



April 11 – 14, 2023

Delft, the Netherlands | Hybrid

PROGRAM



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Conference Info

Welcome to SiliconPV 2023!

The 13th edition of **SiliconPV** will take place from **April 11-13, 2023** and will be hosted by the Delft University of Technology and TNO, the Netherlands.

The conference will be held in a hybrid format, allowing for online and physical presentations and attendance.

Like in recent years, SiliconPV continues its fruitful cooperation with the nPV workshop.

SiliconPV Conference from April 11-13, 2023

The conference covers a variety of exciting topics around crystalline silicon for photovoltaic application, which is still the leading technology for solar electricity generation!

nPV Workshop from April 13-14, 2023

Taking place directly after the SiliconPV conference with one overlapping day, the workshop provides a complete overview of all trends, innovations and developments of n-type technology. The nPV Workshop is hosted by the Delft University of Technology, The Netherlands.



Committees

SiliconPV Conference Chairperson

Chair: Prof. Dr. Arthur Weeber (TNO Energy Transition)

SiliconPV Conference Executive Committee

Pierre Verlinden (Amrock Pty Ltd)

Sébastien Dubois (CEA)

Arthur Weeber (TNO Energy Transition)

Christophe Ballif (EPFL)

Stefan Glunz (Fraunhofer ISE)

Jef Poortmans (imec)

Robby Peibst (ISFH)

Giso Hahn (University of Konstanz)

nPV Workshop Chairperson

Olindo Isabella (TU Delft)

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Chairperson's Message

Dear SiliconPV Friends,

Last year was special with both positive and negative aspects. In 2022 we were able to hold SiliconPV together with nPV and bifPV on site and in a hybrid way. It was great to meet so many PV colleagues in person again and also being able to connect with the colleagues participating online. For the 2023 edition we will use the same format and the conference will be hybrid again.

Negative aspects are still the uncertain COVID19 situation, the climate change, and the geopolitical issues which have impact on the global society. Therefore it is becoming more and more important to enhance the energy transition and develop technologies that will be available for everyone and everywhere, have low cost, and can be manufactured locally. PV is the technology to hasten the energy transition and it can be done big, already now, and in the future with much better technologies. Compared to the current commercial PV technologies conversion efficiencies can be doubled by applying multijunction PV, prices can be reduced by another factor two to three, PV can be fully integrated in every surface, and its environmental impact can be minimized by using earth abundant and non-toxic materials only and by full recyclability. PV already met an important milestone in March 2022 to show its potential: the total globally installed PV capacity reached 1 TWp (DC)!

To speed up the energy transition and reduce dependency on other continents, the EU announced new targets for PV with 320 GWp cumulative installed capacity in 2025 and 600 GWp installed capacity in 2030; a huge increase! Furthermore, many initiatives to re-start manufacturing PV in Europe are ongoing and plans for multi-GW factories have been made or are already being implemented. The European Solar Manufacturing Council (ESMC) has proposed at least 35 GWp manufacturing of PV in the EU by 2025 and 100 GWp manufacturing by 2030. The latter will correspond to about 15% of the global market.

To reach these ambitious goals as well as meeting the climate goals of 2050, technology development will be crucial. An efficiency of 35.9% was obtained by Fraunhofer ISE in 2021 with a hybrid multijunction solar cell consisting of a III-V top and middle cell combined with a silicon bottom cell. Recently 31.25% has been announced by EPFL/CSEM for a perovskite-silicon tandem demonstrating that efficiencies beyond 30% can be reached with low-cost materials and processing; another important milestone and confirming the huge progress made so far!

I am looking forward to hearing the latest results on novel technologies and therefore you are invited to share your results by submitting abstracts and presenting them during the conference. Like previous years, your contribution can be published in a regular journal to ensure global visibility. The conference topics cover the value chain from materials up to and including modules and cover aspects such as reliability, sustainability and circularity. Of course the progress made with tandems and multijunction PV devices with silicon bottom cells will have a prominent position in the conference programme.

Like previous editions, the nPV workshop will be coupled to SiliconPV with an overlapping day in the middle. The whole inspiring event will take place at the campus of Delft University of Technology, which is walking distance from the historical city center.

Looking forward to meeting you in person in Delft or online for the SiliconPV 2023 conference!

Arthur Weeber, Chairman SiliconPV 2023



Conference Program

Tuesday, April 11, 2023

09:00 - 09:20 **Opening Session**
Auditorium

09:00 **Welcome to SiliconPV 2023**
A. Weeber, TNO

09:20 - 10:30 **Highlight Session**
Auditorium

Chair: Arthur Weeber / Olindo Isabella

09:20 **Development and Upscaling of Monolithic Silicon/Perovskite Tandem Solar Cells**
R. Schlatmann, Helmholtz-Zentrum Berlin

09:50 **Interactions of Hydrogen Atoms with Boron and Gallium in Cz-Grown Si Crystals Co-Doped with Phosphorus and Acceptors**
T.O. Abdul Fattah¹, V.P. Markevich¹, J.A.T. De Guzman², J. Coutinho³, N.V. Abrosimov⁴, M.P. Halsall¹, A.R. Peaker¹

¹University of Manchester; ²Philippine Council for Industry, Energy, and Emerging Technology; ³University of Aveiro; ⁴Leibniz-Institut für Kristallzüchtung

10:10 **Process Influences on LeTID in Ga-Doped Silicon**
W. Kwapil¹, F. Maischner¹, Y. Jung², P. Saint-Cast³, J. Greulich³

¹University of Freiburg, Department for Sustainable Systems Engineering (INATECH); ²Institute of Engineering Research, Korea University; ³Fraunhofer Institute for Solar Energy Systems ISE

10:30 - 11:00 **Break**

11:00 - 12:30 **Session 2: Dopant Free / Novel Passivation Layers**
Auditorium

Chair: Meriç Firat / Franz Josef Haug

11:00 **Enhancement of NiOx/poly-Si Contact Performance by Insertion of Ultrathin Metallic Ni Interlayer**

S. Lange¹, B. Fett², Ö.S. Kabakli³, D. Adner¹, P. Schulze³, B. Herbig², C. Hagendorf¹, G. Sextl², K. Mandel²

¹Fraunhofer Center for Silicon-Photovoltaics CSP; ²Fraunhofer Institute for Silicate Research ISC; ³Fraunhofer Institute for Solar Energy Systems ISE

11:15 **Exploring Hafnium Oxide's Potential for Passivating Contacts**

A. Wratten¹, S. Pain¹, D. Walker¹, E. Khorani¹, T. Niewelt¹, N. Grant¹, J. Murphy¹

¹University of Warwick

- 11:30 **Highly Stable Strontium Fluoride as a Thickness-Tolerant Dopant-Free Electron-Selective Contact for Silicon Solar Cells**
W. Wang¹, L. Cai², L. Meng³, N. Chen¹, H. Wei¹, Y. Hong¹, Y. Chen¹, L. Zeng⁴
¹School of Physics, Sun Yat-sen University; ²Energy Technology Research Institute Co., Ltd for Guangzhou High-tech Zone; ³School of Materials Science and Engineering, Anyang Institute of Technology; ⁴School of Physics and Optoelectronic Engineering, Guangdong University of Technology
- 11:45 **PERC Solar Cells with Fully Passivated Rear Contact Enabled by Local Hole-Selective MoO_x/Ag**
H. Nasser¹, G. Altiner¹, F. Cambay Kuban², R. Turan¹
¹The Center for Solar Energy Research and Applications (ODTU-GUNAM), Middle East Technical University; ²KalyonPV Research and Development Center, Kalyon Gunes Teknolojileri Uretim A.S
- 12:00 **Interdigitated-Back-Contacted Silicon Heterojunction Solar Cells Featuring Novel MoO_x-Based Contact Stacks**
K. Kovačević¹, Y. Zhao¹, P. Procel¹, L. Cao¹, L. Mazzarella¹, O. Isabella¹
¹Photovoltaic Materials and Devices Group, Delft University of Technology
- 12:15 **Cu-Plated Bifacial Silicon Heterojunction Solar Cells With MoO_x as Hole Collector**
L. Cao¹, Y. Zhao¹, C. Han¹, P. Procel Moya¹, L. Mazzarella¹, R. Santbergen¹, M. Zeman¹, O. Isabella¹
¹Delft University of Technology
- 12:30 - 13:15 Lunch
- 13:15 - 15:00 Poster Session Tuesday**
- TUE - A - 01 **Hydrogen Thermal Activation in Poly-Si/SiO_x Based Passivating Contacts**
B. Uygun¹, H. Nasser¹, G. Altiner¹, E.H. Ciftpinar¹, H. Osman¹, S. Aslan¹, H.H. Canar¹, A.E. Kececi¹, R. Turan¹
¹The Center for Solar Energy Research and Applications (ODTU-GUNAM), Middle East Technical University
- TUE - A - 04 **LAB to FAB Nanocrystalline Silicon Layers for Single and Double Junction Solar Cells: From Materials Conception to Device Integration**
P. Vasquez¹, G. Masmitja¹, D. Munoz¹, A. Ozanne¹
¹CEA - INES

- TUE - A - 07 **Reduction of Scarce Materials in SHJ Solar Cells and Implications on the Low Light Performance in the Field**
S. Pingel¹, A. Steinmetz¹, M. Bivour¹, J. Huyeng¹, I. Voicu Vulcanean¹, W. Wolke¹, V. Georgiou-Sarlikiotis¹, H. Nagel¹, P. Schmid¹, K. Zimmermann¹, A. Krieg¹, D. Erath¹, T. Wenzel¹, F. Clement¹, J. Rentsch¹, J. Seif¹
Presented by A. Steinmetz¹
¹Fraunhofer ISE
- TUE - A - 10 **Tailoring of interface quality of MoOX/Si for Si solar cells**
A. Kumar¹, M. Dutta²
¹CSIR-National Physical Laboratory; ²National Institute of Solar Energy
- TUE - A - 13 **Blister Free PECVD Polysilicon Layers for Tunnel Oxide Passivated Contact (TOPCon) Solar Cells**
H. Osman¹, H. Osman², H. Nasser², M. Ghasemi², B. Uygun², E. Donercark², R. Turan²
¹ODTU-GUNAM; ²Middle East Technical University
- TUE - A - 16 **Surface Recombination Velocity of the Si/SiO_x Interface in Tunnel-Oxide Passivating Contacts**
F. Haug¹, S. Libraro¹, A. Morisset¹, C. Ballif¹
¹EPFL
- TUE - B - 01 **A Novel Method for Accurately Characterizing Selective Contact Resistivity**
D. Steyn¹, W. Nemeth², D. Young², P. Stradins², S. Agarwal¹
¹Colorado School of Mines; ²National Renewable Energy Lab
- TUE - B - 04 **On the General Current Dependence of the Distributed Series Resistance of Solar Cells: the Influence of the Base Resistivity**
J. Wagner¹, J. Carstensen¹, R. Adelung¹
¹University of Kiel
- TUE - B - 07 **Electrical Contact Solution for Measuring Back Contact Solar Cells**
N. Chen¹, R. Roescu¹, F. Buchholz¹, V.D. Mihailetchi¹
¹ISC Konstanz
- TUE - B - 10 **Analysis of Cell Degradation Using Public IV-Curve Data**
A. Schütt
CELLScan
- TUE - D - 01 **Analysis of the performance of mc-Si and CdTe modules under soiling conditions**
P. Ferrada¹, M. Escalona-Llaguno², A. Marzo³, G. López⁴
¹Centro de Desarrollo Energético Antofagasta (CDEA), Universidad de Antofagasta; ²Universidad Autónoma de Zacatecas; ³Departamento de Óptica, Universidad de Granada; ⁴Departamento de Ingeniería Eléctrica y Térmica, Universidad de Huelva

- TUE - D - 04 **Influence of Material Models on the Numerical Predictions of Thermomechanical Behavior of Silicon Photovoltaic Modules**
S.A. Al-Manaseer¹, J.P. Correia¹, S. Touchal¹
¹University of Strasbourg - ICube Laboratory
- TUE - D - 06 **Investigation of Degradation in 20-Year-Field-Exposed PV Modules From India by Cross-Characterization Using Electroluminescence Imaging and Thermography**
A. Pareek¹, R. Meena², R. Gupta²
¹Indian Institute of Technology Bombay; ²Indian Institute of Technology Bombay, India
- TUE - D - 07 **Performance Assessment of Cell-Separation Processes for Rear-Contact Solar Cells: Comparison of Indoor and Outdoor Measurements**
M. Turek¹, A.A. Abdallah², M. Meusel¹, C. Hagendorf¹
¹Fraunhofer CSP; ²Qatar Environment and Energy Research Institute (QEERI)
- TUE - D - 08 **Impact of Spectral Absorption and Heat Dissipation Mechanism of Each Optical Layer on Module Temperature**
Y. Yu¹, C. Feng¹, Y. Li¹, M. Li¹
¹Longi Green Energy Technology Co., Ltd.
- TUE - D - 09 **Structural Analysis for Maximum Solar Power of Soundproof Photovoltaics**
H. Jang
KU-KIST Green School Graduate School of Energy and Environment
- TUE - E - 01 **Design of an Optical Filter for Thermal Management of Photovoltaic Modules**
J.C. Ortiz Lizcano¹, I. Kaaya², H. Ziar¹, Y. Zhou¹, M. Zeman¹, O. Isabella¹
¹Delft University of Technology; ²Interuniversity Microelectronics Centre (IMEC)
- TUE - G - 01 **Optical Design Strategies for High-Efficiency Monofacial and Bifacial Four-Terminal Perovskite-Silicon Tandem Modules**
Y. Zhao¹, R. Santbergen¹, D. Zhang², S. Veenstra², G. Coletti², A. Weeber¹, M. Zeman¹, L. Mazzarella¹, O. Isabella¹
¹Delft University of Technology; ²TNO
- TUE - G - 04 **Optical Design of Perovskite/Silicon Tandem Solar Cells Applying Different Texture Combinations**
K. Bittkau¹, W. Duan¹, K. Ding¹
¹IEK5-Photovoltaik, Forschungszentrum Jülich GmbH
- TUE - H - 01 **Revisiting Silicon Solar Cells for Space - Electron Irradiation of TOPCon Si Solar Cells**
G. Li¹, X. Wang¹, P. Toth², G. Conibeer¹, B. Hoex¹
¹University of New South Wales; ²Extraterrestrial Power Ltd.

- TUE - H - 04 **Effect of Doping and Regeneration Process on LID and LeTID Mechanisms in B and Ga Doped p-type c-Si PERC Solar Cells in Industrial Production**
K. Celen¹, A. Kumtepe¹
¹ Kalyon PV
- TUE - H - 07 **Tracking Photovoltaic Systems at Mountain Heights**
M. Ilolov¹, F. Inagaki², A. Ilolov³, S. Kabirov⁴, J. Rahmatov¹
¹ Center of Innovative Development of Science and New Technologies/ NAS of Tajikistan; ² Graduate School of International Resource Sciences/ Akita University, Japan; ³ M.S.Osimi Tajik Technical University; ⁴ Ministry of Industry and New Technologies of Tajikistan
- TUE - H - 10 **Ito-Passivated Contacts on Low Temperature Phosphoric Acid-Based Crystalline Silicon Solar Cells: Structural, Optical, and Electrical Characterizations**
S. Sepeai
¹ Solar Energy Research Institute
- TUE - J - 01 **Excellent Passivation by PO_x/Al₂O₃ Stacks: Drawing Parallels Between Si and Ge Surfaces**
R. Theeuwes¹, W. Berghuis¹, B. Macco¹, E. Kessels¹
¹ Eindhoven University of Technology
- TUE - J - 04 **Stable Chemical Enhancement of Passivating HfO₂/Al₂O₃ Stacks Grown by Atomic Layer Deposition**
S. Pain¹, E. Khorani¹, A. Wratten¹, T. Niewelt¹, N. Grant¹, J. Murphy¹
¹ University of Warwick
- TUE - J - 07 **Implementation of Nanoimprinted Light Trapping Structure Into Si Heterojunction Solar Cells**
Y. Kurokawa¹, Y. Kimata¹, Y. Iseki¹, K. Gotoh¹, S. Miyamoto¹, R. Ozaki², K. Nakamura², Y. Ohshita², N. Usami¹
¹ Nagoya university; ² Toyota Technological Institute
- TUE - J - 10 **Optimization of Doped Layers for Totally Screen-Printed Interdigitated Back Contact Solar Cells**
E.H. Ciftpinar¹, A. Aliefendioglu¹, H.H. Canar¹, A.E. Kececi¹, R. Turan¹
¹ ODTU-GUNAM
- TUE - J - 13 **Influence of Inserting Intrinsic Poly-Si Layer Between SiO_x and Doped Poly-Si Layer on Passivating Contact Solar Cell**
H. Lee
¹ Department of Materials Science and Engineering, Korea University
- TUE - J - 16 **The Etching Methods to Control the Surface Morphology of Silicon Wafer for Spin Coating the Perovskite Thin Films on Silicon Sub-Cells**
J. Jeong
¹ Department of Department of Energy System Engineering, KU-KIST Green School, Korea University

15:00 - 16:00 Session 3: Module Characterization, Simulation and Annual Yield

Auditorium

Chair: Nils-Peter Harder /

15:00

Characterization of Mechanical Strength of Shingle Joints Using Die Shear Test

N. Abdel Latif¹, R. Lamsairhri¹, T. Roessler¹

¹Fraunhofer ISE

15:15

A Simple Approach for Module Temperature and Power Prediction

A. Schneider¹, J. Chochollek¹, T. Nierhoff¹

¹University of Applied Sciences Gelsenkirchen

15:30

Recent Advances in Crystalline Silicon Solar Cells with Integrated Power Electronics

D. van Nijen¹, P. Manganiello¹, Y. Mercimek¹, M. Muttillio¹, R. van Swaaij¹, M. Zeman¹, O. Isabella¹

¹Delft University of Technology

15:45

Lightly Doped Silicon Heterojunction Solar Cells in Relevant Field Conditions of Illumination and Temperature

A. Augusto

Dalarna University

16:00 - 16:30

Break

16:30 - 18:15 Session 4: Silicon Materials

Auditorium

Chair: Jan Schmidt / Giso Hahn

16:30

Understanding the Firing Cooling Ramp's Influence on Light and Elevated-Temperature-Induced Degradation in Silicon

B. Hammann¹, N. Assmann², J. Schön³, W. Kwapił³, F. Schindler¹, E.V. Monakhov², M.C. Schubert¹

¹Fraunhofer Institute for Solar Energy ISE; ²University of Oslo; ³University of Freiburg, Department of Sustainable Systems Engineering INATECH

16:45

Atomistic Level Study of the Defect Responsible for Light and Elevated-Temperature-Induced Degradation in Ga-Doped Czochralski Si Using Electron Paramagnetic Resonance

C. Mule¹, P.C. Taylor¹, A. Meyer¹, W. Nemeth², V. LaSalvia², M. Page², S. Agarwal¹, P. Stradins²

¹Colorado School of Mines; ²National Renewable Energy Laboratory

- 17:00 **Reducing Time and Costs of FT-IR Studies of Hydrogen Species in Si Wafers and Solar Cell Structures**
N. Aßmann¹, R. Søndernå², B. Hammann³, E. Monakhov¹
¹Centre for Materials Science and Nanotechnology, University of Oslo; ²Institute for Energy Technology; ³Fraunhofer Institute for Solar Energy ISE
- 17:15 **Investigation on the Long-Term Stability of AlO_x/SiN_y:H and SiN_y Passivation Layers During Illuminated Annealing at Elevated Temperatures**
F. Geml¹, S. Sanz¹, A. Herguth¹, G. Hahn¹, M. Mehler¹
Presented by M. Mehler¹
¹University of Konstanz
- 17:30 **Impact of Fast-Firing on LeTID in Ga-Doped Cz-Si**
M. Winter¹, D.C. Walter¹, J. Schmidt¹
¹Institute for Solar Energy Research Hamelin (ISFH)
- 17:45 **Correlation Study Between Letid Defect Density, Hydrogen and Firing Profile**
J. Simon¹, R. Fischer-Süßlin¹, P. Dufke¹, L. Kutschera¹, S. Roder², G. Hahn¹, A. Herguth¹
¹University of Konstanz; ²Fraunhofer Institute of Solar Energy Systems ISE
- 18:00 **Surface Examination of Structure Loss in N-type Czochralski Silicon Ingots**
R. Hendawi¹, E. Johannes Øvrelid², G. Stokkan², M. Di Sabatino¹
¹NTNU; ²SINTEF industry

Wednesday, April 12, 2023

08:30 - 10:15 Session 5: Cell Characterization

Auditorium

Chair: Sébastien Dubois / Bram Hoex

- 08:30 **Simultaneous Measurement of Charge Carrier Density, Mobility and Lifetime**
D. Krisztián¹, F. Korsós¹
¹ Semilab Co. Ltd.
- 08:45 **LeTID Stability Tests on Gallium-Doped Industrial PERC Cells and Wafers**
T. Niewelt¹, F. Maischner², E. Khorani¹, Y. Jung³, S. Pain¹, M. Frosch⁴, N.E. Grant¹, W. Kwapil⁴, P.P. Altermatt⁵, J.D. Murphy¹
¹ University of Warwick / School of Engineering; ² Fraunhofer ISE; ³ Institute of Engineering Research, Korea University; ⁴ University of Freiburg; ⁵ Trina Solar
- 09:00 **Properties of Engineered Pinholes in Passivating Contacts Formed by Local Dielectric Etching**
H. Guthrey¹, C. Lima Salles², W. Nemeth¹, S. Agarwal³, D. Young¹, P. Stradins¹
¹ National Renewable Energy Laboratory; ² National Renewable Energy Laboratory / Colorado School of Mines; ³ Colorado School of Mines
- 09:15 **Improved Determination and Simulation of the Surface Recombination Parameter JOs**
B. Hammann¹, B. Steinhauser¹, A. Fell¹, R. Post¹, T. Niewelt¹, W. Kwapil², A. Wolf¹, A. Richter¹, H. Höffler¹, M.C. Schubert¹
¹ Fraunhofer Institute for Solar Energy ISE; ² University of Freiburg, Department of Sustainable Systems Engineering INATECH
- 09:30 **Implied Open-Circuit Voltage Imaging of Solar Cells and Cell Precursors: Single Bandpass Filter Method**
A. Mahboubi Soufiani¹, R. Lee-Chin¹, P. Fassl², M.A. Mahmud³, M.E. Pollard¹, J. Zheng³, J.W. Weber¹, A. Ho-Baillie³, T. Trupke¹, Z. Hameiri¹
¹ University of New South Wales; ² Karlsruhe Institute of Technology; ³ The University of Sydney
- 09:45 **Automated Classification of Electroluminescence Images Using Artificial Neural Networks in Correlation to Solar Cell Performance Parameters**
M. Turek¹, M. Meusel¹
¹ Fraunhofer CSP
- 10:00 **Tracking H During Poly-Si/SiO_x Contact Fabrication: an IR Spectroscopy Analysis of Si-H Bond Configurations**
V. Bocquet¹, R. Cabal¹, M. Albaric¹, N. Rochat², R. Ramos¹, J. Barnes², S. Dubois¹
¹ CEA-INES; ² CEA Grenoble

10:15 - 10:45 Break

10:45 - 12:00 Session 6: Tandem Technologies

Auditorium

Chair: Rutger Schlatmann / Gianluca Coletti

10:45

**Impact of Top Cell Degradation and Current Mismatch
in Two and Three-Terminal Perovskite-Silicon Tandem
Solar Cells**

P. Wagner¹, P. Tockhorn¹, S. Hall¹, S. Albrecht¹, L. Korte¹

¹ Helmholtz-Zentrum Berlin für Materialien und Energie

11:00

**Atomic Layer Deposition of NiO for Monolithic Tandem
Perovskite/Silicon with an Industrial Standard PERC
Cell**

N. Phung¹, D. Zhang², C. van Helvoirt¹, M. Verhage¹, M.
Verheijen¹, V. Zardetto², F. Bens², L.J.(. Geerligts³, W.M.M.(.
Kessels¹, B. Macco¹

¹ Eindhoven University of Technology; ² TNO Partner in Solliance; ³ TNO

11:15

**Both Side TOPCon Solar Cells: Towards a Lean Process
Flow for Si Bottom Solar Cell**

J. Seif¹, J. Polzin¹, M. Bories¹, M. Hermle¹, M. Bivour¹

¹ Fraunhofer ISE

11:30

**Optical Simulation-Assisted Design and Optimization of
SHJ Bottom Subcells for High-Efficiency Monolithic
Perovskite-Silicon Tandem Solar Cells**

Y. Zhao¹, M. Fardousi¹, R. Santbergen¹, K. Datta², A. Bracesco²,
D. Zhang², A. Weeber¹, M. Zeman¹, L. Mazzarella¹, M. Creatore²,
R. Janssen², O. Isabella¹

¹ Delft University of Technology; ² Eindhoven University of Technology

11:45

**Niox Films by Industrial Inline Sputtering for
Perovskite-Silicon Tandem Solar Cells: Optical and
Electrical Properties**

G. Masmijà¹, E. Bruhat², P. Carroy², R. Köhler³

Presented by P. Carroy²

¹ Universitat Politècnica de Catalunya (UPC); ² National Institute for Solar
Energy (CEA-INES); ³ Von Ardenne GmbH

12:00 - 12:45 Lunch

12:45 - 14:30 Poster Session Wednesday

WED - A - 02

**Localization of Front Side Passivating Contacts for
Direct Metallization of High-Efficiency C-Si Solar Cells**

J. Humi¹, A. Morisset¹, S. Libraro¹, E. Genç¹, F. Haug¹, C. Ballif¹

¹ EPFL - PV lab

- WED - A - 05 **Key Aspects of p-Type TOPCon on Textured Surface for Silicon Bottom Cells in Tandem Devices**
J. Polzin¹, K. Krieg¹, A. Richter¹, S. Kluska¹, J. Benick¹, M. Hermle¹
¹Fraunhofer Institute for Solar Energy Systems ISE
- WED - A - 08 **Metal-Complex Inks for Lower Cost and Improved Passivation for Silicon Photovoltaic Metallization**
D. Young¹, M. Page¹, W. Nemeth¹, M. Kaupa¹, S. Theingi¹, P. Stradins¹, M. LeMieux²
¹NREL; ²Electroninks Incorporated
- WED - A - 11 **Thermal Annealing Effects on Passivation Properties in Tunnel Oxide Passivated Hole-Selective Contacts**
Y. Kim¹, I.S. Kweon², K.H. Min¹, S.H. Lee¹, S. Choi¹, K.T. Jeong¹, S. Park¹, H. Song¹, H. Song¹, M.G. Kang¹
¹Korea Institute of Energy Research; ²Chungbuk National University
- WED - A - 14 **Ex-situ Phosphorus Doped Polysilicon/SiO_x Passivating Contacts for Application in Single-Junction and Tandems Solar Cells**
A. Chaudhary¹, E.P. Wete¹, T. Schmid¹, A. Causevic¹, R.Z. Gottwick¹, M. Saliba¹, S. Essig¹
¹Institut für Photovoltaik (ipv), University of Stuttgart
- WED - A - 17 **Dopant-Free Carrier-Selective Contacts for Si Heterojunction Solar Cells**
M. Della Noce¹, E. Bobeico¹, L. Lancellotti¹, L.V. Mercaldo¹, I. Usatii¹, P. Delli Veneri¹
¹ENEA Portici Research Center
- WED - A - 19 **Annealing-Free, Electron-Selective Ohmic Contacts Using Zirconium Oxide and Aluminum for n-type Crystalline Si Solar Cells**
L.A.M.K. Madbouly
¹Middle East Technical University
- WED - B - 02 **Numerical Analysis of Three Terminal Perovskite/Silicon Tandem Using Sentaurus TCAD**
P. Procel Moya¹, M. Al-Zoubi¹, M. Vogt¹, Y. Blom¹, R. Santbergen¹, O. Isabella¹
¹TuDelft
- WED - B - 05 **Injection-Dependent Carrier Lifetime Analysis Method of Silicon Solar Cells for Industrial Applications**
S.H. Lee¹, K.H. Min¹, S. Choi¹, H. Song¹, M.G. Kang¹, K.T. Jeong¹, T. Kim²
¹Korea Institute of Energy Research; ²Hyundai Energy Solution

- WED - B - 08 **Current-Detecting Atomic Force Microscopy for Applications in Si-Based Photovoltaics**
M. Hývl
Institute of Physics, Czech Academy of Sciences
- WED - C - 01 **Demonstration and Validation of Silicon LIPV Products**
F. Colberts¹, A. Bondt, de², J. Boumans¹, L. Boumans¹, A. Kingma³, K. Plug⁴, C. Mass-Protzen¹, D. Roosen³, J. Simons¹, Z. Vroon⁵
¹Zuyd University; ²SolaRoad B.V.; ³TNO Solliance; ⁴Strukton; ⁵Zuyd University and TNO
- WED - D - 02 **Unveiling the Potential of Electroluminescence Characteristics in Investigating Different Types of Defects and Degradations in C-Si PV Module**
R. Kumar¹, R. Kumar¹, R. Gupta¹
¹Indian Institute of Technology Bombay
- WED - D - 05 **Analytical Extraction of PV Modules' Electric Parameters in the Lima's "Donkey's Belly" Sky in Peru**
M.Á. Sevillano Bendezú¹, J.A. Palomino Töfflinger¹, J.d.l. Casa Higuera²
¹Pontificia Universidad Católica del Perú; ²Universidad de Jaén
- WED - E - 04 **Influence of Industrial Activity and Coastal Climate on Module Soiling in Northern Chile**
D. Olivares¹, A. Taquichiri¹, R. Espinoza¹, P. Ferrada¹, E. Fuentealba¹, A. Marzo²
¹University of Antofagasta; ²University of Granada
- WED - F - 01 **Fabrication of Silicon Heterojunction Solar Cells Using an In-House Built Hot-Wire (HW) CVD Cluster Tool**
K. Singh¹, A. Kumbhar¹, N. Wadibhasme¹, A. Mandal¹
¹Indian Institute of Technology Bombay
- WED - G - 02 **Passivating Silicon Tunnel Junctions for Pk/Si Tandems: New Insights Into the Subcells Interface Properties**
B. Marteau¹, T. Desrues¹, J. Ditsougou¹, D. Mariolle², F. Saint Antonin³, A. Kaminski⁴, Q. Rafhay⁴, S. Dubois¹
¹CEA INES; ²CEA LETI; ³CEA LITEN; ⁴IMEP LAHC
- WED - G - 05 **CIGSu/Si Tandem Solar Cells With PERT Si Bottom Cell Including a c-Si Tunnel Junction**
T. Charif¹, E. Fourmond², A. Fave²
¹Institut des Nanotechnologies de Lyon (INL- UMR 5270); ²Univ. Lyon, INSA Lyon, CNRS, Ecole Centrale de Lyon,
- WED - H - 02 **Influence of AlOx Interlayers on LeTID Kinetics in Ga-Doped Cz-Si**
J. Kamphues¹, A. Schmid¹, R. Fischer-Süßlin¹, G. Hahn¹, F. Geml¹
¹University of Konstanz

- WED - H - 05 **Influence of Different Post Porosification Cleaning Steps on the Parameters of Porous Silicon Layer Stack**
S. Sanz¹, Y.P. Botchak Mouafi¹, G. Micard¹, G. Hahn¹, B. Terheiden¹
¹ University of Konstanz
- WED - H - 08 **Silicon Quantum Dots Preparation and Its Preliminary Application on Silicon Solar Cells**
R. Chen
¹ SZTU
- WED - H - 11 **The Selection of the Inductor Optimal Design for Electromagnetic Stirring of Silicon Melt**
S. Karabanov¹, D. Suvorov¹, D. Tarabrin¹, E. Slivkin¹, G. Gololobov¹, M. Reginevich¹
¹ Ryazan State Radio Engineering University
- WED - H - 13 **Effect of Phosphorus Gettering Process on Light Induced Degradation of p-Type Mono Silicon Wafers with Various Base Resistivity and Dopant Types**
S. Aslan¹, V. ÖZYAHNI¹, A.E. KEÇECİ¹, H.H. CANAR¹, S.K. BÜTÜNER¹, H. ASAV¹, S. SEYREK¹, G. BEKTAŞ¹, N. YILDIRIM², B. ARIKAN¹, R. TURAN¹
¹ ODTÜ-GÜNAM; ² KalyonPV R&D Center
- WED - J - 02 **Impact of Al₂O₃/IZO Double-Layer Antireflective Coating on the Front Side of Rear Emitter Silicon Heterojunction Solar Cell.**
M.A. Zahid¹, S. Park¹, Y. Kim¹
¹ Sungkyunkwan University
- WED - J - 05 **Mechanism of Hydrogen Passivation in Passivated Contact Si Solar Cells**
S. Mitra¹, M.B. Hartenstein², H. Guthrey¹, W. Nemeth¹, S. Agarwal¹, D. Young¹
¹ NREL; ² Colorado School of Mines
- WED - J - 08 **Practical Jsc Limits for Silicon Heterojunction Devices: Insights from Modelling**
E. Spaans¹, S. Venkataraj², A. Aberle², N. Nampalli²
¹ National University of Singapore; ² Solar Energy Research Institute of Singapore
- WED - J - 11 **Exceptional Surface Passivation of C-Si Utilizing Organic Superacids**
M. Ghasemi¹, K. Tsoi¹, G. Bektas¹, S. Yerci¹, E.G. Gunbas¹
¹ ODTU-GUNAM

WED - J - 14 **Tuning the Optical and Material Properties of Hot-wire CVD Deposited Multi-layer [a-Si:H/a-SiN:H] for Application as the Front Side in IBC SHJ Solar Cells**
K. Singh¹, A. Kumbhar¹

¹Indian Institute of Technology Bombay

WED - J - 17 **Impact of Thickness, Refractive Index and Diffusion Length of Minority Carriers on Antireflection Materials: Study on the Spectral Response of a Monocrystalline Silicon Solar Cell.**
M. Nacire

¹University: Science Faculty

14:30 - 16:00 **Session 7: Module Reliability and Processing** **Auditorium**

Chair: Robby Peibst / tbc

14:30 **Dynamics of BS-Driven Insulation Issues**
C. Buerhop Lutz¹, O. Stroyuk², L. Luer³, M. Peters²

¹Forschungszentrum Jülich GmbH, HI ERN; ²HI ERN; ³Friedrich - Alexander - Universität Erlangen - Nürnberg (FAU)

14:45 **Design Aspects Considering Hotspot Phenomena in Modern High-Performance Silicon Photovoltaic Modules**
C. Reichel

¹Fraunhofer Institute for Solar Energy Systems (ISE)

15:00 **Screen-Printed Front Side Al Metallization: Requirements on Solder Pad Design**
H. Schulte-Huxel¹, T. Daschinger¹, B. Min¹, T. Brendemuehl¹, M. Brinkmann¹, R. Peibst¹, R. Brendel¹

¹Institute for Solar Energy Research in Hamelin (ISFH)

15:15 **Comparing the Role of Na⁺ in Damp Heat-Induced Failure in Bifacial Silicon HJT, PERS and TOPCon Cells**
C. Sen¹, X. Wu¹, H. Wang¹, M.U.K. Khan¹, L. Mao², J. Jaubert², F. Jiang², G. Zhang², C. Chan¹, B. Hoex¹

Presented by B. Hoex¹

¹UNSW Sydney; ²CSI Solar Co. Ltd.

15:30 **Increasing the Speed of Potential-Induced Degradation (PID) Testing at the Cell-Level by Two Orders of Magnitude Using a Salt-Enriched Hybrid Polymer**
M.U. Khan¹, C. Sen¹, C. Chan¹, Y. Wu², R. Lv², J. Jaubert², G. Zhang², B. Hoex¹

¹University of New South Wales (UNSW); ²CSI Solar Co. Ltd

15:45 **PID Evaluation of Transparent Backsheet Modules**
J. Dupuis¹, R. Bodeux², C. Abdel Nour¹, P. Lefillastre³, A. Becker³

¹EDF R&D; ²EDF R&D – IPVF; ³EDF Renouvelables

16:00 - 16:30 Break

16:30 - 18:15 Session 8: Process Technologies / Back-Contacted Solar Cells

Auditorium

Chair: Barbara Terheiden / tbc

16:30

Thermal Laser Separation and Edge Passivation for TOPCon Shingle Solar Cells

E. Lohmüller¹, P. Baliozian², M. Hofmann¹, L. Gutmann¹, L. Kniffki¹, A. Richter¹, J. Geng³, L. Wang⁴, R. Dunbar⁴, A. Lepert⁴

¹Fraunhofer ISE; ²VDMA Photovoltaic Equipment; ³Plasma Electronic GmbH; ⁴Solaria Corporation

16:45

Self-Aligned Laser Opening and Stencil Metallisation for Silver-Free Contacts in Silicon Solar Cells

Y. Xiong

University of Oxford

17:00

Edge Passivation of Shingled Poly-Si/SiO_x Passivated Contacts Solar Cells

F. Dhainaut¹, M. Albaric¹, T. Desrues¹, B. Martel¹, R. Dabadie¹, B. Marie¹, G. Lefevre², S. Dubois¹, O. Palais³

¹CEA-INES; ²CEA-LITEN / DTNM / STDC / LCAE; ³Aix Marseille Univ. Université de Toulon, CNRS, IM2NP

17:15

Contact Resistivity Breakdown in Fired Passivating Contacts

S. Libraro¹, A. Morisset¹, J. Hurni¹, L. Antognini¹, C. Ballif¹, A. Hessler-Wyser¹, F. Haug¹

¹Photovoltaics and Thin Films Laboratory - PV-Lab, École Polytechnique Fédérale de Lausanne

17:30

In-Stable Efficiency Improvement Affected by Iron Contamination in P-Type Back Contact Solar Cell

X. Meng¹, B. Yu¹, J. Fan¹, M. Deng¹, G. Xing¹

¹Tongwei Solar(Chengdu)Co. Ltd

17:45

Integration of Photonic Crystals in Highly Efficient POLO²-IBC Cells – Interplay between Structural, Optical and Electrical Properties

M. Rienäcker¹, J. Maksimovic², Y. Larionova¹, S.H. Ng², T. Katkus², T. Pinedo Rivera³, M. Stuibler³, J. Krügener⁴, F. Haase¹, R. Brendel¹, S. John⁵, S. Juodkazis², R. Peibst¹

¹Institute for Solar Energy Research Hamelin (ISFH); ²Swinburne University of Technology; ³Melbourne Centre for Nanofabrication; ⁴Institute for Electronic Materials and Devices, Leibniz Universität Hannover; ⁵Department of Physics, University of Toronto

18:00 **Fabricating High Aspect Ratio Front Contacts for Solar Cells by String-Printing**
R. Saive¹, M. Van de Voorde¹, J. Andersons¹
¹University of Twente

19:00 - 19:15 Conference Dinner

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Thursday, April 13, 2023

08:30 - 08:45 Opening Session nPV 2023

Auditorium

08:30

Welcome to nPV Workshop 2023

O. Isabella, Delft University of Technology

08:45 - 10:15 Session 9: Silicon Hetero Junction Solar Cells

Auditorium

Chair: Perrine Carroy / Gizem Nogay

08:45

Strategies for Realizing High-Efficiency Silicon Heterojunction Solar Cells Featuring Reduced Consumption of Indium and Silver

Y. Zhao¹, P. Procel¹, C. Han¹, L. Mazzarella¹, L. Cao¹, R. Santbergen¹, K. Kovačević¹, A. Weeber¹, M. Zeman¹, O. Isabella¹

¹Delft University of Technology

09:00

Organically Modified Silica Aerogel as Rear Reflector in Silicon Heterojunction Solar Cells

D. Koçak¹, K. Tsoi², D. Türkay³, M. Koç², E. Dönerçark², H. Budunoğlu⁴, R. Turan²

¹Middle East Technical University; ²ODTÜ-GÜNAM; ³Ecole Polytechnique Fédérale de Lausanne; ⁴ASELSAN

09:15

Feasibility Test of Drastic Indium Cut Down in SHJ Solar Cells and Modules Using Ultra-Thin ITO Layers

T. Gageot¹, J. Veirman¹, F. Jay¹, D. Munoz-Rojas²

¹CEA-INES; ²INP-LMGP

09:30

Method of Contact Resistivity Extraction at Typical Operating Conditions for Heterojunction Solar Cell

S. Zogbo¹, W. FAVRE¹, M. GUEUNIER-FARRET², O. BONINO¹

¹CEA-INES Liten, Université Genobles Alpes; ²Université de Bordeaux

09:45

Nanocrystalline Silicon Layers for Industrial Application in Silicon Heterojunction Solar Cells

J. Seif¹, I. Koc¹, D. Kurt¹, I. Voicu Vulcanean¹, S. Pingel¹, A. Steinmetz¹, M. Hermle¹, M. Bivour¹

Presented by A. Steinmetz¹

¹Fraunhofer ISE

10:00

Identifying and Overcoming the Passivation-Carrier Extraction Trade-Off in Transparent Passivating Contacts

A. Eberst¹, B. Xu¹, W. Duan¹, A. Lambertz¹, U. Rau¹, K. Ding¹

¹IEK-5 Photovoltaics, Forschungszentrum Jülich GmbH

10:15 - 10:45

Break

10:45 - 12:15 Poster Session Thursday

- THU - A - 03 **Investigation of Contact Resistivities on APCVD (p) Poly-Si for Fired Passivating Contacts**
T. Okker¹, R. Glatthaar¹, F. Huster¹, G. Hahn¹, B. Cela Greven², S. Seren³, B. Terheiden¹
¹Universität Konstanz; ²Fenzi Advanced Glass Technologies Netherlands BV; ³Schmid Group | Gebr. Schmid GmbH
- THU - A - 06 **Sputtered Poly-Si Layers for the Formation of Front and Rear Passivating Contacts of PVK/Si Tandem's Bottom Cells**
A. Descoedres¹, C. Allebé¹, P. Wyss¹, N. Pernès¹, A. Walter¹, Q. Jeangros¹, C. Ballif¹, B. Paviet-Salomon¹
Presented by G. Nogay²
¹CSEM; ²PV-Center, Centre Suisse d'Électronique et de Microtechnique (CSEM)
- THU - A - 09 **Plasma-Assisted N₂O Oxidation (PANO) in an Industrial Direct Plasma Reactor for Tunnel-Oxide Passivating Contacts**
M. Bories¹, J. Polzin¹, B. Steinhauser¹, M. Bivour¹, J. Benick¹, M. Hermle¹, S. Glunz¹
¹Fraunhofer Institute for Solar Energy Systems ISE
- THU - A - 12 **Incorporating ALD Oxide Interlayers for Carrier-Selective Passivating Contacts**
E. Khorani¹, C. Messmer², S. Pain¹, T. Niewelt¹, B. Healy¹, A. Wratten¹, M. Walker¹, N. Grant¹, J. Murphy¹
¹University of Warwick; ²Fraunhofer Institute for Solar Energy Systems ISE
- THU - A - 15 **SiC by PECVD for High-Temperature Passivating Contacts**
E. Genç¹, A. Morisset¹, J. Hurni¹, S. Libraro¹, C. Ballif¹, F. Haug¹
¹EPFL-PVLAB
- THU - A - 18 **Silver-Lean Screen-Printed Contacts With a Hybrid Metallization Design for Sustainable PV at the TW Scale**
Y.A. Chang¹, L. Wang¹, H. Wang¹, C. Huang¹, Y. Zhang¹, S. Wang¹, R. Chen¹, C. Chan¹, B. Hallam¹
¹University of New South Wales
- THU - A - 20 **Influence of Firing Profile on Passivating Contacts for High Efficient Silicon Solar Cells**
Y. Cho¹, J.S. Park¹, S. Park¹, Y.J. Kim¹, D. Kim¹, K.H. Im¹, S.H. Lee¹, K.T. JEONG¹, M.G. Gang¹
¹Korea Institute of Energy Research

- THU - B - 03 **Fast Photoluminescence Imaging of Interdigitated Back-Contacts Prepared on Rough Silicon Substrates**
M. Ledinsky¹, R. Dvorak¹, R. Hlavac¹, S. Banerjee¹, A. Fejfar¹
¹Institute of Physics, AS CR
- THU - B - 06 **Minimizing the Cycle Time for a Rapid Quantum Efficiency Measurement by Modulating Multiple Channels of Led Solar Simulators**
M. Turek¹, M. Meusel¹
¹Fraunhofer CSP
- THU - B - 09 **Impacts of Cut Cells and Full Cells on the Performance of Photovoltaic Solar Cells and Modules**
M. Çalışkan Arslan¹, B. Aydoğan¹, H. Duman¹
¹Kalyon PV Güneş Teknolojileri Üretim AŞ.
- THU - D - 03 **Calculation Tool to Determine the Shading Tolerability of PV Modules**
A. Alcañiz¹, N. Rukhshi¹, M. Dallapiccola², M. Zeman¹, O. Isabella¹, H. Ziar¹
¹Delft University of Technology; ²Eurac Research
- THU - E - 03 **Advanced Determination of Temperature Coefficients of Photovoltaic Modules by Field Measurements**
A. Schneider¹, J. Chochollek¹, T. Nierhoff¹
¹University of Applied Sciences Gelsenkirchen
- THU - E - 05 **Heterojunction Bifacial Technology for High Irradiance Regions**
E. Urrejola¹, D. Munoz²
¹ATAMOSTEC; ²CEA – INES
- THU - E - 06 **Tracking Algorithms for Improving Bifacial Modules Energy Yield with Albedo Enhance Materials and Agrivoltaics**
J. Guerrero-Perez¹, A. Ros Gómez¹
¹Soltec Innovations
- THU - G - 03 **Detailed Comparison of Loss Distribution in Monofacial and Bifacial Perovskite/Silicon Tandem PV Systems**
Y. Blom¹, M.R. Vogt¹, C.M.R. Tobon¹, R. Santbergen¹, O. Isabella¹, M. Zeman¹
¹Delft University of Technology
- THU - H - 03 **Gallium-doped Silicon Heterojunction Solar Cells**
B. Vicari Stefani¹, B. Hallam², A. Soeriyadi², M. Wright³, D. Andronikov⁴, I. Nyapshaev⁴, A. Sergey⁴
¹CSIRO; ²UNSW; ³University of Oxford; ⁴Hevel Solar

- THU - H - 06 **SMART Cast-Mono Silicon for High Efficiency TOPCon Cells**
P. Krenckel¹, S. Mack¹, J. Stegmaier¹, A. Steinmetz¹, T. Trötschler¹, S. Riepe¹
Presented by S. Riepe¹
¹Fraunhofer Institute for Solar Energy Systems ISE
- THU - H - 09 **Optical Analysis of Perovskite/Silicon Tandem Solar Cells: Effect of Rear Side Grating and TOPCon Tunnel Junction**
M. Hanser¹, A. Richter¹, B. Bläsi¹, O. Höhn¹, J. Benick¹
¹Fraunhofer ISE
- THU - H - 12 **Si Substrate Dependent-Surface Defects on p-Poly Layers in the p-TOPCon Solar Cells**
D. Kim¹, Y. Kim¹, M. Lee¹, J.S. Yun¹, K. Im¹, S.H. Lee¹, Y. Cho¹, K.T. Jeong¹, S. Park¹, M.G. Kang¹, H. Song¹
¹Korea Institute of Energy Research
- THU - H - 14 **Application of Ag-Coated Polymer-Particle Composites as Transparent Conductive Adhesives for Tandem Solar Cells**
H. Yousof¹, M.Q. Khokhar¹, M.A. Zahid¹, S. Park¹, S. Sanyal¹, Y. Kim¹
¹Sungkyunkwan University
- THU - J - 03 **Toward TCO-Free Silicon Heterojunction Solar Cells - Revisiting the Role of TCO Layers in Electrical Transport and Stability**
H. Sai¹, T. Matsui²
¹Multijunction PV Team, Global Zero Emission Research Center (GZR); ²National Institute of Advanced Industrial Science and Technology
- THU - J - 06 **Effective Contact Formation of Crystalline Silicon Solar Cells by Current Injection Methods**
S. Bae¹, D. Choi², D. Kim²
¹Korea Institute of Energy Research; ²Korea University
- THU - J - 09 **Impact of Texture Height and Ozone-Based Rounding on Silicon Heterojunction Solar Cells Performance**
P. Sansoldo
Fraunhofer Institute for Solar Energy Systems (ISE)
- THU - J - 12 **Investigation of the Microstructure of Underdense Hydrogenated Amorphous Silicon Layers by Raman Spectroscopy and Hydrogen Effusion**
B. Fischer¹, W. Beyer¹, A. Lambertz¹, M. Nuys¹, W. Duan¹, K. Ding¹
¹Forschungszentrum Jülich GmbH

- THU - J - 15 **Optimization of Laser Parameters for Ablation of PECVD SiN_x:H and Removal of Laser Induced Surface Damages on Silicon by Alkaline Solution**
A.E. Keçeci¹, V. Özyahni¹, Y.M. Kaplan¹, M. Korkmaz Arslan¹, S. Aslan¹, H. Asav¹, H.H. Canar¹, G. Çelik¹, G. Bektaş¹, R. Turan¹
¹ODTÜ-GÜNAM
- THU - J - 18 **Optimisation of Photolithographic Fabrication of Photonic Crystals on Rough Wafers for High Efficiency Solar Cells**
L. Salomon¹, R. Peibst², M. Rienäcker², J. Krügener¹
¹Institute of Electronic Materials and Devices, Leibniz University Hannover;
²Institute for Solar Energy Research in Hamelin
- THU - K - 03 **Renewable Energy Application and Carbon Reduction Study on the Campus Teaching Building**
J. He¹, Y. Luo¹, H. Chen¹
¹ShenZhen Technology University
- 12:15 - 13:00 Lunch
- 13:00 - 14:30 Session 10: Poly-Si Passivating Contacts**
Auditorium
Chair: Stefan Glunz / Luana Mazzarella
- 13:00 **Locally Enhanced Doping Under Poly-Si Passivating Contacts**
M. Firat¹, L. Wouters², P. Lagrain², F. Haase³, J. Polzin⁴, A. Chaudhary⁵, G. Nogay⁶, T. Desrues⁷, J. Krügener⁸, R. Peibst⁹, L. Tous¹⁰, H. Sivaramakrishnan Radhakrishnan², J. Poortmans¹¹
¹KU Leuven/imec (Work done at KU Leuven/imec, the author currently affiliated with Oxford PV); ²Imec; ³ISFH; ⁴Fraunhofer ISE; ⁵ISC-Konstanz (Work done at ISC Konstanz, author currently affiliated with University of Stuttgart); ⁶CSEM; ⁷Université Grenoble Alpes, CEA, LITEN, DTS, LPA; ⁸Leibniz University Hannover, Institute of Electronic Materials and Devices; ⁹ISFH/Leibniz University Hannover; ¹⁰imec (Work done at imec, the author currently affiliated with AGC Glass Europe); ¹¹Imec/KU Leuven/Hasselt University
- 13:15 **Influence of the Annealing Temperature of (n) poly-Si/SiO_x Passivating Contacts on their Firing Stability**
J. Linke¹, J. Hoß¹, F. Buchholz¹, J. Lossen¹
¹ISC Konstanz e.V.
- 13:30 **Improvement of Passivation Performance of Silicon Nanocrystal/Silicon Oxide Compound Layer by Two-Step Hydrogen Plasma Treatment**
M. Matsumi¹, K. Gotoh¹, M. Wilde², Y. Kurokawa¹, K. Fukutani²
Presented by N. Usami¹
¹Graduate School of Engineering, Nagoya University; ²Institute of Industrial Science, The University of Tokyo

- 13:45 **Low Resistivity Hole Selective SiNx/p+ poly-Si Passivating Contacts for High Efficiency Solar Cells**
S. McNab¹, A. Morisset², E. genc², F. Haug², M. Wright¹, P. Altermatt³, P. Wilshaw¹, S. Bonilla¹
¹ University of Oxford; ² EPFL STI IEM PV-LAB; ³ Trina Solar
- 14:00 **Impact of Doping Type and Thermal Budget on Long-Term Stability of Poly-Si Passivating Contacts**
A. Morisset¹, A. Ingenito¹, F. Haug¹, C. Ballif¹
¹ EPFL PV-Lab
- 14:15 **Towards >25% Efficiency of Passivated-Contact Solar Cells in Mass Production**
B. Lee¹, F. Fertig¹, M. Fischer¹, I. Höger¹, S. Hörnlein¹, E. Jarzembowski¹, M. Junghänel¹, M. Kauert¹, K. Kim¹, A. Mette², J.W. Müller¹, S. Peters², K. Petter¹, M. Schaper¹, S. Schulz¹, M. Schütze¹, A. Weihrauch¹
¹ Hanwha Q CELLS GmbH; ² Hanwha Q Cells
- 14:30 - 15:00 Closing SiliconPV 2023**
Auditorium
Chair: Arthur Weeber / Sébastien Dubois
- 14:30 **Closing SiliconPV 2023**
A. Weeber, TNO
- 14:40 **SiliconPV Award Ceremony for the Best 10 Abstracts and the Best Posters**
A. Weeber, TNO
- 14:50 **Announcement of SiliconPV 2024**
A. Weeber, TNO
- 15:00 - 15:30 **Break**
- 15:30 - 19:00 Technical Tour**
- 19:00 - 20:30 TGV- Get-Together**
The Green Village - Co Creation Center

Friday, April 14 2023

08:45 - 08:50 **Opening Session Friday**

Auditorium

Chair: Olindo Isabella

08:45 **Summary of nPV R&D Day / Outlook of nPV Industry Day**

O. Isabella, Delft University of Technology

4

08:50 - 10:10 **Session 11: Silicon-related Material and Market Trends**

Auditorium

Chair: Barbara Terheiden / Jan Schmidt

08:50 **Wafer Formats and Trends in the Market**

J. Zhao, CSEM SA

09:10 **Ingots Production at Norwegian Crystals**

M. Peschke, Norwegian Crystals

09:30 **Market Trends in n-type c-Si PV Technology**

S. Chunduri, TaiyangNews

09:50 **Sputtered poly-Si for c-Si Solar Cells Applications**

E. Schneiderlöchner, VON ARDENNE GmbH

10:10 - 10:40 **Break**

10:40 - 12:00 **Session 12: Advanced Production Technologies**

Auditorium

Chair: Robby Peibst / Olindo Isabella

10:40 **Latest Industrial Results from RENA**

D. Brunner, Rena Technologies GmbH

10:55 **Thermal AP Gas Etching Process for Selective Poly-Si Removal**

L. Clochard, Nines Photovoltaics

11:15 **Reactive Plasma Deposition of TCOs**

Q. Chen, ChinaSC

11:35 **Conductive Copper Pastes and ECAs for Lower Costs and Improved Sustainability of PV Metallization**

O. Shochet, Copprint

12:00 - 13:00 **Lunch**

13:00 - 14:20 **Session 13: Solar Cells Production**

Auditorium

Chair: Gizem Nogay / Stefan Glunz

- 13:00 **Record Silicon Heterojunction Solar Cells**
C.X. Xu, LONGi
- 13:20 **Record TOPCon Solar Cells**
X. Zhang, Zhejiang Jinko Solar Co. Ltd
- 13:40 **Tunnel-IBC Solar Cells**
D. Lachenal, Meyer Burger Research
- 14:00 **Silicon Heterojunction Technology at TrinaSolar**
G. Yang, Trina Solar Co., Ltd.

14:20 - 15:40 **Session 14: Modules and Systems**

Auditorium

Chair: Radovan Kopecek / Arthur Weeber

- 14:20 **24% Efficient Maxeon IBC Modules - Cell and Module Characteristics**
J. Tan, Maxeon
- 14:40 **3Sun Silicon Heterojunction PV Modules**
C. Gerardi, ENEL GREEN POWER / 3SUN
- 15:00 **Installations by Jollywood in MENA Area**
J.X. Ni, Jollywood (Taizhou) Solar Technology Co.,Ltd.
- 15:20 **to be announced**
- 15:20 - 15:40 **Break**

16:00 - 17:00 **Session 15: Sustainability, Recycling and Circularity Aspects**

Auditorium

Chair: Perrine Carroy, Malte Vogt

- 16:00 **Terawatt Scale Sustainability with Silicon PV**
T. Barnes, NREL
- 16:20 **Fully Recyclable Solar Panels**
M. Späth, TNO
- 16:40 **Circular PV Modules**
G. de Leede, Solarge

17:00 - 17:20 **Closure of nPV Workshop**

Auditorium

- 17:00 **Closure of nPV Workshop & Announcement Future Events**
O. Isabella, Delft University of Technology

Side Events

Welcome Reception

All participants are invited to take part in the Welcome Reception, which will take place on Monday, April 10, 2023.

It will take place at 't Postkantoor located in the historical centre of Delft. Cosy atmosphere will ensure good vibes and meeting other attendees in an informal settings will surely mark a wonderful start into the SiliconPV Week in Delft!

Day: Monday, April 10, 2023

Time: 17:00 - 19:00 (CEST)

Place: 't Postkantoor, Hippolytusbuurt 14, 2611 HN Delft

Registration is required

Conference Dinner

The SiliconPV Conference Dinner will take place at the Loetje restaurant, beautifully situated at a canal in Delft, just a 20-minute walk from the conference venue.

Day: Wednesday, April 12, 2023

Time: 19:00 - 24:00 (CEST)

The dinner is included in all SiliconPV tickets, pre-registration is required.

Address:

Loetje Delft
Korte Geer 1A
2611 CA Delft



© Loetje

Technical Tour

Take a Tour!

We are happy to invite you to three locations on the grounds of TU Delft as part of the Technical Tour Program:

- The Clean Room at TU Delft PV Technology Center (limited tickets)
- The Electrical Sustainable Power Laboratory
- The Green Village

Day: Thursday, April 13, 2023

Time: 15:15 - 19:15 (CEST)

Registration fee: 15,- EUR

Registration deadline: March 21, 2023

Participants registered for the tour will meet in the foyer (break area) of the Aula to be assigned to small groups.

TU Delft PV Technology Center

One location will be the 300 m² wide thematic clean room within the buildings of the Else Kooi Laboratory. Supported by TNO and imec, this center is equipped with all the necessary instrumentation to process thin-film silicon, crystalline silicon, perovskite and multi-junction solar cells to industrial sizes.

Electrical Sustainable Power Laboratory

Another part of the tour will be the massive laboratory designed for studying energy transition in the power sector and system integration. In the ESP Lab, which is supported by TenneT and the Dutch Ministry of Economic Affairs and Climate, researchers from photovoltaic, wind energy, power electronics, smart grids, and high voltage technologies work together under one roof to accelerate the transition to sustainable energy.

The Green Village

A sustainable future requires innovative ideas and new usable methods and techniques. At The Green Village, our third location, knowledge and educational institutions, companies, governments and citizens research, experiment, validate and demonstrate their sustainable innovations. The Green Village is a low-regulation “open-air laboratory” on TU Delft Campus with a focus on the built environment where tests can be carried out at district, street and building level.

Drinks at TGV

At the end of the tour please join us for an informal get-together at the Co-Creation Center of The Green Village.

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OVERVIEW

Program Overview

*as of 3 April, subject to change

CEST	Monday April 10, 2023	Tuesday April 11, 2023	Wednesday April 12, 2023	Thursday April 13, 2023	Friday April 14, 2023
		SiliconPV Conference			
				nPV Workshop	
8:30				Opening Session nPV 2023	
8:45					Opening
9:00		Opening SiliconPV 2023			
9:20			Cell Characterization	Silicon Hetero Junction Solar Cells	Silicon-related Material and Market Trends
9:45		Highlight Session			
10:00					
10:15			Coffee Break	Coffee Break	Break
10:30		Coffee Break			
10:45					
11:00					
11:15					Advanced Production Technologies
11:30		Dopant Free Contacts / Novel Surface Passivating Layers	Tandem Technologies	Poster	
11:45					
12:00					
12:15			Lunch Break		Lunch Break
12:30				Lunch Break	
12:45		Lunch			
13:00					
13:15					
13:30			Poster		
13:45				Poly-Si Passivating Contacts	Solar Cells Production
14:00		Poster			
14:15					
14:30					
14:45				Closing SiliconPV 2023	Modules and Systems
15:00					
15:15		Module Characterization, Simulations, Annual Yield	Module Reliability and Processing	Break	
15:30					Break
15:45					
16:00					
16:15		Break	Break		Sustainability, Recycling and Circularity Aspects
16:30					
16:45					
17:00					
17:15		Silicon Material	Process Technologies / Back-Contacted Solar Cells	Technical Tour	Closure of nPV Workshop
17:30					
17:45					
18:00	Welcome Reception				
18:15					
18:30					
18:45					
19:00					
19:15			Conference Dinner	Drinks at TGV	