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To get the latest version of the scientific program on your cell phone please **scan the QR-code** or enter the URL:

<http://cms2015.siliconpv.com/mobile>



SiliconPV 2015 is proud to be under the patronage of Sigmar Gabriel, Federal Minister for Economic Affairs and Energy, Germany

Chairmens' Message

Dear Friends of Silicon Photovoltaics,

The PV market is still growing year by year, with cumulated installations approaching 200 GWp in the near future. In more and more countries of the world PV electricity is already now a cost-efficient alternative to fossil fuel based electricity, even without subsidies. This trend will continue with further increases in conversion efficiencies and decreasing manufacturing costs. To continue this success story, further research and development activities are needed, covering all areas of the value chain for a fast transfer of knowledge 'from lab to fab'.

Silicon photovoltaics is sometimes believed to be an 'old lady', with the first proper crystalline silicon solar cell presented already 60 years ago. But the dynamics in this field of research is huge, with many excellent results being published in the recent past from both research institutions as well as industry. This is true for very applied research with high industrial relevance for current wafer, solar cell and module production, as well as for fundamental issues allowing for a better understanding of the underlying physics and operation principles. All of these topics are covered in the conference and will be addressed by international researchers.

When the conference series was started five years ago, there was a need for a conference covering research on high class level and allowing for a close interaction of researchers, covering all areas of possible contributions in form of orals, poster presentations or face-to-face discussions. And we think that this is still true in 2015. In contrast to many other conferences, SiliconPV has the motto 'from scientists for scientists', and will provide a forum for exchange of knowledge and ideas in an atmosphere allowing both presentation of top class, cutting-edge research results and open-minded, discussion oriented exchange of ideas. We intentionally avoid parallel sessions to allow everybody to attend all presentations in the three day event. For the second time SiliconPV will be linked to the nPV workshop with an overlapping day of both events on Wednesday. On that day the focus is laid on n-type silicon for PV applications.

I am convinced that you will enjoy the atmosphere of the conference as well as the location and welcome you to the 5th SiliconPV 2015 in beautiful Konstanz!



Giso Hahn



Giso Hahn
University of Konstanz
*Chairman
of SiliconPV 2015*

Dear PV Colleagues,

The long lasting PV crisis is almost over and the winners are cost effective but high efficiency c-Si solar cells and modules. I am extremely excited about how cost effective PV systems have become. Now it is time to spread PV similar to the Internet- everyone has to have access to it.

It is now also time to invest in new solar cell and module technologies to further increase the module power per area and constantly lower the LCOE. Some of such advanced technologies offer n-type Si solar cells. I would like to invite you to our 5th nPV workshop, where you will have the possibility to update yourself on how institutes and companies have progressed in the development of HIT, PERT and IBC solar cells. Together we will discuss what will be important to tackle in the future to make these technologies cost effective. You will have also enough time to connect with potential partners. This event will be followed by an EU project workshop HERCULES, which you can join free of charge.

I am looking forward to meet you in Konstanz for this interesting conference and workshops week,



Radovan Kopecek



Radovan Kopecek
ISC, Germany
*Chairman
of nPV workshop 2015*

Committees SiliconPV

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Committees nPV workshop

Chair of nPV workshop

ISC, Germany: R. Kopecek

Program Committee

ISC, Germany: R. Kopecek

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Sunday, March 22, 2015

17:00 – Welcome Reception and Pre-registration

19:00

Refreshments will be served at the Konzil / Council Congress Center

Monday, March 23, 2015

07:30 Registration

08:30 - Opening Session

08:45

Chair: Giso Hahn (University of Konstanz)

08:30

Welcoming Speech

Helmfried Meinel, Director General, Ministry of the Environment, Climate Protection and the Energy Sector

08:40

Opening Speech Chairman SiliconPV 2015

Giso Hahn, Chairman SiliconPV 2015

08:45 - Session 1: Surface Passivation

10:15

Chair: Barbara Terheiden (University of Konstanz)

08:45

Passivation of c-Si Surfaces by ALD Tantalum Oxide Capped with PECVD Silicon Nitride

Yimao Wan¹, James Bullock¹, Andres Cuevas¹

¹ Australian National University

09:15

Morphology and Hydrogen in Passivating Amorphous Silicon Layers

Sebastian Gerke¹, Hans-Werner Becker², Detlef Rogalla², Giso Hahn¹, Reinhart Job³, Barbara Terheiden¹

¹ University of Konstanz; ² RUBION - Central Unit for Ion Beams and Radioisotopes; ³ Department of Electrical Engineering and Computer Science

09:30

High-resolution Structural Investigation of Passivated Interfaces of Silicon Solar Cells

Susanne Richter¹, Kai Kaufmann¹, Volker Naumann¹, Martina Werner¹, Anamaria Moldovan², Christian Hagendorf¹

¹ Fraunhofer CSP; ² Fraunhofer ISE

- 09:45 On the Role of Surface Doping Concentration on the Charge-carrier Recombination at the Passivated Si Surface
Bas van de Loo¹, Gaby Janssen², Ingrid Romijn², Ji Liu², Martien Koppes², Yuji Komatsu², Erwin Kessels¹
¹Eindhoven University of Technology; ²ECN
- 10:00 2D Mapping of Chemical and Field Effect Passivation of Al₂O₃ on Si Substrates
Paul Jordan¹, Daniel Kai Simon¹, Thomas Mikolajick², Ingo Dirnstorfer¹
¹NaMLab gGmbH; ²Institut für Halbleiter- und Mikrosystemtechnik
- 10:15 Coffee Break
- 10:45 - 12:00 Session 2: Advanced Emitters and Carrier Selective Structures**
Chair: Pierre Verlinden (Trina Solar) and Moustafa Ghannam (Kuwait University)
- 10:45 Ion Implantation of Boric Molecules for Silicon Solar Cells
Jan Krügener¹, Robby Peibst², Eberhard Bugiel¹, Fabian Kiefer², Rolf Brendel², H. Jörg Osten¹
¹Leibniz University of Hanover; ²Institute for Solar Energy Research Hamelin
- 11:00 Solar Cells with Epitaxial or Gas Phase Diffused Emitters Above 21% Efficiency
Thomas Rachow¹, Stefan Reber¹, Stefan Janz¹
Presented by Nena Milenkovic¹
¹Fraunhofer ISE
- 11:15 A Theory of Passivating and Carrier-selective Contacts for Silicon Solar Cells
Zachary Holman¹, Mathieu Boccard¹, Priyaranga Koswatta¹
¹Arizona State University
- 11:30 Theoretical Investigation of Carrier-selective Contacts Featuring Tunnel Oxides by Means of Numerical Device Simulation
Heiko Steinkemper¹, Frank Feldmann¹, Martin Bivour¹, Martin Hermle¹
¹Fraunhofer ISE
- 11:45 Tunnel Oxide Passivated Carrier-selective Contacts Based on Ultra Thin SiO₂ Layers Grown by Photooxidation or Wet-chemical Oxidation in Ozonated Water
Anamaria Moldovan¹, Frank Feldmann¹, Martin Zimmer¹, Jochen Rentsch¹, Martin Hermle¹, Kai Kaufmann², Volker Naumann², Martina Werner², Christian Hagendorf²
¹Fraunhofer ISE; ²Fraunhofer CSP

12:00 Lunch Break

13:00 - 15:00 Poster Session 1

The poster numbers are based on topics:

- A Advanced Characterization and Simulation
- B Advanced Light Management
- C High Efficiency Devices
- D Junction Formation
- E Module Architectures, Materials, and Reliability
- F Novel Cell Structures, e.g. Applying Tandems, New Material Combinations or Nanostructures
- G Process Integration
- H Silicon Material
- I Structuring and Contact Formation
- J Surface Morphology and Passivation
- K Wafering and Kerfless Technologies

A-01 Analysis of Activation Energies and Decaytime Constants of Potential-induced Degradated Crystalline Silicon Solar Cells

Mario Bähr¹

¹ CiS Forschungsinstitut für Mikrosensorik und Photovoltaik GmbH

A-04 Out-of-plane Excess Carrier Density Variations in Point Contact Lattice-based Test Structures for QSSPC Contact Recombination Current Measurements

Jan Deckers¹, Maarten Debucquoy¹, Robert Mertens¹, Jef Poortmans¹

¹ imec

A-07 Grain to Grain Contrasts in Photoluminescence Images of Silicon Wafers

Hannes Höffler¹, Jonas Haunschild¹, Stefan Rein¹

¹ Fraunhofer ISE

A-10 Precipitate-related Injection-dependent Carrier Lifetime in n- and p-Type Silicon

Wolfram Kwapil¹, Jonas Schön¹, Wilhelm Warta¹, Martin C. Schubert¹

¹ Fraunhofer ISE

A-13 A Computational Tool for Advanced Simulation of Durability of PV Modules

Marco Paggi¹, Irene Berardone², Mauro Corrado²

¹ IMT Institute for Advanced Studies Lucca; ² Politecnico di Torino

- A-16 Understanding the Optimization of the Emitter Coverage in BC-BJ Solar Cells
Paul Procel¹, Marco Guevara¹, Vincenzo Maccaronio¹, Felice Crupi¹, Guiseppe Cocorullo¹
¹Universita Della Calabria
- A-19 Measurement Uncertainties of a Compact Array Spectrometer
Felix Schubert¹, Karsten Klameth¹, Sylvain Darou¹, Daniel Spinner¹
¹Aescusoft GmbH
- A-22 Characterization of Silicon Solar Cells and Module Materials Using Terahertz Radiation
Vincas Tamošiūnas¹, Linas Minkevičius¹, Andrius Vaitkūnas¹, Andrzej Urbanowicz¹, Andrius Maneikis¹, Arūnas Šetkus¹, Gintaras Valušis¹, Vincas Tamošiūnas¹
Presented by Vincas Tamošiūnas¹
¹Center for Physical Sciences and Technology
- A-25 Device Architecture and Lifetime Requirements for High Efficiency Multicrystalline Silicon Solar Cells
Hannes Wagner¹, Jasmin Hofstetter¹, Bernhard Mitchell², Carlos del Canizo¹, Pietro Altermatt³, Tonio Buonassisi¹
¹Massachusetts Institute of Technology; ²University of New South Wales; ³University of Hanover
- B-01 TiO₂/ SiO₂ Nano Composite Light Scattering Back Reflector
Hiroshi Nagayoshi¹
¹Tokyo National College of Technology
- C-01 Double-sided Contacted Solar Cells with Carrier-selective Contacts
Frank Feldmann¹, Kurt-Ulrich Ritzau¹, Anamaria Moldovan¹, Martin Hermle¹, Stefan Glunz¹
¹Fraunhofer ISE
- D-01 Selective Emitter Solar Cell Fabrication via Single Step Doping
Emine Hande Çiftçınar¹, Firat Es¹
¹Middle East Technical University - GUNAM
- D-04 Electron Beam Doping: A Novel Approach for Creating Selective Emitters in Crystalline Silicon Solar Cells
Vincent Fischer¹, Benjamin Graffel¹, Björn Meyer¹, Falk Winckler¹, Florian Fache²
¹Fraunhofer FEP; ²TU Bergakademie Freiberg

- F-04 Via Hole Conditioning in Silicon Heterojunction Metal Wrap Through Solar Cells
Ingo Dirnstorfer¹
¹NaMLab gGmbH
- F-07 Properties of Liquid Phase Crystallized Interdigitated Back-contact Solar Cells on Glass
Paul Sonntag¹, Daniel Amkreutz¹, Jan Haschke¹, Sven Kühnapfel¹, Bernd Rech¹
¹Helmholtz Zentrum Berlin
- G-01 Model-based Continuous Improvement of Industrial p-Type PERC Technology over 21% Efficiency
Gerd Fischer¹, Matthias Müller¹, Stefan Steckematz¹, Franziska Wolny¹, Christian Koch¹, Eric Schneiderlöchner¹, Holger Neuhaus¹
¹SolarWorld Innovations
- H-01 Characterization of as-Deposited Al₂O₃ Thin Films Prepared by Thermal ALD
Corina Barbos¹, Alain Fave¹, Elisabeth Blanquet², Alexandre Crisci², Mustapha Lemiti¹, Andrei Sabac¹, Khaled Ayadi¹, Philippe Girard¹, David Albertini¹, Geneviève Grenet¹, Claude Botella¹, Danièle Blanc¹
¹Institut des Nanotechnologies de Lyon; ²Science et Ingénierie des Matériaux et Procédés
- H-04 Influence of Si Surface Orientation on Screen-printed Ag/Al Contacts
Susanne Fritz¹, Axel Herguth¹, Stefanie Riegel¹, Giso Hahn¹
¹University of Konstanz
- H-07 Toward Identifying the Lifetime-limiting Defect in Multicrystalline Silicon After High-temperature Gettering
Jasmin Hofstetter¹, Stephanie Scott¹, Ashley Morishige¹, Mallory Jensen¹, Hannes Wagner¹, Carlos del Canizo¹, Tonio Buonassisi¹
¹Massachusetts Institute of Technology
- H-10 Epitaxial Growth of High Quality n-Type Silicon Foils in a Quasi-inline APCVD Reactor
Nena Milenkovic¹, Thomas Rachow¹, Stefan Janz¹, Stefan Reber¹
¹Fraunhofer ISE
- H-13 Impurity Imaging of Silicon Wafers Via Injection and Temperature Dependent PL
Martin Schubert¹, Laura Mundt¹, Tim Niewelt¹, Bernhard Michl¹, Florian Schindler¹, Wilhelm Warta¹
¹Fraunhofer ISE

- H-16 Temperature Dependent Quantum Efficiency in Multicrystalline Silicon Solar Cells
Rune Søndena¹, Charly Berthod², Jan Ove Odden³, Anne-Karin Søliland³, Marie Syre Wiig¹, Erik Stensrud Marstein¹
¹Institute for Energy Technology; ²University of Agder; ³Elkem Solar
- I-01 Doping Level Effect on Sample Temperatures in Infra-red Belt Furnace Firing
Evert Bende¹
¹ECN
- I-04 Electron Beam-fired Contacts in Thick Metal Layers
Benjamin Graffel¹, Eric Zschieschang¹, Daniel Dressler¹, Falk Winckler¹
¹Fraunhofer FEP
- I-07 Removal and Quantification of Background Plating on Silicon Wafer Solar Cells
Martin Heinrich¹, Martin Lieder², Bram Hoex³, Armin G. Aberle³, Markus Glatthaar²
¹University of Freiburg, Institut für Mikrosystemtechnik; ²Fraunhofer ISE; ³SERIS
- I-10 Contact Resistance on Plated Silicon Heterojunction Cells
Agata Lachowicz¹
¹CSEM
- I-13 The Impact of N₂ Anneal on the Defects Caused Both by Laser Thermal Effect and by the Existence of Dielectrics
Lujia Xu¹, Klaus Weber¹, Xinbo Yang¹, Andreas Fell¹, Evan Franklin¹
Presented by Andreas Fell¹
¹Australian National University
- J-01 Hybrid Laser-etching-process for Wafer Texturing
Verena Blattmann¹, Daniel Trusheim¹
¹Fraunhofer ILT
- J-04 Effective Lifetime Studies After Nano Imprint Texturation of p-Type Silicon Wafers
Wilfried Favre¹, Stefan Landis², Julie Stendera¹, Mélanie Louro², François Nardelli², Barbara Glueck², Carole Socquet-Clerc², Olivier Pollet², Sébastien Dubois¹
¹CEA/INES; ²CEA/LETI
- J-07 Effective Liquid Source SiO₂ Passivation on n-Type Silicon Using Perhydropolysilazane
Hiroshi Nagayoshi¹
¹Tokyo National College of Technology

- J-10 Thin Oxides Formed by Field-induced Anodisation for Passivating Tunnel Oxides of Carrier-selective Contact Solar Cells
Jingnan Tong¹, Xi Wang¹, Zi Ouyang¹, Alison Lennon¹
¹ University of New South Wales
- K-01 Numerical Modelling of Thermally-induced Spalling
Irene Berardone¹, Marco Paggi², Sarah Kajari-Schröder³, Raphael Niepelt³
¹ Politecnico di Torino DISEG; ² IMT Institute for Advanced Studies Lucca; ³ ISFH
- K-04 Determination of the Surface Damage of Diamond Wire Sawn Silicon Wafers Depending on Wire Velocity
Sindy Würzner¹, Rajko Buchwald¹, Hans Joachim Möller¹
¹ Fraunhofer THM
- 15:00 - 16:15 Session 3: Contact Formation**
Chair: Radovan Kopecek (ISC Konstanz) and Holger Neuhaus (SolarWorld Innovations)
- 15:00 Progress in Fine Line Metallization by Coextrusion Printing on Cast Mono Silicon PERC Solar Cells
Philipp Richter¹, Gerd Fischer¹, Melanie Hentsche¹, Eric Schneiderloechner¹, Markus Valtere², Corie Cobb³, Scott E. Solberg³, Holger Neuhaus¹, Scott Elrod³
¹ SolarWorld Innovations; ² Private; ³ PARC, a Xerox Company
- 15:30 Phosphorus-diffused Polysilicon Contacts for Silicon Solar Cells
Di Yan¹, Andres Cuevas¹, Yimao Wan¹, James Bullock¹, Christian Samundsett¹
¹ Australian National University
- 15:45 Comprehensive Simulation and Acceleration of the Foil-metallization Laser Process, Enabling Solar Cell Efficiencies Above 21%
Jan Nekarda¹, Andre Streek², Martin Graf¹, Andreas Brand¹, Rico Böhme³
¹ Fraunhofer ISE; ² Laserinstitut Hochschule Mittweida; ³ Innolas-Solutions
- 16:00 Electrical and Mechanical Properties of Plated Ni/Cu Contacts for Si Solar Cells
Sven Kluska¹, Jonas Bartsch¹, Andreas Arnold Brand¹, Sybille Hopman¹, Jan Nekarda¹, Markus Glatthaar¹
¹ Fraunhofer ISE
- 16:15 Coffee Break

16:45 - 18:00 **Session 4: Degradation / Regeneration**

Chair: Ralf Preu (Fraunhofer ISE) and Donghwan Kim (Korea University)

16:45 From Simulation to Experiment: Understanding BO-Regeneration Kinetics in Different Si Materials
Svenja Wilking¹, Maxime Forster², Stanislav Stoyanov¹, Axel Herguth¹, Giso Hahn¹
¹ University of Konstanz; ² ApollonSolar

17:00 Advanced Hydrogenation for Silicon Solar Cells
Brett Hallam¹, Phill Hamer¹, Sisi Wang¹, Lihui Song¹, Nitin Nampalli¹, Malcolm Abbott¹, Catherine Chan¹, Doris Lu¹, Alison Wenham¹, Ly Mai¹, Nino Borojevic¹, Alex Li¹, Stuart Wenham¹
¹ University of New South Wales

17:15 Pseudo FF and VOC Analysis of Cz-Si Based Low Concentrator Solar Cells
Tobias Fellmeth¹
¹ Fraunhofer ISE

17:30 A New mc-Si Degradation Effect Called LeTID
Friederike Kersten¹, Peter Engelhart¹, Hans-Christoph Ploigt¹, Andrey Stekolnikov¹, Thomas Lindner¹, Florian Stenzel¹, Matthias Bartzsch¹, Andy Szpeth¹, Kai Petter¹, Jörg Müller¹, Johannes Heitmann²
Presented by Peter Engelhart¹
¹ Hanwha Q CELLS GmbH; ² TU Bergakademie Freiberg

17:45 Light-induced Degradation of Si Solar Cells with Aluminium Oxide Passivated Rear Side
Karin Krauß¹, Fabian Fertig¹, Stefan Rein¹
¹ Fraunhofer ISE

18:30 Technical Tour and Sightseeing Tour – *refer to page 36 for more information*

Tuesday, March 24, 2015

08:00 Registration

08:30 - 10:15 Session 5: Modules

Chair: Arthur Weeber (ECN) and Delfina Muñoz (CEA-INES)

08:30 Power Loss Prognosis from Thermographic Images of PID Affected Silicon Solar Modules

Thomas Kaden¹, Katrin Lammers¹, Hans Joachim Möller¹
¹ Fraunhofer THM

08:45 Defect Etching of PID-s Crystal Defects and Proof of Sodium Decoration After Corona Degradation

Volker Naumann¹, Stephan Großer¹, Dominik Lausch¹, Christian Hagendorf¹
¹ Fraunhofer CSP

09:00 Drift Characteristics of Mobile Ions in SiN_x ARC Films and Solar Cells

Marshall Wilson¹, Jacek Lagowski¹, Alexandre Savtchouk¹, Peter Edelman¹
¹ Semilab SDI

09:15 Outdoor Performance of Bifacial Modules by Measurements and Modelling

Gaby Janssen¹, Anna A. Carr¹, Agnes A Mewe¹, Bas B van Aken¹
¹ ECN

09:30 Numerical Modeling of c-Si Modules by Coupling the Semiconductor with the Thermal Conduction and Radiation Equations

Malte R. Vogt¹, Matthias Winter¹, Fabian Wilde¹, Rolf Brendel¹, Pietro P. Altermatt¹
¹ University of Hanover

09:45 High Cycle Fatigue of Cracked Solar Cells Leading to Permanent Module Power Loss

Jörg Käsewieter¹
¹ ISFH

10:00 Reduction of Thermomechanical Stress Using Electrically Conductive Adhesives

Torsten Geipel¹, Li Carlos Rendler¹, Manuel Stompe², Ulrich Eitner¹, Lutz Rissing²
¹ Fraunhofer ISE; ² Institut für Mikroproduktionstechnik der Leibniz University of Hanover

10:15 Coffee Break

10:45 - 12:00 Session 6: Optics and Special Cells

Chair: Rolf Brendel (ISFH) and Zachary Holman (Arizona State University)

10:45 Experimental Determination of the Uncertainty of the Absorption Coefficient of Crystalline Silicon

Carsten Schinke¹, Peter Christian Peest¹, Jan Schmidt¹, Rolf Brendel¹, Karsten Bothe¹, Malte R. Vogt², Alfred Schirmacher³, Ingo Kröger³, Stefan Winter³, Hieu Nguyen⁴, Siew Lim⁴, Daniel MacDonald⁴

¹ISFH; ²Leibniz University of Hanover; ³Physikalisch-Technische Bundesanstalt (PTB); ⁴Australian National University

11:00 Rear Side Sphere Gratings - Improving Light Trapping in Crystalline Si Single-junction and Si-based Tandem Solar Cells

Johannes Eisenlohr¹, Benjamin Lee¹, Jan Benick¹, Frank Feldmann¹, Thomas Rachow¹, Marion Drießen¹, Benedikt Bläsi¹, Jan Christoph Goldschmidt¹, Martin Hermle¹

¹Fraunhofer ISE

11:15 p⁺nn⁺ Silicon Solar Cell with a Full-area Rear MIS Passivated Contact

Yimao Wan¹, James Bullock¹, Andres Cuevas¹, Christian Samundsett¹, Di Yan¹

¹Australian National University

11:30 Design of 4-Terminal Solar Modules Combining Thin-film Wide-bandgap Top Cells and c-Si Bottom Cells

Ruud Schropp¹, Dong Zhang¹, Wim Soppe¹

¹ECN

11:45 Progress Towards a 30% Efficient GaInP/Si Tandem Solar Cell

Stephanie Essig¹, Scott Ward¹, Myles Steiner¹, Daniel Friedman¹, John Geisz¹, Paul Stradins¹, David Young¹

¹National Renewable Energy Laboratory

12:00 Lunch Break

13:00 - 15:00 Poster Session 2

The poster numbers are based on topics:

- A Advanced Characterization and Simulation
- B Advanced Light Management
- C High Efficiency Devices
- D Junction Formation
- E Module Architectures, Materials, and Reliability
- F Novel Cell Structures, e.g. Applying Tandems, New Material Combinations or Nanostructures
- G Process Integration
- H Silicon Material
- I Structuring and Contact Formation
- J Surface Morphology and Passivation
- K Wafering and Kerfless Technologies

A-02 Temperature Coefficients of Compensated Silicon Solar Cells – Influence of Ingot Position and Blend-in Ratio

Charly Berthod¹, Rune Strandberg¹, Jan Ove Odden²

¹ University of Agder; ² Elkem Solar

A-05 Optical Simulation and Analysis of ISO-Textured Silicon Solar Cells Including Light Trapping

Johannes Greulich¹, Anne-Kristin Volk¹, Nico Woehrle¹, Ingrid Haedrich¹, Martin Wiese¹, Martin Hermle¹, Stefan Rein¹

¹ Fraunhofer ISE

A-08 Progress in the Industrial Evaluation of the mc-Si PERCT Technology Based on Boron Diffusion

Steffen Keller¹, Andreas Teppe¹, Chun Gong¹, Tobias Friess¹, Holger Habenicht¹, Jens Krümborg¹, Markus Klenk¹, Peter Fath¹, Sentao Wang², Yanke Jia², Shuisheng Zhou², Jianming Dong²

¹ RCT Solutions GmbH; ² Shanxi Lu'an Solar Technology Co. Ltd.

A-11 Combined Impact of Heterogeneous Lifetime and Gettering on Solar Cell Performance

Ashley Morishige¹, Hannes Wagner¹, Jasmin Hofstetter¹, Ibrahim Avci², Carlos del Cañizo¹, Tonio Buonassisi¹

¹ Massachusetts Institute of Technology; ² Synopsys, Inc.

A-14 Injection-dependent Minority Carrier Lifetime in Epitaxial Silicon Layers by Time-resolved Photoluminescence

Stéphanie Parola¹, Mehdi Daanoune², Rémi Louvencourt³, Anne Kaminski-Cachopo², Guillaume Chareyre³, Mustapha Lemiti³, Danièle Blanc-Pélissier⁴

¹ INL; ² IMEP-LAHC; ³ Université de Lyon; ⁴ Institut des Nanotechnologies de Lyon

- A-17 Modeling of the Surface Defect Density in c-Si/a-Si:H Heterojunctions Using the Defect-pool
David Réaux¹, Jean-Paul Kleider², Marie-Estelle Gueunier-Farret²
¹ Group of electrical engineering of Paris, UMR8507; ² Laboratoire de Génie Electrique de Paris (LGEP)
- A-20 Optimization of Silicon Solar Cells by Variational Minimization of Entropy Generation
Sjoerd Smit¹, Erwin Kessels¹
¹ Eindhoven University of Technology
- A-23 Quantification of Electroluminescence Measurements on Modules
Marko Turek¹, Felix Frühauf¹
¹ Fraunhofer CSP
- A-26 Overcoming Systematic Photocurrent Calculation Errors in Ray Tracing Simulations
Nico Woehrlé¹, Johannes Greulich¹, Stefan Rein¹
¹ Fraunhofer ISE
- F-08 Optimizing Plasmonically Enhanced Upconversion
 Søren Madsen, Department of Engineering, Aarhus University
- I-14 Effects of Current Induced Firing with Ag Paste in Boron Emitter
 Chanseok Kim, Korea University
- B-02 Optimization of the Antireflection Coating of Thin Epitaxial Crystalline Silicon Solar Cells
Josefine Selj¹, David Young², Sachit Grover²
¹ Institute for Energy Technology; ² National Renewable Energy Laboratory
- E-17 Impact of Glass-EVA Interface Films on PID of Crystalline Silicon PV Modules
 Soohyun Bae, Korea University
- C-01 Implanted Poly-Si Layer as Passivating Contacts in IBC Solar Cells
Guangtao Yang¹, Guangtao Yang¹, Nienke van Hameren¹, Andrea Ingenito¹, Olindo Isabella¹, Miro Zeman¹
¹ Delft University of Technology
- D-02 Dissolution of Electrically Inactive Phosphorus by Low Temperature Annealing
Amir Dastgheib-Shirazi¹, Ana Peral², Gabriel Micard¹, Michael Steyer¹, Hannes Wagner³, Giso Hahn¹
¹ University of Konstanz; ² University of Madrid; ³ Massachusetts Institute of Technology

- D-05 TCO-Free Low-temperature p⁺ Emitters for Back-Junction c-Si Solar Cells
Isidro Martín¹, Arnau Coll¹, Gema López¹, Pablo Ortega¹, Thibaut Desrues², Albert Orpella¹, Ramon Alcubilla¹
¹ Polytechnic University of Catalonia; ² INES
- D-08 Optimization of Boron Spin on Dopant Diffusion in Emitter Formation and its Elemental Isotopic Analysis
Bandana Singha¹, Chetan Singh Solanki¹
¹ Indian Institute of Technology Bombay
- D-11 Organic-silicon Solar Cells Exceeding 20% Efficiency
Dimitri Zielke¹, Claudia Niehaves¹, Jan Schmidt¹, Wilfried Loevenich², Matthias Hörteis², Andreas Elschner²
¹ ISFH; ² Heraeus Precious Metals
- E-02 Service Life Estimation of Crystalline PV Modules
Stephan Hoffmann¹, Michael Köhl¹
¹ Fraunhofer ISE
- E-05 Combined Weathering Testing of PV Modules
Michael Köhl¹
¹ Fraunhofer ISE
- E-08 Performance Improvement Techniques for PV Strings in Qatar: Results of First Year of Outdoor Exposure
Diego Martinez Plaza¹, Amir Abdallah¹, Benjamin W. Figgis¹, Talha Mirza²
Presented by Amir Abdallah¹
¹ Qatar Environment and Energy Research Institute; ² GreenGulf
- E-11 Impact of Cell Texturing Quality on Cell to Module Losses
Andreas Schneider¹, Rudolf Harney¹, Simon Koch²
¹ ISC Konstanz; ² Photovoltaik Institut Berlin AG
- E-14 Analysis of Ohmic Losses Due to Solder and Pressure Interconnection and Related Interface Resistances for Solar Cells
Tobias Urban¹, Alexander Schmid¹, Johannes Heitmann¹, Ansgar Mette²
¹ TU Bergakademie Freiberg; ² Hanwha Q Cells
- F-02 Simple Solar Cells Featuring Molybdenum Oxide Hole Contacts
James Bullock¹, Di Yan¹, Andres Cuevas¹, Christian Samundsett¹, Yimao Wan¹
¹ Australian National University
- F-05 Silicon Microwires as Solar Cells
Fredrik Aleksander Martinsen¹, Ursula Gibson¹
¹ Norwegian University of Science and Technology

- G-02 Extensive Comparison of Solar Modules Manufactured with Single and Double Printed Cells
Marco Galiazzo¹, Alessandro Voltan¹, Giorgio Cellere¹, Xi Zhang², Shi Jinchao², Duchao Zhang², Cindy Hu², Jianming Wang²
¹ Applied Materials; ² Yingli Solar
- H-02 Do Lomer Dislocations Spoil High Performance of mc-Si Solar Cells?
Jan Bauer¹, Angelika Hähnel², Horst Blumtritt¹, Hakan Deniz¹, Annika Zuschlag³, Otwin Breitenstein¹
¹ Max Planck Institute; ² Fraunhofer IWM; ³ University of Konstanz
- H-05 Influence of Copper Diffusion on Lifetime Degradation in n-Type Czochralski Silicon for Solar Cells
Guilherme Gaspar¹, Chiara Modanese¹, Marisa Di Sabatino¹, Lars Arnberg¹, Eivind Øvrelid¹
¹ NTNU
- H-08 Low Temperature Self Aligned Process for High Efficiency IBC c-Si Solar Cells
Andea Ingenito¹, Olindo Isabella¹, Miro Zeman¹
¹ Delft University of Technology
- H-11 Micron-scale Photoluminescence Spectroscopy on Dislocations in MC-Silicon
Hieu Nguyen¹, Fiacre Rougieux¹, Fan Wang¹, Hoe Tan¹, Daniel Macdonald¹
¹ Australian National University
- H-14 Imaging Stress and Defects in Monocrystalline PV Wafers Using Lock-in Photoelasticity and Photoluminescence
Bjoern Seipel¹, Harley Johnson², Gavin Horn²
¹ SolarWorld; ² University of Illinois at Urbana-Champaign
- H-17 Lifetime Spectroscopy and Hydrogenation of Chromium in n- and p-Type CZ Silicon
Chang Sun¹, Anyao Liu¹, Fiacre Rougieux¹, Daniel Macdonald¹
¹ Australian National University
- I-02 Pattern of Partial Rear Contacts for Silicon Solar Cells
Félix Gérenton¹, Fabien Mandorlo¹, Jean-Baptiste Brette², Mustapha Lemiti¹
¹ University of Lyon, INSA de Lyon; ² S'TILE
- I-05 Microstructure of Void Formation Stages at Local Rear Contacts
Stephan Großer¹, Christian Hagendorf¹
¹ Fraunhofer CSP

- I-08 On the Contact of Transparent Conductive Oxide to p-Type Amorphous Silicon
Simon Kirner¹, Lars Korte¹, Luana Mazzarella¹
Presented by Lars Korte¹
¹ Helmholtz-Zentrum Berlin
- I-11 Electrical and Optical Analysis of Polymer Rear Insulation Layers for Interdigitated Back Contact Cells
Zhongtian Li¹, Yang Li¹, Zi Ouyang², Yu Jiang², Pei-Chieh Hsiao², Alison Lennon¹
¹ University of New South Wales; ² UNSW Australia
- J-02 Extrinsic Passivation of Silicon Surfaces for Solar Cells
Ruy Sebastian Bonilla¹, Fred Woodcock¹, Christian Reichel², Martin Hermle², Peter R Wilshaw¹
¹ University of Oxford; ² Fraunhofer ISE
- J-05 Hierarchical Etching for Improved Optical Front-side Properties of Monocrystalline Si Solar Cells
Frank Heinemeyer¹, Verena Steckenreiter¹, Fabian Kiefer¹, Rolf Brendel¹, Robby Peibst¹
¹ ISFH
- J-08 Investigation on Blistering Behaviour for n-Type Silicon Solar Cells
Zih-Wei Peng¹, Po-Tsung Hsieh¹, Yuan-Jun Lin¹, Chih-Jen Huang¹
¹ Motech Industries, Inc.
- K-02 Efficiencies Above 16% on Novel RGS Material
Yves Patrick Botchak Mouafi¹
¹ University of Konstanz
- K-05 Improvement of V_{oc} for Thin RST Solar Cells by Enhanced Back Side Passivation
Benjamin Albrecht¹
¹ University of Konstanz
- 15:00 - 16:15** **Session 7: Characterisation and Simulation**
Chair: Ron Sinton (Sinton Instruments)

- 15:00 How Reliable are Thermography- and Luminescence-based R_s and J_{01} Images?
Otwin Breitenstein¹, Jan Bauer¹, David Hinken², Karsten Bothe²
¹Max Planck Institute; ²ISFH
- 15:15 Carrier-diffusion Corrected J_0 -Analysis by QSSPC for Increased Consistency
Achim Kimmerle¹
¹PSE AG
- 15:30 IV-Curve Analysis for Non-linear Solar Cells and Operation Beyond Low Injection
Bernhard Fischer¹
¹pv-tools GmbH
- 15:45 Short-circuit Current Density Imaging Methods for Silicon Solar Cells
Fabian Fertig¹, Milan Padilla¹, Hannes Höffler¹, Ino Geisemeyer¹, Otwin Breitenstein², Martin C. Schubert¹, Stefan Rein¹
¹Fraunhofer ISE; ²Max Planck Institute
- 16:00 Simulation-based Efficiency Gain Analysis of 21.2%-Efficient Screen-printed PERC Solar Cells
Christopher Kranz¹, Jan Petermann¹, Thorsten Dullweber¹, Rolf Brendel¹
¹ISFH
- 16:15 Coffee Break
- 16:45 - 17:45 Session 8: Modelling and Characterisation**
Chair: Martin Schubert (Fraunhofer ISE) and Bram Hoex (UNSW)
- 16:45 PC1Dmod 6.1 - State-of-the-art Models in a Well-known Interface for Improved Simulation of Si Solar Cells
Halvard Haug¹, Achim Kimmerle², Johannes Greulich², Erik Stensrud Marstein¹
¹Institute for Energy Technology; ²Fraunhofer ISE
- 17:00 On the Relationship Between Wafer Sawing, Chemical Etching, Wafer Texture, and Wafer Reflectivity
Jörg Acker¹, Birgit Meinel¹, Tim Koschwitz¹, Thomas Langner¹
¹Brandenburg Technical University Cottbus-Senftenberg

- 17:15 Mono-silicon Wafer Characterization Using Lock-in Infrared Photoelasticity and Discrete Dislocation Modeling
Harley Johnson¹, Tung-Wei Lin¹, Gavin Horn¹, Hareesh Tummala², Marc Fivel²
¹University of Illinois at Urbana-Champaign; ²Université Grenoble-Alpes
- 17:30 Assessing the Device-performance Impacts of Structural Defects with TCAD Modeling
David Berney Needleman¹, Hannes Wagner¹, Pietro P. Altermatt², Tonio Buonassisi¹
¹Massachusetts Institute of Technology; ²Leibniz University of Hanover
- 19:00 Conference Dinner – refer to page 35 for more information

Wednesday, March 25, 2015

08:00 Registration

08:30 - Opening Session nPV workshop

08:45

Chair: Radovan Kopecek (ISC Konstanz)

08:30

5 Years nPV workshop

Radovan Kopecek, ISC Konstanz

08:45 - Session 9: Hetero-Junctions

10:15

Chair: Stefan Glunz (Fraunhofer ISE)

08:45

Process Simplifications in Large Area Hybrid Silicon Heterojunction Solar Cells

Loic Tous¹, Patrick Choulat¹, Stefano Nicola Granata¹, Twan Bearda¹, Angel Uruena¹, Joachim John¹, Richard Russell¹, Filip Duerinckx¹, Jozef Szlufcik¹

¹imec

09:00

Valence Band Offsets and Electron Hole Transport in Amorphous/Crystalline Silicon Heterojunction Solar Cells

Mathias Mews¹, Martin Liebhaber¹, Tim Schulze¹, Lars Korte¹

¹Helmholtz-Zentrum Berlin

- 09:15 Impact of the Front Contact Transparent Conducting Oxide (TCO) Work Function on the Open Circuit Voltage of TCO/a-Si:H(p⁺/i)/c-Si(n) HIT Cells
Moustafa Ghannam¹, Yaser Abdulraheem¹, Ghadah Shehadah¹
¹ Kuwait University
- 09:30 Silicon Heterojunction Solar Cells: Temperature Impact on Passivation and Performance
Johannes Seif¹, Gopal Krishnamani¹, Bénédicte Demaurex², Silvia Martin de Nicolas¹, Niels Holm¹, Stefaan De Wolf², Christophe Ballif¹
¹ EPFL STI IMT PV-LAB; ² EPFL, IMT, PV-LAB
- 09:45 Alternative Contact Materials for Induced Junction Silicon Solar Cells
Martin Bivour¹, Heiko Steinkemper¹, Jan Temmler¹, Martin Hermle¹
¹ Fraunhofer ISE
- 10:00 Evolution of Bulk c-Si Properties During the Processing of GaP/c-Si Heterojunction Cell
Varache Renaud¹, Darnon Maxime², Delfina Muñoz¹, Descazaux Médéric¹, Baron Thierry²
¹ CEA-INES; ² LTM-CNRS
- 10:15 Coffee Break
- 10:45 - 12:00 Session 10: IBC Cells**
Chair: Jef Poortmans (imec) and Ajeet Rohatgi (Suniva)
- 10:45 Impact of Dead Regions on Cell Performance in Interdigitated Back Contact Silicon Heterojunction Cells: a Simulation Study
Takefumi Kamioka¹, Kyotaro Nakamura², Yutaka Hayashi¹, Yoshio Ohshita¹
¹ Toyota Technological Institute; ² Meiji University
- 11:00 Analysis of n-Type IBC Solar Cells with Diffused Boron Emitter Locally Blocked by Implanted Phosphorus
Ralph Müller¹, Christian Reichel¹, Julian Schrof¹, Milan Padilla¹, Marisa Selinger¹, Ino Geisemeyer¹, Jan Benick¹, Martin Hermle¹
¹ Fraunhofer ISE
- 11:15 All-screen-printed Dopant Paste Interdigitated Back Contact Solar Cell
Giuseppe Scardera¹
¹ Dupont Silicon Valley Technology Center

11:30 Soft Breakdown Behavior of Interdigitated Back-contact Silicon Solar Cells

Haifeng Chu¹, Lejo J. Koduvelikulathu¹, Valentin D. Mihailetchi¹, Giuseppe Galbiati¹, Andreas Halm¹, Radovan Kopecek¹

¹ISC Konstanz

11:45 Universal Passivation for p⁺⁺ and n⁺⁺ Areas on Back Side Contacted Solar Cells

Kai Carstens¹, Morris Dahlinger¹, Jürgen R. Köhler¹, Renate Zapf-Gottwick¹, Jürgen H. Werner¹

¹Institute for Photovoltaics

12:00 Lunch Break

13:00 - 15:00 Poster Session 3

The poster numbers are based on topics:

- A Advanced Characterization and Simulation
- B Advanced Light Management
- C High Efficiency Devices
- D Junction Formation
- E Module Architectures, Materials, and Reliability
- F Novel Cell Structures, e.g. Applying Tandems, New Material Combinations or Nanostructures
- G Process Integration
- H Silicon Material
- I Structuring and Contact Formation
- J Surface Morphology and Passivation
- K Wafering and Kerfless Technologies
- nPV nPV workshop

A-03 FFE IBC Cells: Impact of Busbars on Cell Performance with Circuit Modelling

Antonius Burgers¹, Ilkay Cesar¹, Nicolas Guillemin¹, Agnes Mewe¹, Pierpaolo Spinelli¹

¹ECN

A-06 Comparison of BO Regeneration Dynamics in PERC and Al BSF Solar Cells

Axel Herguth¹, Renate Horbelt¹, Svenja Wilking¹, Reinhart Job², Giso Hahn¹

¹University of Konstanz; ²University of Applied Sciences Münster

A-09 Tunneling Contact Passivation Simulations Using Silvaco Atlas

Frode Kløw¹, Sean Erik Foss¹

¹Institute for Energy Technology

- A-12 Simulation Study of Multi-wire Front Contact Grids for Silicon Solar Cells
Massimo Nicolai¹, Mauro Zanucoli¹, Paolo Magnone², Marco Galiazzo³, Diego Tonini³, Matteo Bertazzo³, Enrico Sangiorgi¹, Claudio Fiegna¹
¹ University of Bologna; ² DTG - University of Padova; ³ Applied Materials Italia
- A-15 Optoelectrical Modeling of Novel Self-aligned Crystalline Silicon IBC Solar Cell
Silvio Piero¹
¹ Università della Calabria
- A-18 Iron Detection in Crystalline Silicon by Different Lifetime Measurement Techniques
Matthias Rost¹, Daniel Stichtenoth¹, Karsten Meyer¹
¹ Solarworld AG
- A-21 Challenges for LBIC in IBC FFE Cells, and FFE-Voltage Mapping as a New Approach to Loss Analysis of IBC FFE Cells
Pierpaolo Spinelli¹, Nicolas Guillevin¹, Teun Burgers¹, Agnes Mewe¹, Bart Geerligs¹, Arthur Weeber¹, Ilkay Cesar¹
¹ ECN
- A-24 Rapid Testing of External Quantum Efficiency Using Led Solar Simulators
Marko Turek¹, Tabea Luka¹
¹ Fraunhofer CSP
- A-27 3D-FIB Investigation of Cu Precipitates in c-Si After High Temperature Treatments
Annika Zuschlag¹, David Kohberger¹, Giso Hahn¹
¹ University of Konstanz
- B-03 Crystalline Silicon Solar Cells with Enhanced Light Trapping via Rear Side Diffraction Grating
Nico Tucher¹, Johannes Eisenlohr¹, Martin Graf¹, Hubert Hauser¹, Jan Benick¹, Claas Müller², Jan Christoph Goldschmidt¹, Martin Hermle¹, Benedikt Bläsi¹
¹ Fraunhofer ISE; ² Albert-Ludwigs-University, IMTEK
- D-03 Shallow B-implanted Emitters with Laser Overdoping from AlOx Passivating Layer
Thibaut Desrues¹
¹ CEA-INES
- D-06 Microcrystalline Silicon Oxide Emitters for Silicon Heterojunction Solar Cells
Luana Mazzarella¹, Simon Kirner¹, Onno Gabriel¹, Lars Korte¹, Bernd Stannowski¹, Bernd Rech¹, Rutger Schlatmann¹
¹ Helmholtz-Zentrum Berlin

- D-09 New Method for Determination of Electrically Inactive Phosphorus in n-type Emitters
Michael Steyer¹, Amir Dastgheib-Shirazi¹, Giso Hahn¹, Barbara Terheiden¹
¹University of Konstanz
- E-03 Specific Loads for PV Modules in Deserts
Elisabeth Klimm¹, Karl-Anders Weiss¹
Presented by Stephan Hoffmann¹
¹Fraunhofer ISE
- E-06 Long-term and Annealing Stable, Solderable PVD Metallization with Optimized Al Diffusion Barrier
Julia Kumm¹, Rony V. Chacko¹, Hassan Samadi¹, Philip Hartmann¹, Dirk Eberlein¹, Andreas Wolf¹
¹Fraunhofer ISE
- E-09 Minimization of Electrical Losses of PV Modules Located in Places with High Solar Irradiance
Jorge Rabanal-Arabach¹, Andreas Schneider¹, Enrique Cabrera¹
¹ISC Konstanz
- E-12 Impact of Cell Texturing Quality on Cell to Module Losses
Jens Schneider¹, Sebastian Schindler¹, Stefan Eiternick¹, Marko Turek¹
¹Fraunhofer CSP
- E-15 Bifacial Photovoltaic Systems Energy Yield Modelling
Stanley Wang¹, Oscar Wilkie¹, Rob Steeman¹, Jenny Lam¹, Wilson Zhang¹, Kah Sing Khoo¹, Hannes Rostan¹
¹REC
- F-03 Crystalline Silicon Substrate Issues During Processing of Homo-heterojunction Solar Cells
Tristan Carrere¹, Renaud Varache¹, Jérôme Le Perchec¹, Delfina Muñoz¹, Jean-Paul Kleider²
¹CEA - INES; ²Laboratoire de Génie Electrique de Paris (LGEP)
- F-06 Doped Dielectrics and Associated Precursors for Industrial Bifacial Silicon Solar Cells
Prabal Goyal¹, Elias Urrejola¹, Junegie Hong¹, Alain Madec¹
¹Air Liquide
- G-03 Enhanced Stable Regeneration of High Efficiency Cz PERC Cells
Franziska Wolny¹, Torsten Weber¹, Gerd Fischer¹, Axel Herguth², Svenja Wilking²
¹SolarWorld Innovations GmbH; ²University of Konstanz

- H-03 Measurement and Modeling of Surface Recombination Velocity as a Function of Temperature and Injection Level
Mariana Bertoni¹, Simone Bernardini¹, Adrienne Blum²
¹Arizona State University; ²Sinton Instruments
- H-06 Towards a Model for Regeneration by Means of Charge State Control of Hydrogen
Marcus Gläser¹, Dominik Lausch¹
¹Fraunhofer CSP
- H-09 Saw Damage Gettering
George Martins¹, Toby Burton¹, Phi MacDonald¹, Peter Wilshaw¹
¹Oxford University
- H-12 Light-induced Degradation and Regeneration in n-Type Silicon
Tim Niewelt¹, Juliane Broisch¹, Jonas Schön¹, Jonas Haunschild¹, Stefan Rein¹, Wilhelm Warta¹, Martin C. Schubert¹
¹Fraunhofer ISE
- H-15 Inline Optical CVD for Silicon Deposition at Low Temperature and Atmospheric Pressure
Joao Serra¹, A. Augusto², F. Serra¹, Jorge Maia Alves¹, Antonio Vallera¹
¹University of Lisbon; ²University of Lisbon and SESUL;
- H-18 Modelling of Open Circuit Voltage Gains via Localised Emitters on Silicon Solar Cells
Peinan Teng¹, Xinrui An¹, Craig Johnson¹, Stuart Wenham¹, Allen Barnett¹
¹University of New South Wales
- I-03 Effect of Zn and Al Concentrations Analyzed by ICP-OES on the Properties of co-Sputtered ZnO:Al Films
Angelika Gorgulla¹, Dominik-Pascal Ertel¹, Michael Steyer¹, Giso Hahn¹, Barbara Terheiden¹
¹University of Konstanz
- I-06 Sol-gel Synthesized Dielectric Films as a Diffusion Barrier to Rear Side Contact Metal
Bilge Gündüz¹
¹Merck KGaA
- I-09 Silver Doping of PV Paste Glasses for Improved Contact Formation
Stefan Körner¹, Markus Eberstein¹
¹Fraunhofer IKTS

- I-12 Laser Contacts and Laser Doped Selective Emitters for p-Type IBC c-Si Solar Cells
Gema Lopez¹, Pablo Ortega¹, Isidro Martín¹, Cristóbal Voz¹, Anna Morales-Vilches¹, Albert Orpella¹, Ramón Alcobilla¹
¹ Polytechnic University of Catalonia
- J-03 Multifunctional ICP-PECVD Silicon Nitride Layers for Silicon Solar Cell Applications
Josh Engelhardt¹, Giso Hahn¹, Barbara Terheiden¹
¹ University of Konstanz
- J-06 Manipulation of Stored Charge Density and Polarity in Anodic Oxides for Silicon Solar Cell Passivation
Zhong Lu¹, Zi Ouyang¹, Yimao Wan², Nicholas Grant², Di Yan², Alison Lennon¹
¹ University of New South Wales; ² Australian National University
- J-09 Impact of Rear Side Roughness on Optical and Electrical Properties of a High-efficiency Solar Cell
Maxi Richter¹, Martin Zimmer¹, Jochen Rentsch¹
¹ Fraunhofer ISE
- K-03 Solar Cells from Epitaxial Si: an Epifoil Epiphany
Jonathan Govaerts¹, Christos Trompoukis¹, Hariharsudan Sivaramakrishnan Radhakrishnan¹, Loic Tous¹, Stefano Granata¹, Enrico Giuseppe Carnemolla¹, Roberto Martini¹, Alessio Marchegiani¹, Marwa Karim¹, Ivan Sharlandziev¹, Twan Bearda¹, Valerie Depauw¹, Kris Van Nieuwenhuysen¹, Ivan Gordon¹, Jozef Szlufcik¹, Jef Poortmans¹
¹ imec
- nPV-1 Silicon Heterojunction Solar Cells: Towards Low-cost High-efficiency Industrial Devices and Application to Low-concentration PV
Antoine Descoedres¹, Christophe Allebé¹, Nicolas Badel¹, Loris Barraud¹, Jonathan Champiaud¹, Fabien Debrot¹, Antonin Faes¹, Agata Lachowicz¹, Jacques Levrat¹, Sylvain Nicolay¹, Laurent Sansonnens¹, Matthieu Despeisse¹, Christophe Ballif¹
¹ CSEM
- nPV-2 Polarisation Effect for Encapsulated n-Type IBC Solar Cells with Front Floating Emitter
Andreas Halm¹, Lacra Popescu¹, Giuseppe Galbiati¹, Valentin Dan Mihailetchi¹, Andreas Schneider¹, Radovan Kopecek¹
¹ ISC Konstanz
- nPV-3 Application of Full-spectrum Encapsulant for Smartwire Connection Technology
Fumiharu Ishimura¹, Takuya Honda¹, Yoshimi Watabe¹
¹ Choshu Industry Co., Ltd.

nPV-4 Influence of the Wafer Position Within a n Type Monocrystalline Ingot on the Conversion Efficiency: A Comparative Study Between Different Cell Architectures
Benoit Martel¹, Jordi Veirman¹, Mathieu Tomassini¹, Miguel Cascant¹, Jérôme Le Perchec¹, Raphael Cabal¹, Adrien Danel¹, Nicolas Enjalbert¹, Catherine Picoulet², Xavier Brun²
¹CEA-INES; ²AET Technologies

nPV-5 A Comparison Study of n-Type PERT and IBC Cell Concepts with Screen Printed Contacts
Valentin Dan Mihailetchi¹, Giuseppe Galbiati¹, Haifeng Chu¹, Lejo Joseph Koduvelikulathu¹, Andreas Halm¹, Radovan Kopecek¹
¹ISC Konstanz

nPV-6 Characterization of n-Type Mono-crystalline Ingots Produced by Continuous Cz Technology
Han Xu¹
¹GT Advanced Technologies

15:00 - 15:30 Session 11: n-Type mc Si

Chair: Valentin D. Mihailetchi (ISC Konstanz)

15:00 Identification of the Most Relevant Metal Impurities in mc n-Type Silicon for Solar Cells
Jonas Schön¹, Florian Schindler¹, Wolfram Kwapil¹, Michael Knörlein¹, Patricia Krenckel¹, Stephan Riepe¹, Wilhelm Warta¹, Martin C. Schubert¹
¹Fraunhofer ISE

15:15 Efficiency Potential of p- and n-Type High Performance Multicrystalline Silicon
Florian Schindler¹, Bernhard Michl¹, Patricia Krenckel¹, Stephan Riepe¹, Frank Feldmann¹, Jan Benick¹, Wilhelm Warta¹, Martin Schubert¹
¹Fraunhofer ISE

15:30 Coffee Break

16:00 - 17:15 Session 12: n-Type: PERT and Surface Passivation

Chair: Giso Hahn (University of Konstanz) and Pierre-Jean Ribeyron (CEA-INES)

16:00 21% Efficient n-Type Back-junction Pert Solar Cell with Thin Industrial 156mm Cz Single Crystalline Silicon Wafer
Jinyoun Cho¹, Hae-Na-Ra Shin¹, Yoon-seok Choi¹, Jongchul Lee¹, Jieun Lee¹, Hoon OH¹, Myung-Ick Hwang¹, Eun-Chel Cho¹
¹Hyundai Green Energy Research Institute

- 16:15 Integration Processes for nPERT Si Solar Cells Using Single-side Emitter Epitaxy and Front Side Laser Doping
Izabela Kuzma-Filipek¹, Maria Recaman Payo¹, Yuandong Li¹, Ali Hajjiah², Angel Uruena De Castro¹, Tom Borgers¹, Emanuele Cornagliotti¹, Loic Tous¹, Richard Russell¹, Filip Duerinckx¹, Jozef Szlufcik¹
¹ imec; ² University of Kuwait
- 16:30 Impact of Boron Doping Profiles on the Specific Contact Resistance of Ag-Al Pastes
Elmar Lohmüller¹, Sabrina Werner¹, René Hoenig¹, Johannes Greulich¹, Florian Clement¹
¹ Fraunhofer ISE
- 16:45 Analysis of the Excellent ALD Al₂O₃ Passivation of n-Type Black Silicon
Guillaume von Gastrow¹, Pablo Ortega², Ramon Alcubilla², Marko Yli-Koski¹, Hele Savin¹
¹ Aalto University; ² Polytechnic University of Catalonia
- 17:00 Analysis and Mitigation of J_{sc} Losses in Back-contacted Silicon Heterojunction Solar Cells
Bertrand Paviet-Salomon¹, Andrea Tomasi², Stefaan De Wolf², Matthieu Despeisse¹, Damien Lachenal³, Christophe Ballif¹
¹ CSEM; ² EPFL, IMT; ³ Meyer Burger Research
- 17:15 - Closing Session SiliconPV**
17:30 Chair: Giso Hahn (University of Konstanz) and Pierre-Jean Ribeyron (CEA-INES)
- 17:15 Closing Remarks
Giso Hahn, University of Konstanz
SiliconPV Award Ceremony for the Best 10 Abstracts
Giso Hahn, University of Konstanz
-  *The ceremony is sponsored by Sinton Instruments Thank you!*
- 17:25 SiliconPV 2016 Announcement

Thursday, March 26, 2015

All presentations take place in the *Speichersaal* (2nd Level)

08:30 - Welcome and Opening of Industry Day of nPV

08:45

Chair: Radovan Kopecek (ISC Konstanz)

08:30 Summary of Wednesday, Preview of Thursday Program and Outlook to HERCULES WS

Radovan Kopecek, ISC Konstanz

08:45 - Motivation and Overview Presentation

09:20

Chair: Radovan Kopecek (ISC Konstanz)

08:45 Change of Wp-thinking to KWh-mentality

Dan Chawla, MEMC/SunEdison

09:20 - Material and Wafers

10:50

Chair: Jan Schmidt (ISFH) and Dan Chawla (MEMC/SunEdison)

09:20 High Quality Cost Effective n-type Ingots

Yu Hu, NorSun AS

09:50 Dark Rings in n-type Cz Wafers after Processing

Paula Bronsveld, ECN

10:10 Solar Cell Performance along the Ingot

Benoit Martel, CEA-INES

10:30 Material Quality for Low Cost IBC Solar Cells

Giuseppe Galbiati, ISC Konstanz

10:50 Coffee Break

11:00 - Industrial Solar Cells in R&D

12:45

Chair: Joachim John (imec) and Stefan Glunz (Fraunhofer ISE)

11:00 Ni/Cu Plated n-type Si Rear Junction Cells with Efficiencies up to 22%

Filip Duerinckx, imec

11:15 NiCu Plating for n-type Solar Cells – Avoiding Voc Losses due to Screen-Printing

Bernd Steinhauser, Fraunhofer ISE

- 11:30 Industrial Ion Implanted, Co-annealed and Fully Screen-printed Bifacial n-PERT Solar Cells with Low-doped Back-surface Fields
Yevgeniya Larionova, ISFH
- 11:45 From n-Pasha to n-MTW: Challenges and Achievements at ECN
Ingrid Romijn, ECN
- 12:00 Status of ZEBRA Solar Cell and Module Technology
Valentin D. Mihailetschi, ISC Konstanz
- 12:15 Status of Heterojunction Solar Cells at INES
Pierre-Jean Ribeyron, CEA-INES
- 12:30 Silicon Heterojunction Solar Cells and Modules: Status on Technology Developments in Neuchâtel
Matthieu Despeisse, CSEM
- 12:45 Lunch Break
- 14:00 - 16:00 Solar Cells in Production**
Chair: Arthur Weeber (ECN) and Delfina Muñoz (CEA-INES)
- 14:00 BiSoN in Production
Franco Traverso, Megacell srl
- 14:15 n-type PERT in Pilot Production
Po-Tsung Hsieh, Motech Industries, Inc.
- 14:30 Ion Implanted High Efficiency Front Junction n-type Silicon Solar Cells with Tunnel Oxide Passivated Back Contact
Ajeet Rohatgi, Suniva
- 14:45 High Efficient n-Type Solar Cells
Ben Heng, Silevo
- 15:00 Doping Techniques and Process Integration Solutions for n-Type Solar Cells
Ronald Naber, Tempres Systems BV
- 15:15 Process Solutions for Passivated Boron Emitter
Wolfgang Jooss, centrotherm photovoltaics AG
- 15:30 Coffee Break
- 15:50 - 16:05 Discussion and Closing of nPV**
Chair: Radovan Kopecek (ISC Konstanz) et al.
- 16:00 Closing Remarks

Side Events

Welcome Reception

All participants are invited to take part in the Welcome Reception, which will take place on Sunday, March 22, 2015, from 17:00 to 19:00 at the conference venue.

The Welcome Reception will not only serve as an opening event and as an initial get-together for social networking in a relaxed atmosphere, it will also give participants the opportunity to register early for the conference. This will allow you to avoid long lines at the registration desks in the morning of the first conference day, and make registration easier for those who arrive later.

During the Welcome Reception, refreshments will be served.

Date: Sunday, March 22, 2015
Time: 17:00 – 19:00
Location: Konzil / Council Congress Center, Konstanz

10 Years ISC Konstanz

Since its foundation on 12.12.2005 ISC Konstanz has gained many international industrial partners and collaborating institutes. The ISC has developed technologies which are constantly transferred to the PV market and it is deeply involved in education and development collaboration abroad.

The ISC is very proud to have survived the long lasting PV crisis, which was only possible with dedicated scientists. Therefore the ISC staff will celebrate with you the 10th anniversary of ISC Konstanz at the institute, present what has been achieved so far and what is on the roadmap. Laboratory tours will be offered as well.

Date: Wednesday, March 25, 2015
Time: 18:30
Location: ISC Konstanz, Rudolf Diesel Strasse 15, 78467 Konstanz, Germany

HERCULES Workshop

Sixteen leading European research institutes, universities and partners from industry have joined forces in order to collaborate closely on the development of next generation of crystalline silicon based solar cells and modules. Together they proposed a concept of "High Efficiency Rear Contact solar cells and Ultra powerful moduLES" with the acronym HERCULES and received a 7 million Euro grant from the European Commission within the 7th Research Framework Program. The project has started the 1st of November 2013 and will finish end 2016 (<http://www.helmholtz-berlin.de/projects/hercules/>).

We have the pleasure to invite you to the HERCULES workshop, which is free of charge. It is organized by the HERCULES consortium in order to inform the public what has been achieved so far and to disseminate the results.

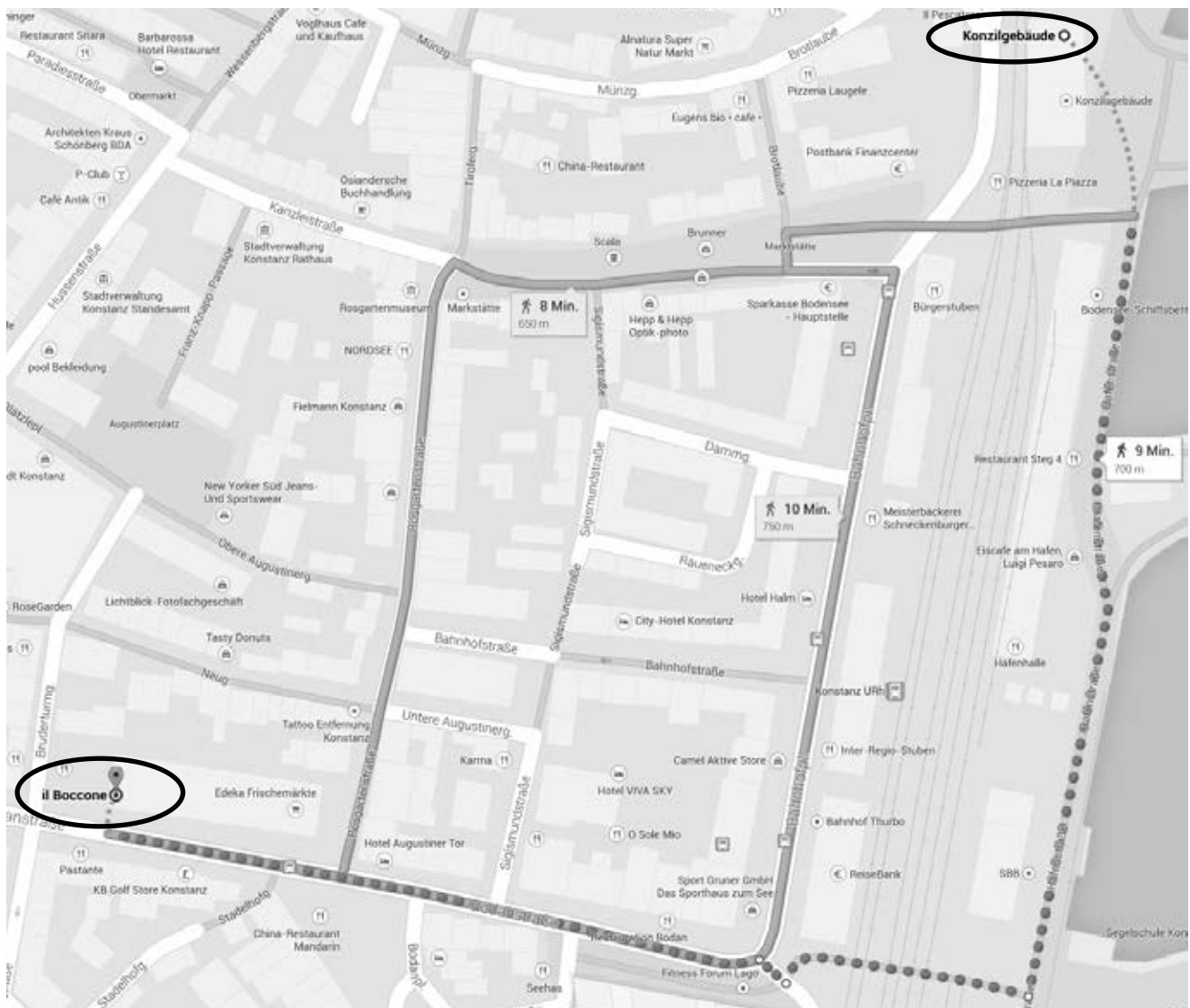
Date and Time: Thursday, March 26: 16:30 – 17:45 Opening HERCULES workshop
Friday, March 27: 8:30 – 12:05 HERCULES workshop
Room: Speichersaal Konzil, 2nd Level

Conference Dinner

Join the SiliconPV 2015 conference dinner and meet with friends and colleagues in a relaxed setting with traditional Italian food and drinks. The conference dinner will take place in the Il Boccone Restaurant situated in the center of Konstanz and a 10 minute walk from the conference venue. A delicious Mediterranean menu will be served in a modern open-space atmosphere suited for networking and enjoyment.

The dinner is included in the conference fee (full tickets and combined tickets). Pre-registration is required.

- Date:** Tuesday, March 24, 2015
Time: 19:00 – 19:30 Dinner Reception, 19:30 – 24:00 Conference Dinner
Location: Il Boccone Restaurant
 Bodanstr. 20-26
 78462 Konstanz
www.ilboccone.de



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Technical Tour

Photovoltaics Division of the University of Konstanz

The conference host, University of Konstanz, stands for top-level research, excellence in teaching and studies, internationality and interdisciplinary collaboration. It is one of the 11 universities in Germany being funded by the German Excellence Initiative to expand university top-level research.

The photovoltaics division of the University of Konstanz is worldwide one of the largest university groups with applied research in silicon photovoltaics. Its equipment allows complete processing of solar cells in industry-type and lab-type manners as well as a detailed characterization of wafers and solar cells.

During this behind-the-scenes tour, the researchers of University of Konstanz will guide you through their facilities and give you an insight into the solar cell manufacturing and characterization capabilities available. The tour will be topped off with a get-together for social and scientific networking in a relaxed atmosphere with refreshments being served. Bus transfer will be provided from the conference center to the university and back to the city center.

Date:	Monday, March 23, 2015
Time:	18:30 – 21:00
Meeting point:	Bus stop „Konzilstraße“ (close to the venue), buses will leave at 18:30
Fee:	10€, pre-registration is required

Sightseeing Tour

Discovery Tour “Back to the Past”

This guided tour through the Old Town of Konstanz offers several architectural highlights which exemplify the complex history of Konstanz. The tour includes the conference venue, the Council of Konstanz, which played an important role during the selection of the pope and introduces several historical public buildings. Many attractions of the historic old town will be visited to give an interesting insight into Konstanz’s lively history.

Nestling in one of Germany’s loveliest landscapes, Konstanz has culture and leisure activities to suit every taste. Immerse yourself in a fascinating journey through time, experience world history in the places where it actually happened and discover a city which is young, modern and vibrant right on the edge of Lake Konstanz and the Rhine. The sightseeing tour can be booked at the registration desk.



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Date:	Monday, March 23, 2015
Time:	18:30
Duration:	1½ – 2h
Meeting point:	Konzil / Council Congress Center, Registration Desk
Fee:	10€, pre-registration is required

General Information

Registration

Each participant has to register in person at the registration desk to collect a conference bag and name badge before attending any sessions. Please make sure to wear your badge for admission to all sessions and social events. Participants who have lost their badge has to report to the registration desk to get a new one. Registration times are on Sunday, March 22, from 17:00-19:00 at the Welcome Reception and during conference hours, starting on Monday at 7:30 and the following days at 8:00 in the Konzil / Council Congress Center.

Poster

See the poster plan on page 38 for more details on poster codes and their specific location. Please mount your poster before the start of the first poster session or during the first break. You may also mount your poster during the Welcome Reception on the eve of the conference.

Do not remove your poster until the end of the conference. The posters are an important part of the scientific program and should be displayed the whole time.

Please remove your poster before you leave. Remaining posters will be discarded.

Certificate of Attendance

A certificate of attendance for regular participants and students will only be available on-site at the registration desk and cannot be issued after the conference.

List of Participants

Registered participants may download a full list of participants on the conference website, www.siliconpv.com. The login and password sent to you during registration will be required to gain access to the download area.

Speaker Information

All presentations must be handed in at the Media Upload Desk one hour before your presentation. You will not be able to display your presentation di-

rectly from your laptop computer or USB flash drive. Our technical support team will welcome you at the Media Upload Desk during all conference days, starting on Monday at 7:30 and the following days at 8:00. Please meet your session chairs inside the conference room at least 10 minutes prior to the beginning of your oral session to acquaint yourself with the technical equipment.

Conference Proceedings

Accepted papers will be published online in Elsevier's Energy Procedia. Energy Procedia is an open-access online platform by Elsevier. All papers published in Energy Procedia feature individual DOI numbers and are therefore fully citable. Before publication, access to all non-reviewed papers will be available in the Download Area on the conference website, which is accessible to all conference participants with the login and password provided after their conference registration.

Full papers of the twenty best abstracts will be published in Elsevier's peer reviewed journal Solar Energy Materials & Solar Cells (SOLMAT) in the Special Issue „SiliconPV 2015“.

Wi-Fi Access

Wi-Fi is available in the Konzil / Council Congress Center free of charge for all participants. Please use the password "Konzil2014".

Evaluation

Please take part in the evaluation. Thank you!



Weblink Evaluation SiliconPV 2015:

<https://de.surveymonkey.com/r/JZJXCGF>



Weblink Evaluation SiliconPV/nPV 2015:

<https://de.surveymonkey.com/r/WKC899B>



Weblink Evaluation nPV 2015:

<https://de.surveymonkey.com/r/XXXWDBR>

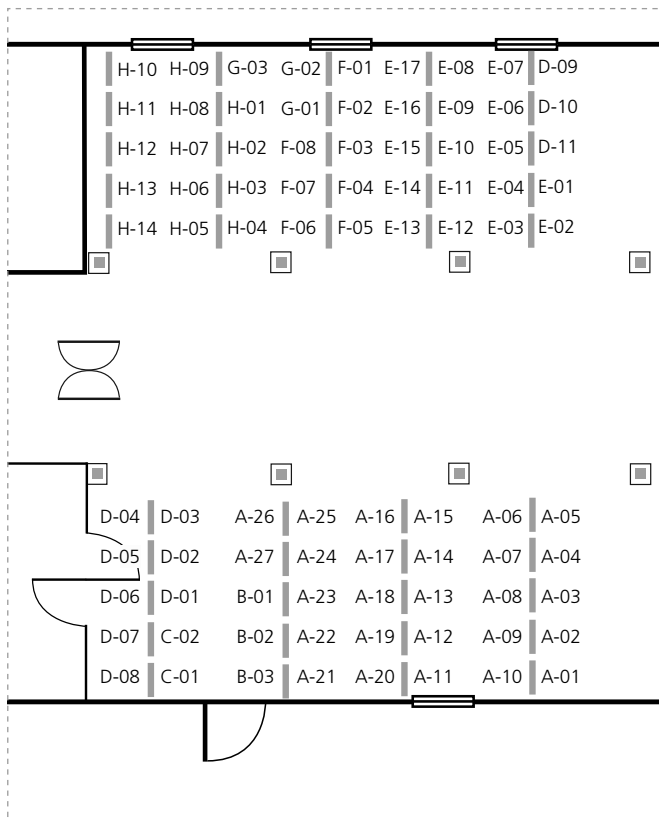
Poster Plan

The poster numbers are based on topics:

- A Advanced Characterization and Simulation
- B Advanced Light Management
- C High Efficiency Devices
- D Junction Formation
- E Module Architectures, Materials, and Reliability
- F Novel Cell Structures, e.g. Applying Tandems, New Material Combinations or Nanostructures
- G Process Integration
- H Silicon Material
- I Structuring and Contact Formation
- J Surface Morphology and Passivation
- K Wafering and Kerfless Technologies
- nPV nPV workshop on Wednesday

Poster Area

Level 0 (Unterer Saal)



Level 1 (Oberer Saal)

