SiliconPV 2014

4th International Conference
on Crystalline Silicon Photovoltaics

npworkshop

's-Hertogenbosch 2014

Advanced technologies and materials for crystalline Si solar cells and modules

PROGRAM

March 25 - 27, 2014
's-Hertogenbosch, The Netherlands

www.siliconpv.com
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Chairmen's Message

Dear Friends of Silicon Photovoltaics,

After three successful years, both the SiliconPV conference and the nPV workshop have established themselves and have joined forces! SiliconPV is a conference from scientists for scientists with a focus on the physical and chemical understanding of the results observed. There is a great need to have an event in which the more fundamental aspects of silicon photovoltaics are discussed and SiliconPV fulfills that need. For the nPV workshop it is similar, but then including more technology related and industrial presentations on n-type silicon solar cell and module technology as well. This proves that there is an overlap between SiliconPV and nPV and the organizing committees decided to organize both 2014 events successively with one overlapping day. It is therefore our pleasure to welcome you to SiliconPV and nPV 2014 on March 25-28, 2014 in 's-Hertogenbosch, The Netherlands.

Currently silicon-based photovoltaics is the main PV technology and we expect that this will continue to be the case for many years to come. The technology has a huge potential for further cost reduction and higher conversion efficiencies. R&D on n-type solar cells, the topic of nPV, has already demonstrated its potential in reaching these higher efficiencies.

In most parts of the world grid parity has been reached due to the recent price reduction for commercial PV modules. On the other hand, in laboratory and pilot line environments, cell efficiencies above 20% have been reached for different cell concepts. The challenge of the PV community is to combine the two: high efficiencies at low cost in large volumes. Reduction in material consumption and the use of low-cost materials at cell- and module level while maintaining the high efficiency and good reliability will be the key to reaching this goal. Therefore, innovative technologies to enable future cell- and module architectures are needed and will be presented and extensively discussed during the SiliconPV 2014 conference and the nPV 2014 workshop.

SiliconPV is a three day conference with only plenary sessions and fully concentrated on science and technology. The scientific committee has set up a high-quality program based on abstracts submitted from all over the world. The first day of nPV corresponds to the third day of SiliconPV. During the second day of nPV more technology-related and industrial presentations will be given with room for extensive discussions. Specialists from all over the world were invited to present their latest results. We are convinced that both events will create an inspiring atmosphere to stimulate the exchange of scientific and technological information between you and your colleagues.

Once again, welcome to 's-Herogenbosch and we wish you a good SiliconPV conference and nPV workshop!

Arthur Weeber
ECN, The Netherlands
Chairman of SiliconPV 2014

Jan Schmidt
ISFH, Germany
Chairman of nPV workshop 2014

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Monday, March 24, 2014

18:00 – 20:00 **Welcome Reception and Pre-Registration**

Snacks and drinks will be served at the 1931 Congrescentrum Brabanthallen

Tuesday, March 25, 2014

07:30 Reception

08:30 **Opening Session**

Opening Speech Chairman SiliconPV

Arthur Weeber, Energy Research Centre of the Netherlands (ECN)

08:45 - 10:15 **Oral Session 1: Silicon Material and Wafering**

Chair: Martin Hermle (Fraunhofer ISE) and Andres Cuevas (Australian National University)

08:45 Lifetimes Exceeding 1 Millisecond in 1 - OHM CM Boron-doped cz-Si

D. Walter[1], K. Bothe[1], R. Falster[2], B. Lim[1], J. Schmidt[1], V.V. Voronkov[2]

[1] Institute for Solar Energy Research Hamelin (ISFH); [2] SunEdison

09:15 Influence of Bound Hydrogen States on BO-Regeneration Kinetics and Consequences for High-speed Regeneration Processes

S. Wilking[1], C. Beckh[1], S. Ebert[1], G. Hahn[1], A. Herguth[1]

[1] University of Konstanz

09:30 Towards a Unified Model for Carrier Mobilities in Crystalline Silicon

F. Schindler[1], J. Broisch[1], M. Forster[2], J. Giesecke[1], S. Rein[1], M.C. Schubert[1], J. Schön[1], W. Warta[1]

[1] Fraunhofer Institute for Solar Energy Systems ISE; [2] Apollon Solar

09:45 Experimental Evidence on Removing Copper from Silicon by Charge and its Impact on LID

Y. Boulfrad[1], J. Lindroos[1], H. Savin[1], M. Wagner[2], F. Wolny[2], M. Yli-Koski[1]
[1] Aalto University; [2] SolarWorld Innovations

10:00 Structured Wire: From Single Wire Experiments to Multi-crystalline Silicon Wafer Mass Production

O. Anspach[1]
[1] PV Crystalox Solar Silicon

10:15 Coffee Break

10:45 - 12:00 Oral Session 2: Advanced Characterization

Chair: Pietro Altermatt (Leibniz University of Hanover) and Ilkay Cesar (ECN)

10:45 Analysis of Solar Cell Cross Sections with Micro Light Beam Induced Current (µLBIC)

M. Breitwieser[1], F.D. Heinz[1], M.C. Schubert[1], J. Schön[1], W. Warta[1]
[1] Fraunhofer Institute for Solar Energy Systems ISE

11:00 An Accurate Method for Calibrating Photoluminescence-based Lifetime Images on Multi-crystalline Silicon Wafers

H.C. Sio[1], D. Macdonald[1], S. Phang[1], T. Trupke[2]
[1] Australian National University; [2] BT Imaging

11:15 Interstitial Oxygen Imaging from Thermal Donor Growth - a Fast Photoluminescence Based Method

T. Niewelt[1], J. Holtkamp[1], S. Lim[2], D. MacDonald[2], M.C. Schubert[1], J. Schön[1]
[1] Fraunhofer Institute for Solar Energy Systems ISE; [2] Australian National University

11:30 Quantitative Surface Recombination Imaging of Single Side Processed Silicon Wafers Obtained by Photoluminescence Modeling

A. Fell[1], E. Franklin[1], D. Macdonald[1], S. Surve[1], D. Walter[1], K. Weber[1], X. Yang[1]
[1] Australian National University

11:45 Dynamic Photoluminescence Lifetime Imaging for Injection-dependent Lifetime Measurements

S. Herlufsen[1], J. Schmidt[1]
[1] Institute for Solar Energy Research Hamelin (ISFH)

12:00 Lunch Break

13:00 - 15:00 Poster Session 1

The poster numbers are based on topics and conference days:

- A Silicon Material
- B Cleaning and Etching
- C Surface Morphology and Passivation
- D Structuring and Contact Formation
- E Module Integration
- F Reliability

A-Tue-1 Determination of Acceptor Ratio and Iron Concentration in Co-doped Silicon

T. Bartel[1], M. Forster[2], F. Gibaja[1]

[1] Calisolar; [2] Apollon Solar

A-Tue-2 Internal Gettering of Iron at Extended Defects

M. Di Sabatino[1], L. Arnberg[1], A. Autruffe[1], M. Knoerlein[1], R. Sondenå[2]

[1] Norwegian University of Science and Technology; [2] Institute for Energy Technology (IFE)

A-Tue-3 ASiSii Defect Model of Light Induced Degradation in Silicon

C. Möller[1], K. Lauer[1]

[1] CiS Forschungsinstitut für Mikrosensorik und Photovoltaik

A-Tue-4 Towards 20% Solar Cell Efficiency Using Silicon from Metallurgical Process Route

P. Preis[1], F. Buchholz[1], P. Diaz-Perez[1], J. Glatz-Reichenbach[1], K. Peter[1], S. Schmitt[1], A. Soiland[2], J. Theobald[1], M. Tindvik[2]

[1] International Solar Energy Research Center Konstanz (ISC); [2]Elkem Solar

A-Tue-5 Epitaxial Layers for Kerfless Wafers: Progress in High-throughput Silicon Deposition

S. Reber[1], M. Arnold[1], S. Heermann[1], M. Keller[1], D. Pocza[1], N. Schillinger[1]

[1] Fraunhofer Institute for Solar Energy Systems ISE

A-Tue-6 Porous Silicon Metal Gettering in Epitaxial Silicon Solar Cells Studied by Minority Carrier Lifetime Measurements

H. Sivaramakrishnan Radhakrishnan[1], M. Debucquoy[1], I. Gordon[1], F. Korsós[2], R. Mertens[1], J. Poortmans[1]

[1] imec; [2] Semilab ZRT

B-Tue-7 Metal-assisted Chemical Etching: A Novel Method to Purify Metallurgical Silicon

X. Li[1], J. Lee[2], S. Schweizer[1], R. Wehrspohn[1], J. Ziegler[1]

[1] Martin-Luther-University Halle-Wittenberg; [2] Hanyang University

C-Tue-9 Optical and Electronic Properties of MAE Textured Nanoporous Silicon

T.K. Chong[1], A.W. Blakers[1], K.J. Weber[1]
[1] Australian National University

C-Tue-10 Deposition of a SiO_x Film Showing Enhanced Surface Passivation through Negative Fixed Charges

P. Descamps[1], S.S. Asad[1], G. Beaucarne[1], R. Delamare[2], V. Kaiser[1], I. Kuzma[3]
[1] Dow Corning; [2] Université Catholique de Louvain; [3] imec

C-Tue-11 Fundamental Studies of Hydrogen at the Silicon/Silicon Nitride Interface

S. Joos[1], H. Becker[2], G. Hahn[1], D. Rogalla[2], Y. Schiele[1], B. Terheiden[1]
[1] University of Konstanz; [2] Ruhr-Universität Bochum

C-Tue-12 Investigation of Rear Side Selective Laser Ablation and Damage Etching Process for Industrial PERC Solar Cell

J. Kim[1], H. Choi[1], Y. Hwang[1], J. Jo[1], H. Kim[1], J. Kim[1], E. Lee[1], J. Lim[1]
[1] Shinsung Solar Energy

C-Tue-13 Requirements to Achieve Field-induced Anodisation for Silicon Surface Passivation

A. Lennon[1], J. Tong[1], X. Wang[1]
[1] University of New South Wales

C-Tue-14 The Effect of Silicon Surface Area on Bulk Lifetime after Annealing at Different Temperatures

P.H.D. Lu[1], M. Abbott[1], A. Lennon[1], N. Nampelli[1], S. Wenham[1]
[1] University of New South Wales

C-Tue-15 Feasability of Antireflection and Passivation Coatings by Atmospheric Pressure PECVD

F. Massines[1], J. Almeida Silva[2], R. Bazinette[2], D. Blanc Pelissier[3], L. Gaudy[2], M. Lemiti[3], A. Lukianov[3], F. Massines[2], S. Pouliquen[4], J. Vallade[2]
[1] PROMES / CNRS; [2] Centre National de la Recherche Scientifique (CNRS), PROMES; [3] Institut des Nanotechnologies de Lyon (INL / INSA); [4] Air Liquide

D-Tue-16 Micro Characterization and Imaging of Spikes in Nickel Plated Solar Cells

A. Buechler[1], M. Glatthaar[1], W. Hoerdt[1], S. Hopman[1], S. Kluska[1]
[1] Fraunhofer Institute for Solar Energy Systems ISE

D-Tue-17 Effects of Firing Ambience and Forming Gas Annealing on Screen-printed Silver Contacts of Crystalline Si Solar Cells

S. Cho[1], H. Kim[1]
[1] Korea University

D-Tue-18 Investigation of Laser Ablation Induced Defects in Crystalline Silicon Solar Cells

C. Dang[1], J. Deckers[1], F. Duerinckx[1], R. Labie[1], J. Poortmans[1], M. Recaman Payo[1], R. Russell[1], L. Tous[1]

[1] imec

D-Tue-19 Laser Processing for Electrical and Mechanical Stable NI-CU Solar Cells

C. Geisler[1], M. Glatthaar[1], S. Hopman[1], W. Hördt[1], S. Kluska[1], A. Mondon[1]

[1] Fraunhofer Institute for Solar Energy Systems ISE

D-Tue-20 Plating Processes on Aluminum and Application to Novel Solar Cell Concepts

M. Kamp[1], J. Bartsch[1], A. Brand[1], R. Keding[1], D. Stüwe[1]

[1] Fraunhofer Institute for Solar Energy Systems ISE

D-Tue-21 Impact of Oxygen Partial Pressure on Ag Paste Contact Formation on mc-Si

S. Koerner[1], M. Eberstein[1], U. Partsch[1], K. Reinhardt[1], U. Schmidt[2]

[1] Fraunhofer Institute for Ceramic Technologies and Systems IKTS; [2] TU Dresden

D-Tue-22 Optimizing Fine Line Dispensed Contact Grids

M. Pospischil[1], D. Biro[1], F. Clement[1], O. Doll[2], T. Fellmeth[1], H. Gentischer[1], M. Hörteis[3], M. Klawitter[1], M. Kuchler[1], M. König[3], S. Nold[1], L. Wende[4], R. Zengerle[5]

[1] Fraunhofer Institute for Solar Energy Systems ISE; [2] Merck; [3] Heraeus Precious Metals; [4] ASYS Group Automatisierungs-systeme; [5] University of Freiburg

D-Tue-23 Observation of the Contact Formation of PV Frontside Pastes by IN-SITU Contact Resistance Measurements

K. Reinhardt[1], M. Eberstein[1], R. Jurk[1], S. Körner[1], U. Partsch[1], U. Schmidt[2]

[1] Fraunhofer Institute for Ceramic Technologies and Systems IKTS; [2] TU Dresden

D-Tue-24 Synthesis of a Lead- and Particle-free Metal-organic INK for Front Side Metallization of Crystalline Silicon Solar Cells

Y. Tamari[1]

[1] Fraunhofer Institute for Solar Energy Systems ISE

E-Tue-25 Cross Testing Components for MWT Modules

K. Broek[1], I. Bennett[1], W. Eerenstein[1]

[1] Energy Research Centre of the Netherlands (ECN)

E-Tue-26 The Mechanical Theory behind the Peel Test

U. Eitner[1], L.C. Rendler[1]

[1] Fraunhofer Institute for Solar Energy Systems ISE

E-Tue-27 Aluminium Foil and Cold Spray Copper Technology as Cost Reduction Process Step in Process Step in Back-contact Module Design

M. Goris[1], I. Bennett[1], W. Eerenstein[1]
[1] Energy Research Centre of the Netherlands (ECN)

E-Tue-28 Development of the Mitigation Method of Corrosion Based on the Field Degradation Mechanism for Crystalline Silicon Photovoltaic Module

J. Kim[1], S. Bae[2], D. Kim[2], W. Oh[2]
[1] Korea Electronics Technology Institute; [2] Korea University

E-Tue-29 Laser-welded Interconnection of Screen-printed Si Solar Cells

H. Schulte-Huxel[1], S. Blankemeyer[1], R. Brendel[1], S. Kajari-Schröder[1], V. Steckenreiter[1]
[1] Institute for Solar Energy Research Hamelin (ISFH)

E-Tue-30 Loss Analysis for Laser Separated Solar Cells

M. Turek[1]
[1] Fraunhofer Center for Silicon Photovoltaics CSP

E-Tue-31 Rapid Module Component Testing and Quantification of Performance Gains

M. Turek[1]
[1] Fraunhofer Center for Silicon Photovoltaics CSP

E-Tue-32 Simulation of Energy Production by Bifacial Modules with Revision of Ground Reflection

U.A. Yusufoglu[1], C. Comparotto[2], A. Halm[2], L.J. Koduvelikulathu[2], R. Kopecek[2], H. Kurz[1], T.H. Lee[1], T.M. Pletzer[1]
[1] RWTH Aachen University; [2] International Solar Energy Research Center Konstanz (ISC)

F-Tue-33 Study of Compatibility of Silicone-based Electrically Conductive Adhesives and Conductive Backsheets for MWT Modules

G. Beaucarne[1]
[1] Dow Corning

F-Tue-34 High-resolution Optical and Electro-optical Microscopy for PV-Modules

S. Großer[1], M. Gläser[1], C. Hagendorf[1]
[1] Fraunhofer Center for Silicon Photovoltaics CSP

F-Tue-35 Investigations of Different Soldering Failure Modes and their Impact on Module Reliability

M. Heimann[1]
[1] Hanwha Q CELLS

F-Tue-36 Solder Bond Failue Mode Suspected as AG Fretting Effect in the Interconnection of Conventional Crystalline Si Module

U. Itoh[1], Y. Takemura[2], K. Takeuchi[2], H. Tokuhisa[1], M. Yoshida[1]
[1] AIST; [2] International Test and Engineering Services (ITES)

F-Tue-37 Investigation of Cracks in Solar Cell Metallization Leading to Module Power Loss under Mechanical Loads

J. Käsewieter[1], F. Haase[1], M. Haro[1], M. Köntges[1]
[1] Institute for Solar Energy Research Hamelin (ISFH)

F-Tue-38 Long-term Stability Analysis of Copper Front Side Metallization for Silicon Solar Cells

A. Kraft[1], J. Bartsch[1], M. Glatthaar[1], A. Lorenz[1]
[1] Fraunhofer Institute for Solar Energy Systems ISE

F-Tue-39 Polymer Foil Additives Trigger the Formation of Snail Trails in Photovoltaic Modules

S. Meyer[1], C. Hagendorf[1], S. Richter[1], S. Timmel[1]
[1] Fraunhofer Center for Silicon Photovoltaics CSP

F-Tue-40 From Short-term Hotspot Measurements to Long-term Module Reliability

T. Roth[1], K. Meyer[1], R. Siebert[1]
[1] Bosch Solar Energy AG

15:00 - 16:15 Oral Session 3: Advanced Characterization and Simulations

Chair: Ron Sinton (Sinton Instruments) and Otwin Breitenstein (Max Planck Institute of Microstructure Physics Halle)

15:00 The Concept of Jo

A. Cuevas[1]
[1] Australian National University

15:15 Limitation of Industrial Phosphorus-diffused Emitters by SRH Recombination

B. Min[1], P. Altermatt[2], A. Dastgheib-Shirazi[3], H. Wagner[2]
[1] RWTH Aachen University; [2] Leibniz University of Hanover; [3] University of Konstanz

15:30 Spatially Resolved Determination of Junction Voltage of Silicon Solar Cells

H. Höffler[1], H. Al-Mohtaseb[1], J. Haunschild[1], M. Kasemann[2], B. Michl[1]
[1] Fraunhofer Institute for Solar Energy Systems ISE; [2] University of Freiburg

15:45 Implementation of Fermi-Dirac Statistics and Advanced Models in PC1D for Precise Simulations of Silicon Solar Cells

H. Haug[1], A. Kimmerle[2]

[1] Institute for Energy Technology (IFE); [2] Fraunhofer Institute for Solar Energy Systems ISE

16:00 A Roadmap for PERC Cell Efficiency towards 22%, Focused on Technology-related Restrictions

P. Altermatt[1], K. McIntosh[2]

[1] Leibniz University of Hanover; [2] PV Lighthouse

16:15 Coffee Break

16:45 - 18:00 Oral Session 4: Surface Passivation

Chair: Joachim John (imec) and Erwin Kessels (Eindhoven University of Technology)

16:45 PassDop Rear Side Passivation Based on Al_2O_3/a-SiC_x:B Stacks for p-Type PERL Solar Cells

B. Steinhauser[1], J. Benick[1], M. Hermle[1], U. Jäger[1]

[1] Fraunhofer Institute for Solar Energy Systems ISE

17:00 Investigations on the Passivation Mechanism of ALN:H and ALN:H-SIN:H Stacks

G. Krugel[1], F. Jenkner[1], A. Moldovan[1], R. Preu[1], J. Rentsch[1], W. Wolke[1]

[1] Fraunhofer Institute for Solar Energy Systems ISE

17:15 The Influence of Orientation and Morphology on the Passivation of Crystalline Silicon Surfaces by Al_2O_3

L. Black[1], A. Cuevas[1], T. Kho[1], K. McIntosh[2]

[1] Australian National University; [2] PV Lighthouse

17:30 PECVD-AlO_x/SiN_x Passivation Stacks on Silicon: Charge Trapping and Interface Defect State Spectroscopy

J.A. Töfflinger[1], L. Korte[1], A. Laades[2], C. Leendertz[1], L.M. Montañez[1], B. Rech[1], H. Sperlich[3], U. Stürzebecher[2]

[1] Helmholtz-Zentrum Berlin (HZB); [2] CiS Forschungsinstitut für Mikrosensorik und Photovoltaik; [3] Roth & Rau AG

17:45 Simple Applicable Cleaning and Conditioning of Silicon Surfaces with UV/OZONE Sources

A. Moldovan[1], F. Feldmann[1], G. Krugel[1], J. Rentsch[1], A. Roth-Fölsch[2], M. Zimmer[1]

[1] Fraunhofer Institute for Solar Energy Systems ISE; [2] Heraeus Noblelight GmbH

18:15 Technical Tour – *refer to page 36 for more information*

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

Wednesday, March 26, 2014

08:30 - 10:00 Oral Session 5: Novel Carrier-selective Contact Structures

Chair: Stefan Glunz (Fraunhofer ISE) and Rolf Brendel (ISFH)

08:30 Efficient Carrier-selective n- and p-Contacts Using Semiconductor-insulator-semiconductor Structures

F. Feldmann[1], M. Bivour[1], S. Glunz[1], M. Hermle[1], M. Hermle[1], C. Reichel[1], M. Simon[1]

[1] Fraunhofer Institute for Solar Energy Systems ISE

09:00 Recombination Behavior and Contact Resistance of n+ and p+ Poly-crystalline Si / Mono-crystalline Si Junctions

U. Römer[1], R. Brendel[1], N. Harder[1], J. Krügener[2], B. Lim[1], R. Peibst[1], T. Wieteler[2]

[1] Institute for Solar Energy Research Hamelin (ISFH); [2] Leibniz University of Hanover

09:15 Novel Hybrid Electrode Using Transparent Conductive Oxide and Silver Nanoparticle Mesh for Silicon Solar Cell Applications

M. Huang[1], A.G. Aberle[1], H. Gong[2], Z. Hameiri[1], T. Mueller[1], W. Wong[2]

[1] Solar Energy Research Institute of Singapore (SERIS); [2] Cima NanoTech

09:30 Aluminum Oxide-Aluminum Stacks for Contact Passivation in Silicon Solar Cells

J. Deckers[1], E. Cornagliotti[1], M. Debucquoy[1], I. Gordon[1], R. Mertens[1], J. Poortmans[1]

[1] imec

09:45 Carrier Selective, Passivated Contacts for High Efficiency Silicon Solar Cells Based on Transparent Conducting Oxides

D. Young[1], S. Grover[1], B. Lee[1], W. Nemeth[1], P. Stradins[1]

[1] National Renewable Energy Laboratory (NREL)

10:00 Coffee Break

10:30 - 12:00 Oral Session 6: Metallization and Process Integration

Chair: Jef Poortmans (imec) and Rob Steeman (REC)

10:30 Fine Line Metallization by Novel Coextrusion Technology for Next Generation Solar Cells

M. Beutel[1], L. Alan[2], F. Bamberg[3], H. Neuhaus[1], M. Prondzinski[2], P. Richter[1], E. Schneiderloechner[1], K. Stegemann[1]

[1] SolarWorld Innovations; [2] SolarWorld Americas; [3] Deutsche Cell

10:45 Laser-doped Metal-plated Bifacial Solar Cells

X. Wang[1], V. Allen[1], A. Lennon[1], B. Tjahjono[2], V. Vais[1], S. Wenham[1], Y. Yao[1], Y. Zhao[1]

[1] University of New South Wales; [2] Sunrise Global Solar Energy

11:00 Passivated Busbars from Screen-printed Low Temperature Copper Paste

D. Wood[1], G. Beaucarne[1], A. Beucher[1], C. Boulord[1], P. Chevalier[1], F. Duerinckx[2], I. Kuzma-Filipek[2], N. Powell[1], R. Russel[2], J. Szlufcik[2], N. Zeghers[1]

[1] Dow Corning; [2] imec

11:15 Industrial Cleaning Sequences for Al_2O_3-passivated PERC Solar Cells

C. Kranz[1], U. Baumann[1], R. Brendel[1], S. Dorn[1], T. Dullweber[1], D. Pysch[2], S. Queisser[2], J. Schweckendiek[2], S. Wyczanowski[1]

[1] Institute for Solar Energy Research Hamelin (ISFH); [2] RENA

11:30 Highly Efficient Multi-crystalline Solar Cells Using Rear Surface Passivation Technology

Y. Chiou[1], F.S.F. Chen[1], K. Hung[1], C. Ko[1], H. Lin[1], N. Ou[1], C. Wu[1], H. Yen[1]

[1] Gintech Energy Corporation

11:45 Quantification of J02 Losses in p-Type All-screen-printed IBC Cells

F. Dross[1], P. Basore[1], K. Fisher[1], J. Hummel[1], Y. Lin[1], P. Murcia[1], V. Noorai[1], O. Park[1], D. Patel[1], E. Shmich[1], E. Van Kerschaver[1], W. Wittmann[1]

[1] Hanwha Solar America (HSA)

12:00 Lunch

13:00 - 15:00 Poster Session 2

The poster numbers are based on topics and conference days:

- A Silicon Material
- B Cleaning and Etching
- C Surface Morphology and Passivation
- G Advanced Characterization and Simulation
- H Junction Formation
- I Wafering Technologies
- J Advanced Light Management
- K Process Integration

G-Wed-1 Quantitative EL Image Analysis Toward Thermo-electro-mechanical Simulations in Solar Cells

I. Berardone[1], M. Paggi[2]

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

G-Wed-2 An Alternative One-diode Model for Illuminated Solar Cells

O. Breitenstein[1]

[1] Max Planck Institute of Microstructure Physics

G-Wed-3 Influence of Technological Changes on the Energy Yield of PV Modules: An Outdoor Study

D. Buß[1], M. Köntopp[1], M. Strobel[1]

[1] Hanwha Q CELLS

G-Wed-4 Impact of Recombination at the Back SiO_2 Passivated Surface on the Ideality of the Dark I-V Characteristics and on the Performance of High Efficiency n+p Junction Silicon Solar Cells

M. Ghannam[1], H. Kamal[1], J. Poortmans[2]

[1] Kuwait University; [2] imec

G-Wed-5 Increased Reliability for J0-Analysis by QSSPC

A. Kimmerle[1], P. Rothhardt[1], A. Wolf[1]

[1] Fraunhofer Institute for Solar Energy Systems ISE

G-Wed-6 Use of QSSPC and QSSPL to Monitor the Recombination Processes in p-Type Silicon Solar Cells

A. Lennon[1], M. Abbott[1], Z. Hameiri[2], Z. Hameiri[2], M. Juhl[1], X. Wang[1], Y. Yao[1]

[1] University of New South Wales; [2] Solar Energy Research Institute of Singapore (SERIS)

G-Wed-7 Study of Photoluminescence Decay by Time-correlated Single Photon Counting for the Determination of the Minority-carrier Lifetime in Silicon

S. Parola[1], D. Blanc-Pélissier[1], M. Daanoune[2], A. Focsa[3], A. Kaminski[2], M. Lemiti[1], E. Picard[3], B. Semmache[3]
[1] Université de Lyon; [2] IMEP-LAHC Grenoble; [3] SEMCO Engineering

G-Wed-8 Simulating the Optics of Textured Multicrystalline Silicon Wafer Solar Cells

M. Peters[1], B. Blaesi[2], H. Hauser[2], Y.S. Khoo[1], T. Walsh[1]
[1] Solar Energy Research Institute of Singapore (SERIS); [2] Fraunhofer Institute for Solar Energy Systems ISE

G-Wed-9 In-line Thermography for Reliable Hot Spot Detection and Production Optimisation

K. Ramspeck[1], A. Metz[1], S. Schenk[1]
[1] h.a.l.m.

G-Wed-10 A Technique for Improved Emitter Saturation Current Density Analysis

A. Thomson[1], N. Grant[1]
[1] Australian National University

G-Wed-11 Series Resistance Contribution of Majority Carriers in CELLO Impedance Analysis

J. Wagner[1], J. Carstensen[1], H. Föll[1], A. Schütt[1]
[1] University of Kiel

G-Wed-12 A Method to Separate Bulk Lifetime and Surface Recombination Velocity of Silicon Bricks based on Transient Photoluminescence

K. Wang[1]
[1] University of New South Wales

G-Wed-13 A Method to Overcome the Step Limitation of PC1D in Transient Excitation Mode

K. Wang[1], I. Perez-Wurfl[1]
[1] University of New South Wales

G-Wed-14 Comparison between Secondary Electron Microscopy Dopant Contrast Image and Electron Beam Induced Current for Laser Doping of Crystalline Silicon

L. Xu[1], Z. Hameiri[2], K. Weber[1], X. Yang[1]
[1] Australian National University; [2] Solar Energy Research Institute of Singapore (SERIS)

H-Wed-15 A Solid-phase Epitaxy Emitter for Silicon Solar Cells

H. Kim[1], S. Ahn[2], K. Ji[2], D. Kim[1], H. Lee[2], H. Lee[1], S. Park[1]
[1] Korea University; [2] Devices and Materials Lab, LG Electronics

H-Wed-16 Damage Annihilation, Solid Phase Epitaxial Regrowth of Phosphorus Implanted Emitters and their Electrical Properties

H. Park[1], D. Kim[1], Y.D. Kim[1], H. Lee[1], S. Park[1]
[1] Korea University

H-Wed-17 Influence of Implant Damage on Emitter Recombination

T. Ratcliff[1], A. Blakers[1], R. Elliman[1], A. Shalav[1]
[1] Australian National University

B-Wed-18 Enhanced Phosphorus Gettering of Impurities in Multicrystalline Silicon at Low Temperature

S. Joonwichien[1]
[1] Nagoya University

A-Wed-19 Low Temperature FTIR Investigation of Aluminum Doped Solar-grade Silicon

K. Lauer[1], T. Bartel[2], F. Kirscht[2], C. Möller[1], R. Porytskyy[1]
[1] CiS Forschungsinstitut für Mikrosensorik und Photovoltaik; [2] Calisolar

A-Wed-20 Tracking Impurities in Silicon Production in a Microwave Furnace

J. Mai[1], G. Raabe[2]
[1] JPM Silicon; [2] University of Braunschweig

A-Wed-21 Reorganization of Porous Silicon: Effect on Epitaxial Layer Quality and Detachment

N. Milenkovic[1], M. Driessen[1], E. Gust[1], S. Janz[1], S. Reber[1]
[1] Fraunhofer Institute for Solar Energy Systems ISE

A-Wed-22 High-quality Exfoliated Crystalline Silicon Foils for Solar Cell Applications

R. Niepelt[1], R. Brendel[1], J. Hensen[1], S. Kajari-Schröder[1], A. Knorr[1], V. Steckenreiter[1]
[1] Institute for Solar Energy Research Hamelin (ISFH)

A-Wed-23 A Statistical Analysis of the Temperature Coefficients of Industrial Silicon Solar Cells

S. Ponce-Alcántara[1], J. Connolly[1], V. Hoffmann[2], J.M. Míguez[2], R. Ordás[2], G. Sánchez[1]
[1] Universitat Politècnica de València; [2] Silicio FerroSolar

A-Wed-24 Kinetic Study of Oxygen Complexes and Vacancy Oxygen-related Defects in Mono-crystalline Solar Silicon

V. Quemener[1], E. Monakhov[1], L. Murin[1], B. Raeissi[1], B. Svensson[1]
[1] University of Oslo

A-Wed-25 Influence of Slim Rod Material Properties to the Siemens Feed Rod and Float Zone Process

S. Richter[1], P. Dold[1], C. Hagendorf[1], R. Kunert[1], H. Riemann[2], H. Rost[2], M. Werner[1], F. Zobel[1]

[1] Fraunhofer Center for Silicon Photovoltaics CSP; [2] Leibniz Institute for Crystal Growth (IKZ)

A-Wed-26 Irradiance Dependent Temperature Coefficients for MC Solar Cells from ELKEM Solar Grade Silicon in Comparison with Reference Polysilicon

M. Tayyib[1], J.O. Odden[2], T.O. Saetre[3], R. Sondena[4]

[1] Teknova; [2] Elkem Solar; [3] University of Agder; [4] Institute for Energy Technology (IFE)

A-Wed-27 Measuring Stress Birefringence in Small Si Samples

B. Wang[1], B. Seipel[2]

[1] Hinds Instruments; [2] SolarWorld Americas

A-Wed-28 High Purity Cast Silicon for High Efficiency PERC Solar Cells

F. Wolny[1], G. Fischer[1], A. Krause[1]

[1] SolarWorld Innovations

I-Wed-29 Solar Cell Processing of Foils Produced by Epoxy-induced Spalling of Silicon

R. Martini[1], V. Depauw[1], M. Gonzalez[1], I. Gordon[1], S. Granata[1], J. Poortmans[1]

[1] imec

I-Wed-30 Deposition of Pure Silicon PV-absorber Thin Films by High-rate Electron Beam Evaporation

S. Saager[1], J. Heinß[1], K. Häfner[1], C. Metzner[1], H. Morgner[1], D. Temmler[1]

[1] Fraunhofer Institute for Electron Beam and Plasma Technology FEP

I-Wed-31 Room Temperature Spalling of Thin Silicon Foils Using a Kerfless Technique

J. Serra[1], P. Bellanger[1]

[1] University of Lisbon

I-Wed-32 Triple Layer Porous Silicon Stacks as a Practical Solution for Easily Detachable Epitaxial Foils with Lifetimes beyond 350 µs

H. Sivaramakrishnan Radhakrishnan[1], V. Depauw[1], I. Gordon[1], R. Martini[1], R. Mertens[1], J. Poortmans[1], K. Van Nieuwenhuysen[1]

[1] imec

J-Wed-33 Experimental Implementation of a Silicon Wafer Tandem Solar Cell

T. Gimpel[1], A.L. Baumann[1], T. Buck[2], K. Günther[3], S. Kontermann[1], E. Lemp[2], V. Mihailetchi[2], D. Rudolph[2], W. Schade[1], J. Theobald[2], E. Wefringhaus[2]

[1] Fraunhofer Heinrich Hertz Institute; [2] International Solar Energy Research Center Konstanz (ISC); [3] Energie Forschungszentrum Niedersachsen

G-Wed-34 Optimized Distributed BRAGG Reflector for Rear Diffused c-Si Solar Cells

A. Ingenito[1], O. Isabella[1], J.C.O. Lizcano[2], S. Luxembourg[3], R. Santbergen[1], A. Weeber[3], M. Zeman[1]

[1] Delft University of Technology; [2] TU Delft; [3] Energy Research Centre of the Netherlands (ECN)

J-Wed-35 Experimental and Simulation Study for High Efficiency Ultra-thin c-Si Solar Cells

O. Isabella[1], L. Gkountakou[1], A. Ingenito[1], M. Zeman[1]

[1] Delft University of Technology

J-Wed-36 Silicon Nanocrystal Down-shifter Applied to a c-Si Solar Cell: Experiment and Simulations

S. Luxembourg[1], T. Burgers[1], T. Gregorkiewicz[2], R. Limpens[2], A. Weeber[1]

[1] Energy Research Centre of the Netherlands (ECN); [2] University of Amsterdam

C-Wed-37 Investigation of Nickel Assisted Nanostructured Silicon Antireflection Layer for PV Applications

M. Pranaitis[1], A. Galdikas[2], L. Jaraminé[1], A. Selskis[3], V. Čyras[1]

[1] Precizika-MET SC; [2] Applied Research Institute for Prospective Technologies; [3] Vilnius University

C-Wed-38 Silicon Nanowire Texturization for Efficiency Improvement in Crystalline Silicon Solar Cell

H. Song[1], S.J. Choi[1], K.S. Do[1], G.H. Kang[1], M.G. Kang[1]

[1] Korea Institute of Energy Research (KIER)

K-Wed-39 The BSK Solar Cell: Double-sided Collection and Bifacial Operation

F. Fertig[1], D. Biro[1], F. Clement[1], J. Greulich[1], K. Krauß[1], R. Preu[1], S. Rein[1]

[1] Fraunhofer Institute for Solar Energy Systems ISE

K-Wed-40 Simulation Based Development of Industrial PERC Cell Production beyond 20.5% Efficiency

G. Fischer[1], A. Fülle[1], F. Lottspeich[1], M. Müller[1], H. Neuhaus[1], R. Schiepe[1], E. Schneiderloechner[1], K. Stegemann[1], K. Strauch[1], T. Weber[1], F. Wolny[1]

[1] SolarWorld Innovations

K-Wed-41 Over 21%-Efficient PERL Solar Cells with Plated Front Contacts on Industrial p-Type Crystalline 156mm Cz Silicon Wafers

T. Kim[1], E. Cho[1], J. Cho[1], M. Kim[1], D. Kyeong[1], J. Lee[1], K. Lee[1], W. Lee[1], J. Lim[1], H. Shin[1]
[1] Hyundai Green Energy Research Institute

15:00 Coffee Break

15:15 - 16:45 Oral Session 7: PV Module Construction

Chair: Andreas Schneider (ISC) and Roland Einhaus (Apollon Solar)

15:15 Unified Methodology for Determining CTM Ratios: Systematic Prediction of Module Power

I. Haedrich[1], U. Eitner[1], M.S. Hendrich[1], A. Spribille[1], M. Wiese[1], H. Wirth[1]
[1] Fraunhofer Institute for Solar Energy Systems ISE

15:45 Multi-wire Interconnection of Busbar-free Solar Cells

J. Walter[1], **U. Eitner[1]**, P. Schmitt[1], M. Tranitz[1], M. Volk[1]
[1] Fraunhofer Institute for Solar Energy Systems ISE

16:00 Contact-free Determination of Ethylene Vinyl Acetate Crosslinking in PV Modules with Fluorescence Emission

A. Morlier[1], S. Blankemeyer[1], I. Kunze[1], M. Köntges[1]
[1] Institute for Solar Energy Research Hamelin (ISFH)

16:15 Two Layer Metallization and Module Integration of Point-contacted Solar Cells

H. Schulte-Huxel[1], S. Blankemeyer[1], R. Brendel[1], S. Kajari-Schröder[1], Y. Larionova[1], A. Merkle[1], R. Peibst[1], U. Römer[1], V. Steckenreiter[1]
[1] Institute for Solar Energy Research Hamelin (ISFH)

16:30 Cost, Efficiency and Material Optimisation of Back-contact Cell and Module Design

B. Van Aken[1], E. Bende[1], I. Bennett[1], M. Goris[1], M. Lamers[1]
[1] Energy Research Centre of the Netherlands (ECN)

16:45 Short Break

17:00 - 18:00 Oral Session 8: Module Reliability

Chair: Guy Beaucarne (Dow Corning) and Lars Oberbeck (Total)

17:00 In-laminate Strength Testing of Solar Cells after Different Manufacturing Conditions and Subsequent Weathering

M. Sander[1], J. Bagdahn[1], S. Dietrich[1], M. Ebert[1], S. Schindler[1]

[1] Fraunhofer Center for Silicon Photovoltaics CSP

17:15 Comprehensive Study of Material Dependency for Silver Based Conductive Glues

A. Schneider[1], S. Aulehla[1], F. Demiralp[1], R. Harney[1], S. Koch[2], J. Scheurer[3], C. Seeger[4]

[1] International Solar Energy Research Center Konstanz (ISC); [2] PI Photovoltaik-Institut Berlin; [3] soltaBond; [4] Bruker-Spaleck

17:30 Microstructural Investigation of PID-Shunts: Degradation and Recovery

D. Lausch[1], C. Hagendorf[1], V. Naumann[1]

[1] Fraunhofer Center for Silicon Photovoltaics CSP

17:45 Reliable Interconnection of the Front Side Grid Fingers Using Silver-reduced Conductive Adhesives

T. Geipel[1], U. Eitner[1], M.Z. Huq[1]

[1] Fraunhofer Institute for Solar Energy Systems ISE

19:00 Dinner Reception – *refer to page 34 for more information*

20:00 Conference Dinner – *refer to page 34 for more information*

Thursday, March 27, 2014

08:30 Opening Session nPV

Opening Speech Chairman nPV workshop

J. Schmidt, Institute for Solar Energy Research Hamelin (ISFH)

08:45 - 10:15 Oral Session 9: Heterojunction Cells

Chair: Jan Schmidt (ISFH) and Delfina Muñoz (CEA-INES)

08:45 Organic-silicon Heterojunction Solar Cells on n-Type Silicon Wafers

D. Zielke[1], J. Schmidt[1], V. Titova[1], F. Werner[1]

[1] Institute for Solar Energy Research Hamelin (ISFH)

09:00 Improving the a-Si:H/TCO-contact in SHJ Solar Cells by TCO Work Function Engineering

K. Ritzau[1], J. Behnke[1], T. Behrendt[1], M. Bivour[1], M. Hermle[1], P. Reinecke[1], S. Schröer[1], F. Wagner[1]

[1] Fraunhofer Institute for Solar Energy Systems ISE

09:15 Investigation of TCO-induced Band Bending in c-Si/a-Si:H/ZnO:Al Heterostructures and its Effect on Surface Recombination

B. Macco[1], D. Deligiannis[2], E. Kessels[1], S. Smit[1], R. van Swaaij[2]

[1] Eindhoven University of Technology; [2] Delft University of Technology

09:30 Impact of Interface Parameters on the Fill Factor of Silicon Heterojunction Solar Cells

C. Leendertz[1], L. Korte[1], B. Rech[1], R. Rößler[1]

[1] Helmholtz-Zentrum Berlin (HZB)

09:45 Characterization of Ultra-thin µC-Si Fils for Silicon Heterojunction Solar Cells

H. Wernerus[1], M. Bivour[1], M. Hermle[1], L. Kroely[1]

[1] Fraunhofer Institute for Solar Energy Systems ISE

10:15 Coffee Break

10:30 - 11:45 Oral Session 10: Both Sides Contacted n-Type Cells

Chair: Pierre-Jean Ribeyron (CEA-INES) and Barbara Terheiden (University of Konstanz)

10:30 Development of Industrial Processes for the Fabrication of High Efficiency n-Type PERT Cells

T. Blévin[1], R. Cabal[1], B. Grange[1], A. Lanterne[1], Y. Veschetti[1]

[1] CEA - Institut National de l'Énergie Solaire (CEA-INES)

10:45 21.8 % Efficient n-Type Solar Cells with Industrially Feasible Plated Metallization

J. Bartsch[1], J. Benick[1], F. Feldmann[1], M. Glatthaar[1], S. Glunz[1], D. Hartleb[1], M. Hermle[1], M. Kamp[1], A. Mondon[1], A. Richter[1], B. Steinhauser[1], C. Wittich[1]

[1] Fraunhofer Institute for Solar Energy Systems ISE

11:00 Lifetime Degradation of n-Type Wafers with Boron-diffused and SiO_2/SiN-Passivated Surface

E. Fourmond[1], M. Forster[2], S. Parola[1], E. Picard[3], C. Renevier[1]

[1] Institut des Nanotechnologies de Lyon (INL / INSA); [2] Apollon Solar; [3] IRYSOLAR - Semco-Engineering group

11:15 20.5% Efficiency on Large Area n-Type PERT Cells by Ion Implantation

A. Lanterne[1], M. Coig[1], S. Gall[1], J. Le Perchec[1], S. Manuel[1], A. Tauzin[1], Y. Veschetti[1]

[1] CEA - Institut National de l'Énergie Solaire (CEA-INES)

11:30 Microscopic Origin of the Aluminium Spiking Problematique in n-Type Silicon Solar Cells

F. Heinz[1], M. Breitwieser[1], P. Gundel[2], M. Hörteis[2], M. König[2], M. Schubert[1], W. Warta[1]

[1] Fraunhofer Institute for Solar Energy Systems ISE; [2] Heraeus Hanau

11:45 Lunch Break

12:45 - 14:45 Poster Session 3

The poster numbers are based on topics and conference days:

- A Silicon Material
- B Cleaning and Etching
- C Surface Morphology and Passivation
- D Structuring and Contact Formation
- E Module Integration
- F Reliability
- G Advanced Characterization and Simulation
- H Junction Formation
- K Process Integration
- L Posters of the nPV workshop

G-Thu-1 Conceptual Comparison between Standard Si Solar Cells and Back Contacted Cells

A. Ali[1], P.P. Altermatt[2], T. Ohrdes[3], H. Wagner[2]

[1] Government College University Faisalabad; [2] Leibniz University of Hanover; [3] Institute for Solar Energy Research Hamelin (ISFH)

G-Thu-2 Rear Contact Pattern Optimization Based on 3D Simulations for IBC Solar Cells with Point-like Doped Contacts

D. Carrio[1], R. Alcubilla[1], G. Lopez[1], J.M. Lopez-Gonzalez[1], I. Martin[1], C. Voz[1]

[1] Universitat Politecnica de Catalunya

G-Thu-3 Impact of Quantum Confinement Effect on Roles of Amorphous Silicon Layers in Heterojunction Solar Cells

T. Kamioka[1], Y. Hayashi[1], K. Nakamura[1], Y. Ohshita[1]

[1] Toyota Technological Institute

G-Thu-4 2D-Modeling of Metallization Losses in P+ Emitters Assuming SCHOTTKY Barriers and Tunneling

L.J. Koduvelikulathu[1], R. Kopecek[1], V.D. Mihailetchi[1]

[1] International Solar Energy Research Center Konstanz (ISC)

G-Thu-5 Analysis of the Impact of Doping Levels on Performance of Back Contact - Back Junction Solar Cells

P. Procel[1], G. Cocorullo[1], F. Crupi[1], C. Fiegna[2], V. Maccaronio[1], P. Magnone[2], M. Zanuccoli[2]

[1] Università della Calabria; [2] University of Bologna

G-Thu-6 Accouting for Side Effects in Silicon Heterojunction Simulation

R. Varache[1], D. Muñoz[1]

[1] CEA - Institut National de l'Énergie Solaire (CEA-INES)

A-Thu-7 UMG n-Type CZ-Silicon: Influencing Factors of the Light Induced Degradation and its Suitability for PV Production

J. Broisch[1], J.K. Haunschild[1], S. Rein[1], J. Schmidt[1]
[1] Fraunhofer Institute for Solar Energy Systems ISE

L-Thu-8 Exclusively Thermal Donor-doped CZ Wafers for High Efficiency Heterojunction Solar Cells

F. JAY[1], S. Dubois[1], D. Muñoz[1], N. Najid[1], J. Veirman[1]
[1] CEA - Institut National de l'Énergie Solaire (CEA-INES)

A-Thu-9 Iron-boron Pair Kinetic in Compensated n-Type Silicon

C. Möller[1], T. Bartel[2], F. Kirscht[2], K. Lauer[1]
[1] CiS Forschungsinstitut für Mikrosensorik und Photovoltaik;
[2] Calisolar

B-Thu-10 Chemical Treatment for Improved Surface Passivation of Textured Silicon Heterojunction Solar Cells

D. Deligiannis[1], S. Alivizatos[1], A. Ingenito[1], M. Zeman[1], D. Zhang[1], R. van Swaaij[1]
[1] Delft University of Technology

B-Thu-11 Optimized Texturization and Passivation of Silicon Heterojunction Solar Cells

B. Stegemann[1], H. Angermann[2], E. Conrad[2], J. Kegel[1], L. Korte[2], U. Stürzebecher[3]
[1] HTW Berlin; [2] Helmholtz-Zentrum Berlin (HZB);
[3] CiS Forschungsinstitut für Mikrosensorik und Photovoltaik

H-Thu-12 Influence of Interfacial ITO Doping on the Fill Factor of n- and p-Type SHJ Solar Cells

M. Bivour[1], M. Hermle[1], K. Ritzau[1], S. Schröer[1], H. Steinkemper[1], J. Temmler[1]
[1] Fraunhofer Institute for Solar Energy Systems ISE

H-Thu-13 Boron Emitters from Doped PECVD Layers for n-Type Crystalline Solar Cells with LCO

J. Engelhardt[1], A. Frey[1], G. Hahn[1], L. Mahlstaedt[1], B. Terheiden[1]
[1] University of Konstanz

L-Thu-14 Potential Advantage of an Industrially Processed Boron Emitter Compared to a Phosphorus Emitter

Y. Komatsu[1], I.G. Romijn[1], A.H.G. Vlooswijk[2]
[1] Energy Research Centre of the Netherlands (ECN);
[2] Tempress Systems

H-Thu-15 Selective Emitter Formation on n-Type Silicon Wafers by Laser-chemical Processes

D. Linaschke[1], I. Dani[1], N. Schilling[1]
[1] Fraunhofer Institute for Material and Beam Technology IWS

H-Thu-16 N-Type c-Si Solar Cells Based on Laser Processed Dielectric

I. Martin[1], R. Alcubilla[1], M. Colina[1], A. Coll[1], G. López[1], A. Orpella[1], P. Ortega[1]

[1] Universitat Politècnica de Catalunya

H-Thu-17 Single-layer ITO vs ITO/ZNO: AL Layer Stacks in a-Si:H/c-Si Solar Cells: A Comparison

R. Rößler[1], L. Korte[1], S. Kämpfer[1], B. Rech[1], B. Strahm[1]

[1] Helmholtz-Zentrum Berlin (HZB)

H-Thu-18 Etch-back of p+ Structures for Selective Boron Emitters in n-Type c-Si Solar Cells

Y. Schiele[1], G. Hahn[1], S. Joos[1], B. Terheiden[1]

[1] University of Konstanz

H-Thu-19 SHJ Solar Cells Based on a-Si:H/Al_2O_3/ZnO Stacks: Experimental Results and a New Quantitative Analysis of the Band Structure

S. Smit[1], P. Bronsveld[2], E. Kessels[1], P. Manshanden[2], A. Weeber[2]

[1] Eindhoven University of Technology; [2] Energy Research Centre of the Netherlands (ECN)

H-Thu-20 Recombination Losses Analysis in Rear Emittter Silicon Heterojunction Solar Cells

R. Varache[1], D. Muñoz[1], N. Nguyen[1], A. Valla[1]

[1] CEA - Institut National de l'Énergie Solaire (CEA-INES)

H-Thu-21 Boron Implanted, Laser Annealed P+ Emitter for n-Type Interdigitated Back-contact Solar Cells

X. Yang[1], Q. Bi[1], R. Elliman[1], W. Liang[1], D. Macdonald[1], R. Muller[2], A. Shalav[1], K. Weber[1], L. Xu[1]

[1] Australian National University; [2] Fraunhofer Institute for Solar Energy Systems ISE

C-Thu-22 MF-Sputtered AZO for a-Si SHJ Solar Cells

J. Jeurink[1], F. Wagner[1]

[1] Fraunhofer Institute for Solar Energy Systems ISE

C-Thu-23 Dielectric Passivation Schemes for High Efficiency n-Type c-Si Solar Cells

M. Lamers[1], D. Borsa[2], I. Cesar[1], G. Dingemans[3], L. Gautero[2], E. Granneman[4], A. Gutjahr[1], E. Kessels[5], H. Knoops[5], M. Koppes[1], J. Liu[1], O. Siarheyeva[4], P. Venema[6], A. Vlooswijk[6], K. van Ormelingen[4]

[1] Energy Research Centre of the Netherlands (ECN); [2] Roth & Rau B.V.; [3] ASM; [4] Levitech; [5] Eindhoven University of Technology; [6] Tempress Systems

C-Thu-24 Passivation Properties of Subnanometer Thin Interfacial Silicon Oxide Films

W. Lu[1], H. Angermann[1], L. Korte[1], C. Leendertz[1], B. Rech[1]
[1] Helmholtz-Zentrum Berlin (HZB)

C-Thu-25 Neutron and X-ray Reflectometry Investigations of Amorphous Silicon-based Surface Passivation Layers

E.S. Marstein[1], I.M. Hasle[1], H. Haug[1], A.J. Qviller[1]
[1] Institute for Energy Technology (IFE)

C-Thu-26 Thermal, Structural and Electrical Study of the Effect of Annealing on the Passivation by a-Si of n-Type Crystalline(100) Silicon Surfaces

H. Meddeb[1]
[1] imec

C-Thu-27 Hydrogen Plasma Treatments of Amorphous/Crystalline Silicon Heterojunctions

M. Mews[1], E. Conrad[1], L. Korte[1], N. Mingirulli[2]
[1] Helmholtz-Zentrum Berlin (HZB); [2] Bosch Corporate Research

C-Thu-28 Black Silicon in Interdigitated Back-contacted Solar Cells

P. Repo[1], R. Alcubilla[2], E. Calle[2], P. Ortega[2], H. Savin[1]
[1] Aalto University; [2] Universitat Politecnica de Catalunya

C-Thu-29 Exploration of Metastability of a-Si:H/c-Si Surface Passivation

R. Vasudevan[1], A. Smets[1], M. Zeman[1]
[1] Delft University of Technology

C-Thu-30 DC Sputtered ZnO: AL as Alternative TCO in Silicon Heterojunction Solar Cells

K. von Maydell[1], O.M. Ghahfarokhi[2]
[1] EWE Forschungszentrum für Energietechnologie e.V.;
[2] EWE Forschungszentrum für Energietechnologie

C-Thu-31 Progress in Sputtering of Hydrogenated Amorphous Silicon for Silicon Solar Cells

X. Zhang[1], A. Cuevas[1]
[1] Australian National University

D-Thu-32 Improvement on Industrial n-Type Bifacial Solar Cell with >20.6% Efficiency

H. Chang[1], P.T. Hsieh[1], C.J. Huang[1], C.C. Li[1], W.C. Mo[1], S.H. Yu[1]
[1] Motech

D-Thu-33 Hard-mask Patterning of Hydrogenated Amorphous Silicon Layers for High Open-circuit Voltage Back-contacted Silicon Heterojunction Solar Cells

B. Paviet-Salomon[1], C. Ballif[1], S. De Wolf[1], B. Demaurex[1], N. Holm[1], D. Lachenal[2], B. Legradic[2], S. Martin de Nicolas[1], B. Strahm[2], A. Tomasi[1]

[1] École Polytechnique Fédérale de Lausanne (EPFL); [2] Roth & Rau Research AG

D-Thu-34 IBC-HJ Solar Cells with Electroplated Copper Contacts

Y. Ryabchikov[1], T. Desrues[2], G. D'Alonzo[2], A. Lukianov[3], D. Muñoz[2], T. Nychyporuk[3]

[1] Lyon Institute of Nanotechnologies (INL, INSA de Lyon); [2] CEA - Institut National de l'Énergie Solaire (CEA-INES); [3] Institut des Nanotechnologies de Lyon (INL / INSA)

K-Thu-35 Wafer-thickness Dependence of Double-side Contacted Rear Junction n-Type Solar Cells

T. Ballmann[1], S. Bordihn[1], J. Cieslak[1], M. Kauert[1], C. Klenke[1], M. Köntopp[1], K.H. Küsters[1], V. Mertens[1], J. Müller[1], C. Peters[1], A. Schönmann[1], G. Zimmermann[1]

[1] Hanwha Q CELLS

L-Thu-36 Laser Doped Screen Printed Back Contact Solar Cells Exceeding 21% Efficiency

M. Dahlinger[1], K. Carstens[1], J.R. Köhler[1], T.C. Röder[1], J.H. Werner[1], R. Zapf-Gottwick[1]

[1] University of Stuttgart

L-Thu-37 Bifacial n-Type Silicon Solar Cells Fabricated by Co-diffusion

P. Rothhardt[1], D. Biro[1], C. Demberger[2], S. Maier[1], S. Meier[1], A. Wolf[1]

[1] Fraunhofer Institute for Solar Energy Systems ISE; [2] Schmid Group

E-Thu-38 Adhesive Modification for Excellent Module-level a-Si:H Passivation of Wafers Bonded to Glass

S.N. Granata[1], T. Bearda[1], G. Beaucarne[2], I. Gordon[1], R. Mertens[1], J. Poortmans[1]

[1] imec; [2] Dow Corning

F-Thu-39 Analyses of Potential-induced Degradation at Interdigitated Back Contact Solar Cells

V. Naumann[1], T. Geppert[2], S. Großer[1], C. Hagendorf[1], H. Krokoszinski[2], M. Werner[1], D. Wichmann[2]

[1] Fraunhofer Center for Silicon Photovoltaics CSP; [2] Bosch Solar Energy AG

14:45 - 15:45 Oral Session 11: Rear Junction n-Type Solar Cells

Chair: Pierre Verlinden (Trina Solar) and Frederic Dross (Hanwha Solar)

14:45 MERCURY: A Back Junction Back Contact Cell with Novel Design for High Efficiency and Simplified Processing

I. Cesar[1], J. Anker[1], A.R. Burgers[1], L.J. Geerligs[1], N. Guillevin[1], M. Koppes[1], A.A. Mewe[1], A.W. Weeber[1]

[1] Energy Research Centre of the Netherlands (ECN)

15:00 Ion Implantation for All-alumina IBC Solar Cells with Floating Emitter

R. Müller[1], J. Benick[1], M. Hermle[1], C. Reichel[1]

[1] Fraunhofer Institute for Solar Energy Systems ISE

15:15 A Distributed Electrical Model for Interdigitated Back Contact Silicon Solar Cells

D. Giaffreda[1], M. Debucquoy[2], C. Fiegna[1], P. Magnone[1], N. Posthuma[2]

[1] University of Bologna; [2] imec

15:30 Rear Emitter Silicon Heterojunction Solar Cells: Fewer Restrictions on the Optoelectrical Properties of Front Side TCOS

M. Bivour[1], M. Hermle[1], J. Jeurink[1], K. Ritzau[1], S. Schröer[1], H. Steinkemper[1], F. Wagner[1]

[1] Fraunhofer Institute for Solar Energy Systems ISE

15:45 - 16:15 Oral Session 12: Surface Passivation

Chair: Arthur Weeber (ECN) and Giso Hahn (University of Konstanz)

15:45 Universal Al_2O_3-based Passivation Layers for p- and n-Type Silicon

D.K. Simon[1], F. Benner[2], I. Dirnstorfer[3], P.M. Jordan[2], T. Mikolajick[2], C. Richter[2]

[1] NaMLab; [2] Nanoelectronic Materials Laboratory GmbH; [3] NaMLab GmbH

16:00 'ZERO-CHARGE' SiO_2/Al_2O_3 Stacks for the Simultaneous Passivation OF n+ and p+ Surfaces in Solar Cells

B. van de Loo[1], G. Dingemans[2], E. Kessels[1], H. Knoops[1], M. Lamers[3], I. Romijn[3]

[1] Eindhoven University of Technology; [2] ASM; [3] Energy Research Centre of the Netherlands (ECN)

16:15 Coffee Break

16:45 - 17:15 Oral Session 13: Metallization

Chair: Arthur Weeber (ECN) and Giso Hahn (University of Konstanz)

16:45 Large-area Hybrid Silicon Heterojunction Solar Cells with Ni/Cu Plated Front Contacts

L. TOUS[1], M. Aleman[1], C. Ballif[2], S. De Wolf[2], F. Duerinckx[1], T. Emeraud[3], I. Gordon[1], S. Granata[1], J. John[1], R. Labie[1], J. Lerat[3], S. Martin de Nicolas[2], R. Mertens[4], T. Pletzer[5], J. Poortmans[4], R. Russell[1], J. Szlufcik[1]

[1] imec; [2] École Polytechnique Fédérale de Lausanne (EPFL); [3] EXCICO France; [4] KU Leuven; [5] RWTH Aachen University

17:00 New Insights into the Influence of the Back Contact on the Structural and Photovoltaic Properties of p-Type and n-Type Czochralski and Mono-like Silicon Solar Cells

T. Lafford[1], J. Baruchel[1], S. Dubois[2], N. Enjalbert[2], B. Fernandez[3], T. Schülli[1], T.N. Tran Thi[1]

[1] European Synchrotron Radiation Facility; [2] CEA - Institut National de l'Énergie Solaire (CEA-INES); [3] Institut Néel CNRS

17:15 - 17:45 Closing Session SiliconPV

17:15 Closing Speech Chairman SiliconPV

A. Weeber, Energy Research Centre of the Netherlands (ECN)

17:25 SiliconPV Award Ceremony for the Best 10 Abstracts

A. Weeber, Energy Research Centre of the Netherlands (ECN)

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The ceremony is sponsored by TOTAL, Thank you!

17:35 Presentation SiliconPV 2015

Friday, March 28, 2014

08:45 - 10:15 Future of n-Type Si PV

Chair: Jan Schmidt (ISFH) and Stefan Glunz (Fraunhofer ISE)

08:45 c-Si n-Type Technology: Break Through or Break Down?

R. Kopecek, International Solar Energy Research Center Konstanz (ISC)

09:10 Advanced Silicon Solar Cell Strategy for Lower Cost of Electricity

P. Verlinden, State Key Laboratory of PV Science and Technology, Trina Solar

09:35 Status of Heterojunction Cell and Module Development at Meyer Burger

D. Baetzner, Roth und Rau Switzerland

09:55 Routes Towards High Efficiency, Cost Effective n-Type Rear Junction Cells with Cu-plated Front Contacts

F. Duerinckx, imec

10:15 Coffee Break

10:35 - 12:15 Heterojunction & Back Contact

Chair: Derk Baetzner (Roth und Rau) and Delfina Muñoz (CEA-INES)

10:35 Industrialization of a-Si:H /c-Si Heterojunction Solar Cells at CEA-INES: from R&D to Production Line

P. Ribeyron, CEA - Institut National de l'Energie Solaire (CEA-INES)

10:55 Effects of Wavelength Convertor on Single Cell Module with Silicon Heterojunction Cell

F. Ishimura, Choshu

11:15 Investigating the Influence of Ion Bombardment during Thin i-a-Si:H Film Deposition on a c-Si Wafer

C. Landheer, Utrecht University

11:35 Low-cost Laser-processed IBC Cells with High Efficiency

J.H. Werner, University of Stuttgart

11:55 Modules Based on Back-contacted Cells

B. Verschoor, Eurotron B.V.

12:15 - 12:30 **Discussion**

Chair: Derk Baetzner (Roth und Rau) and Delfina Muñoz (CEA-INES)

12:30 Lunch Break

13:20 - 14:40 **B-emitters**

Chair: Arthur Weeber (ECN) and Radovan Kopecek (ISC Konstanz)

13:20 Doping of n-PERT Solar Cells Using Ion Implantation and Single Thermal Activation

M. Emsley, Applied Materials

13:40 Bifacial n-PERT Solar Cells with 20.4% Efficiency Applying Dual Print as Fineline Metallization Technique

B. Lim, Institute for Solar Energy Research Hamelin (ISFH)

14:00 Cell Mass Production and Array Field Demonstration of n-Type Bifacial 'EarthON'

S. Goda, PVG Solutions Inc.

14:20 Development of High-efficiency of n-PERT Bifacial Solar Cells

C. Li, Motech Industries, Inc.

14:40 Coffee Break

15:00 - 15:40 **Materials**

Chair: Joachim John (imec) and Bianca Lim (ISFH)

15:00 n-Type Silicon Wafer Specifications: Directions and Cost Impact

O. Nielsen, NorSun AS

15:20 Impact of Wafer Quality on Boron-diffused n-Type Bifacial Solar Cells

M. Forster, Apollon Solar

15:40 - 16:10 **General Discussion and Closing**

Chair: Pierre Verlinden (Trina Solar)

Presentation nPV workshop 2015

Side Events

Welcome Reception

All participants are invited to take part in the Welcome Reception, which will take place on Monday, March 24, 2014, from 18:00 to 20:00 at 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:	Monday, March 24, 2014
Time:	18:00 – 20:00
Location:	1931 Congrescentrum Brabanthallen

Conference Dinner

Enjoy the conference dinner of SiliconPV 2014 and the nPV workshop at the conference venue "1931 Congrescentrum Brabanthallen". Savour fine food and drinks as you socialize with your colleagues and peers.

The dinner is not included in the conference fee. You are requested to register in advance. Details on the menu are available on the conference website.

Date:	Wednesday, March 26, 2014
Time:	19:00 – 20:00 Dinner Reception, 20:00 – 23:00 Conference Dinner
Location:	1931 Congrescentrum Brabanthallen
Price:	€ 69 (including food and all drinks)

Please register at the registration desk!


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Technical Tour

The lab facilities of ECN in Eindhoven include research facilities for organic thin film PV's, thin film Si PV's as well as an extensive PV characterization lab. The organic PV lab includes facilities for inkjet printing and slot die coating, both important to upscale the production of organic PV's. The lab facilities for thin film Si layers include a unique set-up for the roll-to-roll processing of thin film layers.

During your visit you will be able to interact with some of the researchers who will guide you through their facility.

The tour is already fully booked!

Date: Tuesday, March 25
Time: 18:15 – 20:45
Buses will leave in front of 1931 Congrescentrum Brabanthallen

Sightseeing Tour

Walk with a guide through the historic city of 's-Hertogenbosch, the Netherlands' most hospitable city! Listen to a variety of fascinating anecdotes as you visit the beautiful sights of the old town. This tour is suitable not only for tourists but also for local residents eager to learn more about the history of their city.

The sightseeing tour can be booked at the registration desk.

Date: Tuesday, March 25
Time: 18:30 – 20:00
Meeting point: Registration desk
Fee: € 12

General Information

Registration

Each participant must 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 must report to the registration desk to get a new one. Registration times are on Monday, March 24, from 18:00-20:00 at the Welcome Reception and during conference hours, starting on Tuesday at 7:30 and the following days at 8:00 in the 1931 Congress centre.

Poster

The poster area is located in the 1931 Congress centre. See the poster plan on page 42 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.


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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 directly 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 Tuesday 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.

Full papers from the twenty best abstracts will be published in Solar Energy Materials & Solar Cells (SOLMAT), which is not an open-access journal. These papers will be accessible on the SiliconPV website until publication in SOLMAT.

Before publication, access to all non-reviewed papers will be available on the restricted area of the conference website, which is accessible to all conference participants with the login and password provided after their conference registration.

WiFi Access

WiFi is available in the foyer of the 1931 Congress centre free of charge for all participants. The name of the free WiFi network is **KPN Hotspot**. Please choose "Accept the general terms and conditions" to activate the WiFi.

Poster Plan

The poster numbers are based on topics and conference days:

- A Silicon Material
- B Cleaning and Etching
- C Surface Morphology and Passivation
- D Structuring and Contact Formation
- E Module Integration
- F Reliability
- G Advanced Characterization and Simulation
- H Junction Formation
- I Wafering Technologies
- J Advanced Light Management
- K Process Integration
- L Posters of the nPV workshop

E-Wed-14

Topic: Module Integration

Conference day: Wednesday

Continuous numbering

Poster Area

A-Tue-1	A-Wed-22	A-Wed-25	B-Tue-7
A-Wed-19	A-Tue-4	A-Thu-7	B-Wed-18
A-Tue-2	A-Wed-23	A-Wed-26	B-Thu-10
A-Wed-20	A-Tue-5	A-Thu-9	B-Tue-8
A-Tue-3	A-Wed-24	A-Wed-27	B-Thu-11
A-Wed-21	A-Tue-6	A-Wed-28	C-Thu-22

D-Tue-18	D-Tue-23	E-Tue-27	H-Wed-15	K-Wed-40	I-Wed-30
D-Tue-19	D-Tue-24	E-Tue-28	H-Wed-16	K-Wed-41	I-Wed-31
D-Thu-32	D-Thu-33	E-Thu-38	H-Wed-17	J-Wed-33	I-Wed-32
D-Tue-20	D-Thu-34	E-Tue-29	K-Thu-35	J-Wed-35	H-Thu-12
D-Tue-21	E-Tue-25	E-Tue-30	K-Wed-39	J-Wed-36	H-Thu-13
D-Tue-22	E-Tue-26	E-Tue-31	E-Tue-32	I-Wed-29	H-Thu-15

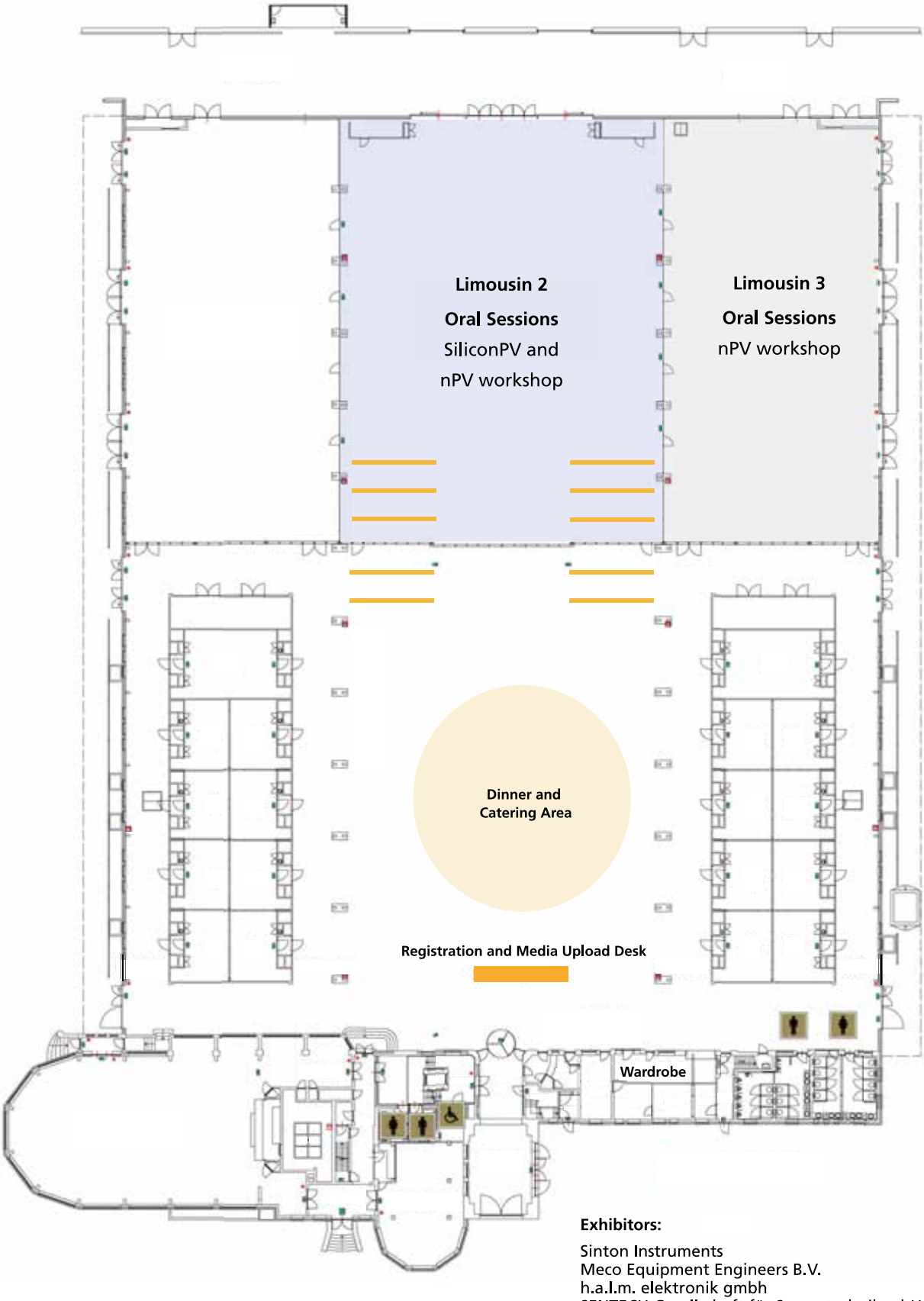
Foyer

Limousin 2

C-Thu-23	C-Thu-24	C-Thu-25	C-Thu-29
C-Tue-9	C-Tue-11	C-Tue-13	C-Thu-30
C-Wed-37	C-Wed-38	C-Thu-26	C-Tue-15
C-Tue-10	C-Tue-12	C-Tue-14	C-Thu-31
L-Thu-8	L-Thu-36	C-Thu-27	D-Tue-16
L-Thu-14	L-Thu-37	C-Thu-28	D-Tue-17

F-Tue-33	F-Tue-38	G-Wed-3	G-Wed-7	G-Wed-11	H-Thu-16
F-Tue-34	F-Tue-39	G-Wed-4	G-Wed-8	G-Wed-12	H-Thu-17
F-Tue-35	F-Tue-40	G-Wed-5	G-Thu-4	G-Wed-13	H-Thu-18
F-Thu-39	G-Thu-1	G-Thu-2	G-Wed-9	G-Thu-6	H-Thu-19
F-Tue-36	G-Wed-1	G-Thu-3	G-Wed-10	G-Wed-14	H-Thu-20
F-Tue-37	G-Wed-2	G-Wed-6	G-Thu-5	G-Wed-34	H-Thu-21

Conference Area



Exhibitors:

Sinton Instruments
Meco Equipment Engineers B.V.
h.a.l.m. elektronik gmbh
SENTECH Gesellschaft für Sensortechnik mbH
ECN

Poster Walls

Program Overview

SiliconPV 2014

nPV workshop 2014

	Monday March 24	Tuesday March 25	Wednesday March 26	Thursday March 27	Friday March 28
07:30					
08:00		Reception	Reception	Reception	
08:15					
08:30		Opening Session	Novel Carrier-selective Contact Structures	Opening Session nPV	
08:45		Silicon Material and Wafering		Heterojunction Cells	Future of n-Type Si PV
10:00			Coffee Break	Coffee Break	
10:15		Coffee Break			Coffee Break
10:30			Metallization and Process Integration	Both Sides Contacted n-Type Cells	Heterojunction & Back Contact
10:45		Advanced Characterization			
11:45				Lunch Break	
12:00		Lunch Break	Lunch Break		Discussion
12:15					Lunch Break
12:30					
12:45				Poster Session III	
13:00		Poster Session I	Poster Session II		B-emitters
13:20					
14:40				Rear Junction n-Type Solar Cells	Coffee Break
15:00		Advanced Characterization and Simulations	Coffee Break		Materials
15:15			PV Module Construction		
15:45				Surface Passivation	General Discussion and Closing
16:15		Coffee Break		Coffee Break	
16:45		Surface Passivation	Short Break	Metallization	
17:00			Module Reliability	Closing Session SiliconPV	
17:15					
17:45					
18:00	Welcome Reception and Pre-Registration	Technical Tour 18:15 – 20:45 Sightseeing 18:30 – 20:00	Dinner Reception		
19:00					
20:00			Conference Dinner (SiliconPV 2014 and nPV workshop)		
23:00					