing of Shallow Boron Implantation for Back Surface Passivation of Backside-illuminated CMOS Image Sensors	209
Zahra Ait Fqir Ali-Guerry, Karim Huet, Didier Dutartre, Rémi Beneyton, Daniel Bensahel, Philippe Normandon, and Guo-Neng Lu	

THIN FILM SILICON ALLOYS

Effect of Substrate Temperature on Hardness and Transparency of SiOC(-H) Thin Films Synthesized by Atmospheric Pressure Plasma Enhanced CVD Method	217
Mayui Noborisaka, So Nagashima, Hidetaka Hayashi, Naoharu Ueda, Kyoko Kumagai, Akira Shirakura, and Tetsuya Suzuki	

Use of a-SiC:H Multilayer Transducers for Detection of Fluorescence Signals from Reactive Cyan and Yellow Fluorophores.223
P. Louro, M. Vieira, M.A. Vieira, J. Costa, M. Fernandes, and A. Karmali	
Properties of a-(Si,Ge) Materials and Devices Grown Using Chemical Annealing229
Ashutosh Shyam, Daniel Congreve, Max Noack, and Vikram Dalal	
Effect of Dynamic Bias Stress (AC) in Short-channel (L=1.5μm) p-Type Polycrystalline Silicon (Poly-Si) Thin Film Transistors (TFTs) on the Glass Substrate235
Sung-Hwan Choi, Yeon-Gon Mo, and Min-Koo Han	
The Suppression of Leakage Current in the Solid Phase Crystallized Silicon (SPC-Si) TFT Employing Off-state Bias Annealing Under Light Illumination.241
Sang-Geun Park, Seung-Hee Kuk, Jong-Seok Woo, and Min-Koo Han	
Investigation of Amorphous IGZO TFT Employing Ti/Cu Source/Drain and SiNx Passivation247
Young Wook Lee, Sung-Hwan Choi, Jeong-Soo Lee, Jang-Yeon Kwon, and Min-Koo Han	
Reliability of Oxide Thin Film Transistors Under the Gate Bias Stress with 400 nm Wavelength Light Illumination253
Soo-Yeon Lee, Sun-Jae Kim, Yongwook Lee, Woo-Geun Lee, Kap-Soo Yoon, Jang-Yeon Kwon, and Min-Koo Han	
DC and AC Gate-bias Stability of Nanocrystalline Silicon Thin-film Transistors Made on Colorless Polyimide Foil Substrates.259
I-Chung Chiu, I-Chun Cheng, Jian Z. Chen, Jung-Jie Huang, and Yung-Pei Chen	

SIMULATION AND CHARACTERIZATION

- Wide-spectral-range, Expanded-beam Spectroscopic Ellipsometer and its Application for Imaging/Mapping of Graded Nanocrystalline Si:H Films**267
 A. Nemeth, D. Attygalle, L.R. Dahal,
 P. Aryal, Z. Huang, C. Salupo, P. Petrik,
 G. Juhasz, C. Major, O. Polgar, M. Fried,
 B. Pecz, and R.W. Collins
- Numerical 3D-simulation of Micromorph Silicon Thin Film Solar Cells**273
 Stefan Geißendörfer, Karsten von Maydell,
 and Carsten Agert
- Correlated Photoluminescence Spectroscopy Investigation of Grain Boundaries and Diffusion Processes in Nanocrystalline and Amorphous Silicon (nc-Si:H) Mixtures**279
 Jeremy D. Fields, K.G. Kiriluk,
 D.C. Bobela, L. Gedvilas, and P.C. Taylor
- Hopping Transport in Doped Co-deposited Mixed-phase Hydrogenated Amorphous/Nanocrystalline Silicon Thin Films**285
 L.R. Wienkes, C. Blackwell,
 and J. Kakalios
- Photocarrier Excitation and Transport in Hyperdoped Planar Silicon Devices**291
 Peter D. Persans, Nathaniel E. Berry,
 Daniel Recht, David Hutchinson,
 Aurore J. Said, Jeffrey M. Warrender,
 Hannah Peterson, Anthony DiFranzo,
 Christina McGahan, Jessica Clark,
 Will Cunningham, and Michael J. Aziz
- * **Theoretical Studies of Structure and Doping of Hydrogenated Amorphous Silicon**297
 Bin Cai and D.A. Drabold

*Invited Paper

<i>Ab Initio</i> Structure Characterization for the Amorphous Assembly of Si Clusters Encapsulating Transition Metal307
Takehide Miyazaki, Noriyuki Uchida, and Toshihiko Kanayama	
* Microscopic Characterizations of Nanostructured Silicon Thin Films for Solar Cells313
Antonín Fejfar, Petr Klapetek, Jakub Zlámal, Aliaksei Vetushka, Martin Ledinský, and Jan Kočka	
Band Alignment at Amorphous/Crystalline Silicon Hetero-interfaces323
L. Korte, T.F. Schulze, C. Leendertz, M. Schmidt, and B. Rech	
Electron Emission from Deep Traps in Hydrogenated Amorphous Silicon and Silicon-germanium: Meyer-Neldel Behavior and Ionization Entropy329
Qi Long, Steluta Dinca, Eric A. Schiff, Baojie Yan, Jeff Yang, and Subhendu Guha	

NANOSTRUCTURES

* Opto-electronic Properties of Co-deposited Mixed-phase Hydrogenated Amorphous/Nanocrystalline Silicon Thin Films337
James Kakalios, U. Kortshagen, C. Blackwell, C. Anderson, Y. Adjallah, L.R. Wienkes, K. Bodurtha, and J. Trask	
Mixed Phase Silicon Oxide Layers for Thin-film Silicon Solar Cells349
Peter Cuony, Duncan T.L. Alexander, Linus Löfgren, Michael Krumrey, Michael Marending, Mathieu Despeisse, and Christophe Ballif	
Silicon Thin-films From Nanoparticle Dispersion: Tailoring Morphological, Electrical and Optical Characteristics355
Etienne Drahi, Sylvain Blayac, and Patrick Benaben	

*Invited Paper

Electric Field Effect in Amorphous Semiconductor Films Assembled from Transition-metal-encapsulating Si Clusters361
N. Uchida, T. Miyazaki, Y. Matsushita, K. Sameshima, and T. Kanayama	

Optical Characterization Using Ellipsometry of Si Nanocrystal Thin Layers Embedded in Silicon Oxide367
E. Agocs, P. Petrik, M. Fried, and A.G. Nassiopoulou	

GROWTH MECHANISM

* Control of Materials and Interfaces in $\mu\text{c-Si:H}$-Based Solar Cells Grown at High Rate375
Yasushi Sobajima, Chitose Sada, Akihisa Matsuda, and Hiroaki Okamoto	

Monitoring the Growth of Microcrystalline Silicon Deposited by Plasma-enhanced Chemical Vapor Deposition Using In-situ Raman Spectroscopy387
S. Muthmann, F. Köhler, M. Hülsbeck, M. Meier, A. Mück, R. Schmitz, W. Appenzeller, R. Carius, and A. Gordijn	

Deposition of p-Type Nanocrystalline Silicon Using High Pressure in a VHF-PECVD Single Chamber System393
Xiaodan Zhang, Guanghong Wang, Xinxia Zheng, Shengzhi Xu, Changchun Wei, Jian Sun, Xinhua Geng, Shaozhen Xiong, and Ying Zhao	

Influence of the Electrode Spacing on the Plasma Characteristics and Hydrogenated Amorphous Silicon Film Properties Grown in the DC Saddle Field PECVD System399
Keith R. Leong, Nazir P. Kherani, and Stefan Zukotynski	

SENSORS AND NOVEL DEVICES

Development of Si Microliquid Processing Using Piezo Actuator407
Muneki Akazawa, Shunki Koyanagi, and Seiichiro Higashi	

*Invited Paper

Thin Film Power Harvesting System for Displays	413
Arman Ahnood, Reza Chaji, and Arokia Nathan	
Optical Bias Controlled Amplification in Tandem Si-C Pinpin Devices	417
M. Vieira, M.A Vieira, P. Louro, M. Fernandes, A. Fantoni, and M. Barata	
* Amorphous Silicon Based Particle Detectors	423
N. Wyrsh, A. Franco, Y. Riesen, M. Despeisse, S. Dunand, F. Powolny, P. Jarron, and C. Ballif	
Amorphous Silicon Photosensors for Detection of Intrinsic Cell Fluorophores	435
A. Joskowiak, V. Chu, D.M.F. Prazeres, and J.P. Conde	
Self Optical Gain in Multilayered Silicon-carbon Heterostructures: A Capacitive Active Band-pass Filter Model	441
M.A. Vieira, M. Vieira, P. Louro, M. Fernandes, J. Costa, and A.S. Garção	
Optical Demultiplexer Device: Frequency and Optical Bias Analysis	449
P. Louro, M. Vieira, M.A. Vieira, and T. Silva	
Thin-film Photodiode with an a-Si:H/nc-Si:H Absorption Bilayer	455
Y. Vygranenko, M. Vieira, and A. Sazonov	
Author Index	461
Subject Index	465

*Invited Paper

PREFACE

This volume includes sixty-eight papers presented in the 2011 MRS Spring Meeting Symposium A, “Amorphous and Polycrystalline Thin Film Silicon Science and Technology – 2011”, which took place April 25-29, in San Francisco, California. The symposium covers the science and technology of thin-film silicon based materials and devices. The symposium traditionally started off on April 25 with an extremely well-attended full-day tutorial aimed at young researchers and people new to the field. The tutorial was lectured by Profs. Andrew Flewitt and Arokia Nathan. During the four days of fourteen oral sessions and two evenings of poster presentations, seventeen invited talks reviewed the recent progress and addressed the scientific and technical issues in the field. The oral and poster presentations reported new results in various areas, covering fundamental studies and technology advances.

Among various applications, solar cells for photovoltaic solar energy and thin-film transistors for flat-panel display have been the two major driving forces for research and development of thin-film silicon materials and devices. In the last few years, the thin-film silicon community has mainly focused on thin-film silicon solar cells to address the issues of efficiency, manufacturing capability and manufacturing cost. This year Symposium A held focused sessions on the topic of solar cell efficiency. Microcrystalline ($\mu\text{c-Si:H}$) or nanocrystalline silicon (nc-Si:H) offers the potential for improving the cell efficiencies. Dr. Friedhelm Finger (Forschungszentrum Jülich, Germany) reviewed the recent efficiency improvement in $\mu\text{c-Si:H}$ solar cells with an emphasis on $\mu\text{c-SiC:H}$ and $\mu\text{c-SiO:H}$ doped layers and effective light management. Dr. Finger expected that over 14% efficiency with a-Si:H/ $\mu\text{c-Si:H}$ tandem solar cells will be attained soon. Prof. Miro Zeman (Delft University of Technology, The Netherlands) showed that 23% efficiency is achievable using a-SiC:H/a-SiGe:H/nc-Si:H triple-junction structure with advanced light trapping to enhance the photon harvesting of the sun light. Along this line, many new light trapping and light management approaches have been investigated, including plasmonic light scattering using metal and dielectric nano-particles and photonic structures. Theoretical and simulation studies show that the classical limit of $4n^2$ can be exceeded using advanced light trapping techniques. Dr. Takuya Matsui (AIST, Japan) presented their recent progress in developing $\mu\text{c-SiGe:H}$ materials as low bandgap materials to absorb long wavelength light, which provides a new material for high efficiency solar cells. Significant progress in advancing the nc-Si:H technology for mass production has been made. Dr. Arindam Banerjee of United Solar Ovonic LLC (Michigan, USA) reported achieving initial 12% and stable 11.2% encapsulated module (400 cm^2) efficiencies with an a-Si:H/nc-Si:H/nc-Si:H triple-junction structure. The high module efficiencies are new world records for thin film silicon solar modules measured by the National Renewable Energy Laboratory. In addition, Symposium A had three sessions on thin film transistors, sensors and other novel devices reporting advances in these areas. To improve the device quality significant fundamental studies have been presented, especially advanced microscopic characterization (Dr. A. Fejfar, Academy of Sciences, Czech Republic) and simulations (Prof. D. Drabold, Ohio University, USA). The presentations covered the thin-film silicon materials ranging from amorphous to nano- and micro-structured materials, and polycrystalline thin films. The unique optical

properties of black silicon attracted significant attention for its potential application in solar cells as an effective light trapping material.

We had a very successful and enjoyable symposium. The number of presentations and attendees reflect the great need for development of thin-film silicon materials and devices. Unique and advanced results ensured the high quality of the symposium. As the organizers of Symposium A, we greatly acknowledge the invaluable contributions of the authors of oral and poster presentations, especially those who made written contributions to this volume

The symposium organizers thank all the people evolved in the Symposium before, during, and after the conference. The organizers greatly appreciate the program committee members of V. Chu (INESC, Portugal), A. Fejfar (Academy of Sciences of the Czech Republic, Czech Republic), F. Finger (Forschungszentrum Jülich, Germany), A. Flewitt (University of Cambridge, United Kingdom), T. Matsui (AIST, Japan), E.A. Schiff (Syracuse University, USA), P. Stradins (NREL, USA), J. Robertson (University of Cambridge, United Kingdom), and M. Zeman (Delft University of Technology, The Netherlands). They kindly reviewed all of the abstracts, which helped the organizers to prepare an interesting program. Special appreciation goes to all of the referees for their careful review of papers in the proceedings and valuable feedback given to the authors. We sincerely thank Mary Ann Woolf, who supervised and managed the abstract and manuscript reviewing process. Her experience and hard work allowed for smooth and timely production of this volume. The MRS staff provided friendly and professional support throughout the organization of the Symposium and Proceedings

On behalf of all the participants, we thank the generous financial support of our corporate sponsors: ITRI, NREL, ULVAC Inc., and United Solar Ovonic LLC.

Baojie Yan
Qi Wang
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Seiichiro Higashi

September 2011

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