

# Content

Chairmen's Messages .....	4
Committees .....	6
Scientific Program .....	8
Sunday, March 18, 2018 .....	8
Monday, March 19, 2018 .....	9
Tuesday, March 20, 2018 .....	18
Wednesday, March 21, 2018 .....	29
Thursday, March 22, 2018 .....	40
General Information .....	43
Technical Tour .....	44
Conference Dinner .....	45
Poster Plan .....	46

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<https://cms2018.siliconpv.com/program>



# Chairmen's Messages

## Welcome to Silicon PV 2018 at EPFL, Lausanne, Switzerland!

Dear Participants, dear Colleagues, dear Students,

What exciting times to welcome you at the EPFL in Lausanne! Here are the three reasons why:

First, some may think no more research is needed in photovoltaics. What an error! Commercial silicon modules are still far from the possible efficiency limit, and the last years have witnessed a wealth of new ideas being worked out at an impressive pace: reducing silicon usage significantly, manipulating material defects, creating high performance passivating contacts, inventing low-cost patterning steps and reducing the cell to module efficiency gap. The next steps are to add junctions on top of silicon for the ultimate efficiency. We are still far from the Carnot efficiency and photovoltaic research will continue. With an annual PV market which could grow up to 500 GW in the next 12 to 20 years and with PV being the absolute lowest cost electricity source, we are just at beginning of the solar era. Any investment in universities, research centers or industries and in young talents is an investment in the future of the planet!

Second, the world is changing in its perception of energy and environment, except for some soon-to-be extinct dinosaurs. In that context, Switzerland is special: it is the sole country where the population put a binding vote of 58% in favor of a progressive energy strategy that implies, among other things, less CO<sub>2</sub> emission and more renewables, including solar which will provide 20-25% of the annual electricity production. Also, Switzerland hosts several PV-related industries, including reputed equipment and hardware makers, metrology and component supply companies, and many innovative start-ups. This is completed by a strong community of researchers in PV at the Swiss research institutions. And of course in the field of crystalline silicon, you'll have a chance to visit the EPFL-PV-lab and the CSEM, both located only 45 minutes away in Neuchâtel.

Third and finally, this year's event takes place on the vibrant EPFL campus in Lausanne in the Rolex Learning Center, facing Lake Geneva and the Alps. In addition to impressive architectural monuments, there are several MWs of PV on the EPFL campus, and it operates a revolutionary grid control and energy management system. Ranked one of the top engineering schools in Europe, EPFL hosts several research groups involved in all aspects of the voted energy transition. You will not be far from Lausanne, a charming city with a beautiful historic downtown and many cultural highlights. In a little more than one hour you could be skiing some of the most amazing slopes in the world.

Altogether, EPFL is the ideal place to welcome the 2018 edition of the SiliconPV. On behalf of the committee, I wish you a fantastic conference!



*Prof. Christophe Ballif*

*Conference Chairman*

*EPFL, Photovoltaics and Thin Film Electronics Laboratory, Neuchâtel*



**Prof. Christophe Ballif**  
EPFL

*Conference Chair  
SiliconPV 2018*

## Dear PV-friend, welcome to the nPV Workshop 2018 in Lausanne, Switzerland!

Photovoltaic cells and modules experienced considerable reductions in manufacturing costs coupled with technological improvements, bringing PV to low levelized cost of electricity (LCOE) in 2017. This is highlighted by several PV power plant power purchase agreements below 5 \$ct/kWh, and by records below 3 \$ct/kWh, placing PV as ultra-competitive compared to other energy sources. Since few years, the silicon PV community is further witnessing a strong dynamism in the improvement of conversion efficiency with potential for further lowering LCOE. The introduction of new materials, processes and concepts, is triggering the introduction of advanced technologies in production. In that context, high efficiency n-type silicon technologies are developing with impressive dynamics! At R&D level, ultra-high efficiency was achieved by Kaneka, Japan, using back-contacted silicon hetero-junction, with up to 26.7 % and 24.37 % demonstrated at cell and module levels respectively. Continuous progress is being made with HJT, n-PERT and IBC technologies, driving towards an increasing mass production of highly efficient n-type devices, as highlighted by the introduction of 2 GW n-PERT production capacity by Jolywood in 2017.

In such exciting context, we are happy to welcome you at the nPV Workshop to discover what is next to come in 2018! The event takes place at the EPFL campus in Lausanne, in the beautiful Rolex Learning center, next to Lake Geneva and facing snowy Alps at this period of time! The first day will be coupled with SiliconPV for in-depth presentations of latest developments in n-type technologies at the R&D level. The second day will be dedicated to nPV industry, providing the platform to highlight and discover industrial progress in n-type technologies, from wafer to cell and module technologies, and to discuss and debate the development and market roadmaps for n-PV technologies.

The nPV Workshop is a unique occasion to update yourself on nPV technologies and industrial developments, and to discuss it with scientists and industrials from all over the world in a great atmosphere!

I am welcoming you in Lausanne, Switzerland, enjoying 2018 nPV Workshop!

On behalf of the organizing committee



*Dr. Matthieu Despeisse*

*Chairman nPV 2018*  
*CSEM*



*Matthieu Despeisse*  
*CSEM*  
*Chairman nPV 2018*

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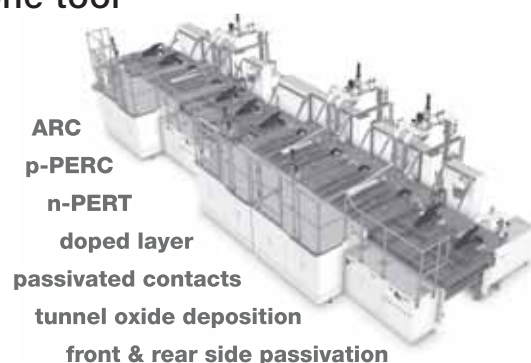
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## Monday, March 19, 2018

07:45 Registration

### 08:30 - Opening Session 09:00

08:30 Welcome to SiliconPV  
**Christophe Ballif**, EPFL

08:45 Awards - First 3 Abstracts  
**Christophe Ballif**, EPFL

### 09:00 - Session 1: Passivating Contacts

**10:00** Chairs: Stefan Glunz (Fraunhofer ISE) & Robby Peibst (ISFH)

09:00 Laser Contact Openings for Local Poly-Si-Metal Contacts  
**Felix Haase**<sup>1</sup>, Christina Klamt<sup>1</sup>, Sören Schäfer<sup>1</sup>, Agnes Merkle<sup>1</sup>, Michael Rienäcker<sup>1</sup>, Jan Krügener<sup>2</sup>, Rolf Brendel<sup>1</sup>, Robby Peibst<sup>1</sup>  
<sup>1</sup> ISFH; <sup>2</sup> Leibniz University of Hannover

09:15 Towards the Efficiency Limits of Multicrystalline Silicon Solar Cells  
**Florian Schindler**<sup>1</sup>, Ralph Müller<sup>1</sup>, Jan Benick<sup>1</sup>, Andreas Fell<sup>1</sup>, Armin Richter<sup>1</sup>, Frank Feldmann<sup>1</sup>, Patricia Krenckel<sup>1</sup>, Stephan Riepe<sup>1</sup>, Martin Schubert<sup>1</sup>, Stefan Glunz<sup>1</sup>  
<sup>1</sup> Fraunhofer ISE

09:30 SiC<sub>x</sub> as Passivating Contacts for High Efficiency Si Solar Cells  
**Gizem Nogay**<sup>1</sup>, Matej Hvlý<sup>2</sup>, Martin Ledinsky<sup>2</sup>, Josua Stuckelberger<sup>1</sup>, Philippe Wyss<sup>1</sup>, Quentin Jeangros<sup>1</sup>, Andrea Ingenito<sup>1</sup>, Christophe Allebe<sup>3</sup>, Matthieu Despeisse<sup>4</sup>, Antonin Fejfar<sup>2</sup>, Franz-Josef Haug<sup>1</sup>, Philipp Loeper<sup>1</sup>, Christophe Ballif<sup>1</sup>  
<sup>1</sup> EPFL; <sup>2</sup> LNSM; <sup>3</sup> CSEM; <sup>4</sup> CSEM PV-Center

09:45 Tailoring Atomic-Layer-Deposited TiO<sub>x</sub> to Form an Electron-Selective Passivating Contact  
**Jimmy Melskens**<sup>1</sup>, Willem-Jan Berghuis<sup>1</sup>, Bart Macco<sup>1</sup>, Lachlan Black<sup>1</sup>, Bas van de Loo<sup>1</sup>, Erwin Kessels<sup>1</sup>  
<sup>1</sup> Eindhoven University of Technology

10:00 - 10:30 Coffee Break



**10:30 - Keynote**

**11:15** From Academia to the World Most Powerful Commercial Silicon Solar Cells: History, Lesson Learned and Perspectives

**Richard M. Swanson**, SunPower Corporation



**Dr. Richard Swanson**

Richard „Dick“ Swanson received his BSEE and MSEE from Ohio State University in 1969 and his PhD in Electrical Engineering from Stanford University in 1975. After completing his PhD, he joined the Electrical Engineering faculty at Stanford. In 1975 he received grants for his solar energy research from the Electric Power Research Institute and the U.S. Department of Energy. His research investigated the semiconductor properties of silicon relevant for better understanding the operation of silicon solar cells. These studies have helped pave the way for steady

improvement in silicon solar cell performance. In 1985 he founded SunPower Corporation. In 1991 Dr. Swanson resigned from his faculty position to devote full time to SunPower Corporation, where he served as its President and Chief Technology Officer until May 2010, when he became President Emeritus. SunPower produces today the highest performance commercial flat-plate photovoltaic panels. Dr. Swanson has received widespread recognition for his work. Among others, in 2002, he was awarded the William R. Cherry award by the IEEE for outstanding contributions to the photovoltaic field, and in 2006 the Becquerel Prize in Photovoltaics from the European Communities

**11:15 - Session 2: Tandems**

**12:15** Chairs: Daniel Kirk (Oxford PV) & Zachary Holman (Arizona State University)

**11:15** Monolithic III-V//Si Tandem Solar Cells with Efficiency > 33%

**Jan Benick**<sup>1</sup>, Romain Cariou<sup>1</sup>, Paul Beutel<sup>1</sup>, David Lackner<sup>1</sup>, Frank Feldmann<sup>1</sup>, Oliver Höhn<sup>1</sup>, Hubert Hauser<sup>1</sup>, Martin Hermle<sup>1</sup>, Stefan Glunz<sup>1</sup>, Frank Dimroth<sup>1</sup>

<sup>1</sup> Fraunhofer ISE

**11:30** Monolithic Perovskite/Silicon-Homojunction Tandem Solar Cell with Over 22% Efficiency

**Yiliang Wu**<sup>1</sup>, Di Yan<sup>1</sup>, The Duong<sup>1</sup>, Jun Peng<sup>1</sup>, Sieu Pheng Phang<sup>1</sup>, Yimao Wan<sup>1</sup>, Thomas White<sup>1</sup>, Kylie Catchpole<sup>1</sup>, Klaus Weber<sup>1</sup>

<sup>1</sup> Australian National University



- 11:45 High Efficiency 4-terminal Perovskite/c-Si Tandem Cells  
**Dong Zhang**<sup>1</sup>, Mehrdad Najafi<sup>1</sup>, Valerio Zardetto<sup>2</sup>, Astrid Gutjahr<sup>3</sup>, Ingrid Romijn<sup>3</sup>, Sjoerd Veenstra<sup>1</sup>, Bart Geerligs<sup>3</sup>, Tom Aernouts<sup>4</sup>, Ronn Andriessen<sup>5</sup>  
<sup>1</sup> ECN-Solliance; <sup>2</sup> TNO-Solliance; <sup>3</sup> ECN Solar Energy; <sup>4</sup> imec; <sup>5</sup> Holst Centre-Solliance
- 12:00 High-Efficiency Monolithic 2-terminal Silicon/Perovskite Tandem Solar Cells  
**Quentin Jeangros**<sup>1</sup>, Florent Sahli<sup>1</sup>, Jérémie Werner<sup>1</sup>, Matthias Bräuninger<sup>1</sup>, Peter Fiala<sup>1</sup>, Terry Chien-Jen Yang<sup>1</sup>, Esteban Rucavado<sup>1</sup>, Brett Kamino<sup>2</sup>, Arnaud Walter<sup>2</sup>, Soo-Jin Moon<sup>2</sup>, Michael Rienaecker<sup>3</sup>, Robby Peibst<sup>3</sup>, Raphael Niepelt<sup>3</sup>, Rolf Brendel<sup>3</sup>, Loris Barraud<sup>2</sup>, Bertrand Paviet-Salomon<sup>2</sup>, Christophe Allebé<sup>2</sup>, Raphaël Monnard<sup>1</sup>, Mathieu Boccard<sup>1</sup>, Monica Morales-Masis<sup>1</sup>, Matthieu Despeisse<sup>2</sup>, Sylvain Nicolay<sup>2</sup>, Bjoern Niesen<sup>2</sup>, Christophe Ballif<sup>1</sup>  
<sup>1</sup> EPFL; <sup>2</sup> CSEM; <sup>3</sup> ISFH
- 12:15 - 13:15 Lunch Break
- 13:15 - 14:45 Session 3: Characterization and Passivation**  
Chairs: Ron Sinton (Sinton Instruments) & Pietro Altermatt (Trina Solar)
- 13:15 Temperature Dependent Imaging of Solar Cell Losses  
**Rebeka Eberle**<sup>1</sup>, Wolfram Kwapil<sup>1</sup>, Martin Schubert<sup>1</sup>  
<sup>1</sup> Fraunhofer ISE
- 13:30 Impact of Different Capping Layers on Carrier Injection Efficiency Between Amorphous and Crystalline Silicon Measured Using Photoluminescence  
**Appu Paduthol**<sup>1</sup>, Mattias Juhl<sup>2</sup>, Gizem Nogay<sup>3</sup>, Andrea Ingenito<sup>3</sup>, Philipp Löper<sup>3</sup>, Thorsten Trupke<sup>2</sup>  
<sup>1</sup> University of New South Wales; <sup>2</sup> UNSW Sydney; <sup>3</sup> EPFL
- 13:45 Suns-Ilit: Accurate Method for Non-Contacted Local IV Measurements  
**Wolfram Kwapil**<sup>1</sup>, Sven Wasmer<sup>1</sup>, Andreas Fell<sup>1</sup>, Johannes Greulich<sup>1</sup>, Martin Schubert<sup>1</sup>  
<sup>1</sup> Fraunhofer ISE
- 14:00 Atomic-Layer Deposited Nb<sub>2</sub>O<sub>5</sub>: A Novel Passivating Contact Material?  
**Bart Macco**<sup>1</sup>, Jimmy Melskens<sup>1</sup>, Bas van de Loo<sup>1</sup>, Lachlan Black<sup>1</sup>, Willem-Jan Berghuis<sup>1</sup>, Martin Bivour<sup>2</sup>, Martin Hermle<sup>2</sup>, Erwin Kessels<sup>1</sup>  
<sup>1</sup> Eindhoven University of Technology; <sup>2</sup> Fraunhofer ISE

14:15 On the Stability of Surface Passivation Quality of SiN<sub>x</sub>:H Layers/Stacks on Highly-Doped Crystalline Silicon

**David Sperber**<sup>1</sup>, Anton Schwarz<sup>1</sup>, Axel Herguth<sup>1</sup>, Giso Hahn<sup>1</sup>

<sup>1</sup> University of Konstanz

14:30 Excellent Passivation of C-Si Surfaces by PO<sub>x</sub> Capped by Al<sub>2</sub>O<sub>3</sub>

**Lachlan Black**<sup>1</sup>, Marcel Verheijen<sup>1</sup>, Erwin Kessels<sup>1</sup>

<sup>1</sup> Eindhoven University of Technology

14:45 - 15:15 Coffee Break

## 15:15 - **Session 4: Characterization and Modelling**

**16:30** Chairs: Keith McIntosh (PV Lighthouse) & Franz-Josef Haug (EPFL)

15:15 An Original 3-terminal Wide Gap/Silicon Heterojunction Tandem Solar Cell Concept: Design and Calculations

**Zakaria Djebbour**<sup>1</sup>, Walid El-Huni<sup>2</sup>, Anne Migan<sup>2</sup>, Jean-Paul Kleider<sup>2</sup>

<sup>1</sup> GeePs - CNRS; <sup>2</sup> GeePs - CentraleSupélec

15:30 Detailed 3D Full-Cell Modeling in Quokka3: Quantifying Edge and Solder-Pad Losses in an Industrial PERC Cell

**Andreas Fell**<sup>1</sup>, Pietro Altermatt<sup>2</sup>

<sup>1</sup> Fraunhofer ISE; <sup>2</sup> Trina Solar

15:45 Vertically Integrated Modeling of Light-Induced Defects: Process Modeling, Degradation Kinetics and Device Impact

**Hannu Laine**<sup>1</sup>, Henri Vahlman<sup>1</sup>, Antti Haarahiltunen<sup>1</sup>, Mallory Jensen<sup>2</sup>, Chiara Modanese<sup>1</sup>, Matthias Wagner<sup>3</sup>, Franziska Wolny<sup>3</sup>, Tonio Buonassisi<sup>2</sup>, Hele Savin<sup>1</sup>

<sup>1</sup> Aalto University; <sup>2</sup> Massachusetts Institute of Technology;

<sup>3</sup> SolarWorld Industries GmbH

16:00 Transient In-line I-V and Capacitance-Measurement of High Efficiency Solar Cells Using Led Solar Simulators

**Kai Sporleder**<sup>1</sup>, Marko Turek<sup>1</sup>

<sup>1</sup> Fraunhofer CSP

16:15 Determination and Evaluation of the Intrinsic Reflectance of a Backsheet

**Keith McIntosh**<sup>1</sup>, Jürgen Jung<sup>2</sup>, Malcolm Abbott<sup>1</sup>, Ben Sudbury<sup>1</sup>

<sup>1</sup> PV Lighthouse; <sup>2</sup> AGFA

**16:30 - Poster Session 1 (with Apéro)**

**18:00** The poster topics are labeled with the following letters:

- A Advanced characterization and simulation
- B Carrier selective contacts and contact formation
- C Cleaning, etching, surface morphology and surface passivation
- D High and record efficiency devices
- E Junction formation
- F Module processing and materials
- G Module reliability and production yield
- H Process integration and low-cost manufacturing
- I Si-based tandem cells, new materials and novel approaches
- J Silicon material and defect engineering
- K Wafering technologies
- nPV Posters of nPV Workshop

**1-A-01**  $\mu$ -TLM Contact and Sheet Resistance Measurements in Thin Film Systems for Next Generation Solar Cell Contacts

**Kai Kaufmann**<sup>1</sup>, Mehran Habibi<sup>1</sup>, Volker Naumann<sup>1</sup>, Christian Hagendorf<sup>1</sup>

<sup>1</sup> Fraunhofer CSP

**1-A-02** Investigation of n-Type Contact Passivated Back Junction Silicon Solar Cells by Means of Numerical Device Simulation

**Cangming Ke**<sup>1</sup>, Zheng Xin<sup>1</sup>, Ranjani Sridharan<sup>1</sup>, Gurleen Kaur<sup>1</sup>, Zhi Peng Ling<sup>1</sup>, Rolf Stangl<sup>1</sup>

<sup>1</sup> Solar Energy Research Institute of Singapore (SERIS)

**1-A-03** Imaging of Internal Field and Junction Leaks of Back-Contact Si Solar Cells with a Laser Terahertz Emission Microscope

**Toshimitsu Mochizuki**<sup>1</sup>, Akira Ito<sup>2</sup>, Tomihisa Tachibana<sup>1</sup>, Katsuto Tanahashi<sup>1</sup>, Hidetoshi Nakanishi<sup>2</sup>, Iwao Kawayama<sup>3</sup>, Masayoshi Tonouchi<sup>3</sup>, Katsuhiko Shirasawa<sup>1</sup>, Hidetaka Takato<sup>1</sup>

<sup>1</sup> Fukushima Renewable Energy Institute, AIST; <sup>2</sup> SCREEN Holdings Co., Ltd.; <sup>3</sup> Osaka University

**1-A-04** Relevance of Bifacial Illumination and Sorting Criteria of Bifacial Solar Cells for Module Power

**Aina Alapont Sabater**<sup>1</sup>, Johannes Greulich<sup>1</sup>, Nico Wöhrle<sup>1</sup>, Stefan Rein<sup>1</sup>

<sup>1</sup> Fraunhofer ISE

**1-A-05** Two-Dimensional Electrical Modeling of High Geometrical Aspect Ratio Emitters

**Deniz Turkey**<sup>1</sup>, Selcuk Yerci<sup>1</sup>

<sup>1</sup> GUNAM

- 1-A-06 Improving Transient Photoconductance Lifetime Measurements on Ingots with Deeper Photogeneration  
**Mohsen Goodarzi**<sup>1</sup>, Ronald Sinton<sup>2</sup>, Daniel Macdonald<sup>1</sup>  
<sup>1</sup> Australian National University; <sup>2</sup> Sinton Instruments
- 1-A-07 Saturation Current as a Function of Sheet Resistance in Si  
**Luigi Abenante**  
ENEA
- 1-A-08 Collection Efficiency at Near-Bandgap Wavelengths in Actual Si Solar Cells  
**Luigi Abenante**  
ENEA
- 1-A-09 Quantitative Local Efficiency Loss Analysis on Cast-Mono PERC Solar Cells Using the DLIT ,Local I-V' Method  
**Matthias Müller**<sup>1</sup>, Matthias Wagner<sup>2</sup>, Andreas Krause<sup>3</sup>, Holger Neuhaus<sup>2</sup>  
<sup>1</sup> Technical University Bergakademie Freiberg; <sup>2</sup> SolarWorld Industries GmbH; <sup>3</sup> SGS INSTITUT FRESENIUS GmbH
- 1-A-10 Simple Modeling of Intrinsic Bulk Lifetime in Doped Silicon  
**Luigi Abenante**  
ENEA
- 1-A-11 Influence of Interconnection Concepts for IBC Solar Cell Performance by Simulation  
**Jonas David Huyeng**<sup>1</sup>, Alma Spribille<sup>1</sup>, Li Carlos Rendler<sup>1</sup>, Christian Reichel<sup>1</sup>, Roman Keding<sup>1</sup>, Ulrich Eitner<sup>1</sup>, Andreas Fell<sup>1</sup>  
<sup>1</sup> Fraunhofer ISE
- 1-A-12 Advanced Simulation of a PV Module's Color  
**Keith McIntosh**<sup>1</sup>, Mohamed Amara<sup>2</sup>, Fabien Mandorlo<sup>2</sup>, Malcolm Abbott<sup>1</sup>, Ben Sudbury<sup>1</sup>  
<sup>1</sup> PV Lighthouse; <sup>2</sup> Univ Lyon, CNRS, INSA-Lyon
- 1-A-13 Towards a Fast Determination of the Hydrogen Concentration in Thin Passivating A-Si:H Layers Using GD-OES  
**Jonathan Steffens**<sup>1</sup>, Giso Hahn<sup>1</sup>, Barbara Terheiden<sup>1</sup>  
<sup>1</sup> University of Konstanz
- 1-A-15 Temperature Coefficients in Compensated Silicon Solar Cells Investigated by Temperature Dependent Lifetime Measurements and Numerical Device Simulation  
**Halvard Haug**<sup>1</sup>, Åsmund Skomeland<sup>1</sup>, Rune Søndena<sup>1</sup>, Marie Syre Wiig<sup>1</sup>, Erik Stensrud Marstein<sup>1</sup>  
<sup>1</sup> IFE (Institute for Energy Technology)

- 1-A-16 Characterising the Operating Conditions of Bifacial Modules  
**Robert Kenny**<sup>1</sup>, Elisa Garcia Menendez<sup>1</sup>, Juan Lopez Garcia<sup>1</sup>  
<sup>1</sup> Joint Research Centre
- 1-A-17 Simulation of Optical and Electrical Losses of PV Modules in Moderate and Desert Conditions  
**Hamed Hanifi**<sup>1</sup>, Jens Schneider<sup>1</sup>  
<sup>1</sup> Fraunhofer CSP
- 1-A-18 Cell Tester Miscalibration due to Measurement Hysteresis Effects  
**Thomas Roth**<sup>1</sup>, Hendrik Sträter<sup>1</sup>  
<sup>1</sup> SolarWorld Industries GmbH
- 1-A-19 Simulation Analysis of Heterojunction Solar Cells Based on P-Si Wafer  
**Lun Cai**<sup>1</sup>, Zongcun Liang<sup>1</sup>  
<sup>1</sup> Sun Yat-Sen University
- 1-A-20 Aluminium-BSF Versus PERC Solar Cells: Study of Rear Side Passivation Quality and Diffusion Length  
**Andreas Schütt**  
CELLOscan
- 1-A-21 Defects Detection in P-N Junction Isolation by Electroluminescence  
**Vanesa Fano**<sup>1</sup>, Alona Otaegi<sup>1</sup>, Nekane Azkona<sup>1</sup>, Eneko Cereceda<sup>1</sup>, Lourdes Perez<sup>1</sup>, Pedro Rodriguez<sup>1</sup>, Federico Recart<sup>1</sup>, José Rubén Gutierrez<sup>1</sup>, Juan Carlos Jimeno<sup>1</sup>  
<sup>1</sup> University of The Basque Country
- 1-A-22 A Critical Review and Discussion of Different Methods to Determine the Series Resistance of Solar Cells:  $R_{s,dark}$  vs.  $R_{s,light}$ ?  
**Jan-Martin Wagner**<sup>1</sup>, Jürgen Carstensen<sup>1</sup>, Andreas Schütt<sup>1</sup>, Rainer Adelung<sup>1</sup>  
<sup>1</sup> University of Kiel
- 1-A-23 Leverage of the Thermionic Emission Barrier on Carrier Reflection at the a-Si:H/c-Si Hetero-Interface and on the Fill Factor of p+/n and n+/p Silicon Heterojunction Solar Cells with Moderately Doped a-Si:H  
**Moustafa Ghannam**<sup>1</sup>, Yaser Abdulraheem<sup>1</sup>  
<sup>1</sup> Kuwait University
- 1-A-24 On the Optimal Doping Profile Under Local Metal Contacts  
**Gabriel Micard**<sup>1</sup>, Barbara Terheiden<sup>1</sup>, Giso Hahn<sup>1</sup>  
<sup>1</sup> University of Konstanz

- 1-C-01 Optimization of Texturing Yield by Monitoring the Surface Energy of As-Cut Wafers  
**Sylke Meyer**<sup>1</sup>, Alfatih Mustafa<sup>1</sup>, Petra Müller<sup>2</sup>, Alexander Oehlke<sup>2</sup>  
<sup>1</sup> Fraunhofer CSP; <sup>2</sup> SolarWorld Industries GmbH
- 1-C-02 Ionic Solution Passivation of Silicon with Surface Recombination Velocities Below 1 cm/s  
**Nicholas Grant**<sup>1</sup>, Alex Pointon<sup>1</sup>, Evé Wheeler-Jones<sup>1</sup>, John Murphy<sup>1</sup>  
<sup>1</sup> University of Warwick
- 1-C-03 Modeling of the Initial Si Surface Roughening During Maskless Plasma Texturing for Black Silicon Through Linear Stability Analysis  
**Maria Gaudig**<sup>1</sup>, Matthias Maiberg<sup>1</sup>, Alexander Sprafke<sup>1</sup>, Ralf B. Wehrspohn<sup>1</sup>  
<sup>1</sup> Martin-Luther-Universität Halle-Wittenberg
- 1-C-04 Study of Changes in Intrinsic a-Si:H Passivation Layer Induced by the Growth of n-Doped Microcrystalline Layer  
**Oleg Sergeev**  
DLR Institute of Networked Energy Systems
- 1-C-05 Anodic Electrochemical Texturing of Slurry-Cut and Diamond-Wire Sawn Multicrystalline Silicon in KOH Solution  
**Justinas Trapnauskas**<sup>1</sup>, Jonas Bartsch<sup>1</sup>, Sven Kluska<sup>1</sup>, Markus Glatthaar<sup>1</sup>  
<sup>1</sup> Fraunhofer ISE
- 1-C-06 Impact of Growth Temperature on Passivation Performance and Hydrogen Profile Near the a-Si:H/c-Si Interface  
**Kauzhiro Gotoh**<sup>1</sup>, Shohei Ogura<sup>2</sup>, Shinya Kato<sup>3</sup>, Yasuyoshi Kurokawa<sup>1</sup>, Katsuyuki Fukutani<sup>2</sup>, Noritaka Usami<sup>1</sup>  
<sup>1</sup> Nagoya University; <sup>2</sup> University of Tokyo; <sup>3</sup> Nagoya Institute of Technology
- 1-C-07 Effect of Laser Parameters and Post-Texturing Treatments on the Optical and Electrical Properties of Laser Textured Si Wafer  
**Behrad Radfar**<sup>1</sup>, Firat Es<sup>1</sup>, Hisham Nasser<sup>1</sup>, Ozan Akdemir<sup>1</sup>, Alpan Bek<sup>1</sup>, Rasit Turan<sup>1</sup>  
<sup>1</sup> Center for Solar Energy Research and Applications (GUNAM)
- 1-C-08 Simplified Surface Cleaning for Fabrication of Silicon Heterojunction Solar Cells  
**Xiaoqian Lu**<sup>1</sup>, Martien Koppes<sup>1</sup>, Paula Bronsveld<sup>1</sup>  
<sup>1</sup> ECN
- 1-C-09 Texturisation of Multicrystalline DWS Wafers by HF/HNO<sub>3</sub>/H<sub>2</sub>SO<sub>4</sub> at Elevated Temperature  
**Katrin Krieg**<sup>1</sup>, Niko Jenek<sup>1</sup>, Martin Zimmer<sup>1</sup>  
<sup>1</sup> Fraunhofer ISE

- 1-C-10 Impact of Wafer Thickness on the Photovoltaic Performance in a-Si:H/c-Si Heterojunction Solar Cells  
**Hitoshi Sai**<sup>1</sup>, Takuya Matsui<sup>1</sup>, Shota Nunomura<sup>1</sup>, Tomoyuki Kawatsu<sup>2</sup>, Hidetaka Takato<sup>1</sup>, Koji Matsubara<sup>1</sup>  
<sup>1</sup> AIST; <sup>2</sup> Komatsu NTC Ltd.
- 1-C-11 Refractive Index of PECVD-SiN<sub>x</sub> Films Effects on the Rear Side Passivation for PERC-type Solar Cell  
**Supawan Joonwichien**<sup>1</sup>, Yasuhiro Kida<sup>1</sup>, Masaaki Moriya<sup>1</sup>, Satoshi Utsunomiya<sup>1</sup>, Katsuhiko Shirasawa<sup>1</sup>, Hidetaka Takato<sup>1</sup>  
<sup>1</sup> AIST
- 1-C-12 Understanding the Optics of Industrial Black Silicon  
**David Payne**<sup>1</sup>, Tsun Fung<sup>1</sup>, Jose Cruz-Campa<sup>2</sup>, Keith McIntosh<sup>3</sup>, Stuart Wenham<sup>1</sup>, Malcolm Abbott<sup>1</sup>  
<sup>1</sup> UNSW Sydney; <sup>2</sup> 1366 Technologies; <sup>3</sup> PV Lighthouse
- 1-C-13 Development of an Ozone-Based Inline Cleaning and Conditioning Concept  
**Andreas Fischer**<sup>1</sup>, Anamaria Moldovan<sup>1</sup>, Jan Temmler<sup>1</sup>, Martin Zimmer<sup>1</sup>, Jochen Rentsch<sup>1</sup>  
<sup>1</sup> Fraunhofer ISE
- 1-C-14 a-Si:H Passivation Layer Growth by HWCVD for Si Heterojunction Solar Cells: Critical Dependence on Substrate Temperature  
**Aparajita Mandal**<sup>1</sup>, Nilesh Wadibhasme<sup>1</sup>, Alka Kumbhar<sup>1</sup>, Subhas V Ghaisas<sup>1</sup>, Rajiv O Dusane<sup>1</sup>  
<sup>1</sup> IIT Bombay
- 1-C-15 Investigation of Interface Characteristics of Al<sub>2</sub>O<sub>3</sub>/Si by O<sub>2</sub> Plasma Exposure Time During Deposition of Al<sub>2</sub>O<sub>3</sub> Using PA-ALD  
**Jeong In Lee**<sup>1</sup>, Kwan Hong Min<sup>2</sup>, Sungjin Choi<sup>2</sup>, Myeong Sang Jeong<sup>2</sup>, Kyung Taek Jeong<sup>1</sup>, Sungeun Park<sup>1</sup>, Min Gu Kang<sup>1</sup>, Hee-Eun Song<sup>1</sup>  
<sup>1</sup> Korea Institute of Energy Research; <sup>2</sup> Korea University
- 1-C-16 Study of Inverted Pyramids Textures and ARC on Silicon Solar Cells for Emissivity Control  
**Lourdes Ferre Llin**<sup>1</sup>, Diego Alonso-Alvarez<sup>2</sup>, Alexander Mellor<sup>2</sup>, Ned Ekins-Daukes<sup>2</sup>, Douglas Paul<sup>1</sup>  
<sup>1</sup> University of Glasgow; <sup>2</sup> Imperial College London
- 1-I-01 Yield Analysis and Comparison of GaInP/Si and GaInP/GaAs Tandem Solar Cells  
**Henning Schulte-Huxel**<sup>1</sup>, Timothy J Silverman<sup>2</sup>, Daniel J. Friedman<sup>2</sup>, Michael G. Deceglie<sup>2</sup>, Michael Rienäcker<sup>1</sup>, Malte R. Vogt<sup>1</sup>, Manuel Schnabel<sup>2</sup>, Emily L. Warren<sup>2</sup>, Raphael Niepelt<sup>1</sup>, Pauls Stardins<sup>2</sup>, Robby Peibst<sup>1</sup>, Adele C. Tamboli<sup>2</sup>  
<sup>1</sup> ISFH; <sup>2</sup> National Renewable Energy Laboratory (NREL)



1-I-02 Investigating the Effect of PMMA Thickness as an Optical Spacer on the Performance of 4-terminal Semitransparent Perovskite/Silicon Tandem Solar Cells

**Ali Hajjiah**<sup>1</sup>, Fahad Parmouneh<sup>1</sup>, Afshin Hadipour<sup>2</sup>, Manoj Jaysankar<sup>2</sup>, Wenya Song<sup>2</sup>, Tom Aernouts<sup>2</sup>, Ivan Gordon<sup>2</sup>, Jef Poortmans<sup>2</sup>

<sup>1</sup> Kuwait University; <sup>2</sup> imec

1-I-03 Opto-Electrical Simulation of III-V Nanowire Based Tandem Solar Cells on Si

**Anne Kaminski-Cachopo**<sup>1</sup>, Vladimir Maryasin<sup>1</sup>, Quentin Rafhay<sup>1</sup>, Davide Buccì<sup>1</sup>, Jérôme Michallon<sup>1</sup>, Anne Kaminski-Cachopo<sup>1</sup>

<sup>1</sup> Univ Grenoble Alpes, CNRS, Grenoble INP

18:00 - Technical Tour  
23:00

## Tuesday, March 20, 2018

08:00 - Registration  
08:30

### 08:30 - Session 5:

#### 10:00 Silicon Materials and Defect Engineering

Chairs: Arthur Weeber (ECN) & Mowafak Al-Jassim (NREL)

08:30 A Generalized Model for BO-LID in Crystalline Silicon

**Axel Herguth**<sup>1</sup>, Brett Hallam<sup>2</sup>

<sup>1</sup> University of Konstanz; <sup>2</sup> University of New South Wales

08:45 Correlation of the LeTID Amplitude to the Aluminium Bulk Concentration in PERC Cells Made of B-Doped Cz-Si

**Matthias Wagner**<sup>1</sup>, Franziska Wolny<sup>1</sup>, Frieder Kropfgans<sup>1</sup>, Malte Ernst<sup>1</sup>, Paul Bönisch<sup>1</sup>, Daniel Oriwol<sup>1</sup>, Petra Müller<sup>1</sup>, Nicole Schmidt<sup>1</sup>, Robert Zierer<sup>1</sup>, Viktor Osinniy<sup>1</sup>, Hans-Peter Hartmann<sup>1</sup>, Raik Mehnert<sup>1</sup>, Andreas Krause<sup>1</sup>, Melanie Hentsche<sup>1</sup>, Lamine Sylla<sup>1</sup>, Holger Neuhaus<sup>1</sup>

<sup>1</sup> SolarWorld Industries GmbH

09:00 LeTID Appearance Under High Temperature Dark-Annealing Compared to Intermediate Temperature Light Soaking

**Tabea Luka**<sup>1</sup>, Marko Turek<sup>1</sup>

<sup>1</sup> Fraunhofer CSP

09:15 In-Situ Characterization of Electron-Assisted Regeneration of Cz-Si Solar Cells

**Lailah Helmich**<sup>1</sup>, Dominic Walter<sup>1</sup>, Dennis Bredemeier<sup>1</sup>, Robert Falster<sup>2</sup>, Vladimir Voronkov<sup>3</sup>, Jan Schmidt<sup>1</sup>

<sup>1</sup> ISFH; <sup>2</sup> Private; <sup>3</sup> SunEdison Semiconductor

09:30 Investigations on the Influence of Illumination on the Diffusion of Hydrogen Into Crystalline Silicon

**Philipp Keller**<sup>1</sup>, Axel Herguth<sup>1</sup>

Presented by Axel Herguth<sup>1</sup>

<sup>1</sup> University of Konstanz

09:45 Atom Probe Tomography of Fast-Diffusing Impurities and the Effect of Gettering

**David Twedde**<sup>1</sup>, Eleanor C Shaw<sup>1</sup>, Michael Moody<sup>1</sup>, Peter Wilshaw<sup>1</sup>, Phillip Hamer<sup>1</sup>

<sup>1</sup> Oxford University

10:00 - 10:30 Coffee Break

**10:30 - Invited Talk**

**12:00** Recent Progresses in Silicon Photovoltaics Research in China: From Academia to Industry

**Hui Shen**, Sun Yat-sen University



**Prof. Hui Shen**

Hui Shen studied optical engineering at the Nanjing University of Technology (1978 -1982). His research activities started with new materials, such as thin films and nanomaterials at the Institute of Solid State Physics, the Chinese Academy of Sciences (CAS) in Hefei (1982 -1992). From 1992 to 1996 he was a visiting scholar at the Fraunhofer Institute for Applied Materials in Bremen and also a PhD candidate at the Dresden University of Technology, Germany. He obtained his Dr.-Ing. in 1996.

In 1998, he became associate Professor at South China University of Technology in Guangzhou. In 1999, he obtained a project named „The Program of Hundred Talents“ of CAS and became a Professor at Guangzhou Institute of Energy Conversion, CAS. Since then, his main researches focus on solar photovoltaic technology. Since 2004, he is a Professor, founder and director of the Institute for Solar Energy Systems, Sun Yat-sen University (SYSU) in Guangzhou, since 2010, director of SYSU-Shunde Institute for Solar Energy and since 2010, chairman of the Academic Commission of State Key Lab of Photovoltaic Sci. and Tech (Trina Solar); Since 2012, chairman of the Technical Commission of State Center of Engineering and Technological Research (the 48th institute in Changsha)

**11:00 - Session 6: Process Integration and Low-cost  
12:15 Manufacturing**

Chairs: Anna Battaglia (ENEL) & Joachim John (IMEC)

11:00 Bifacial Shingle Solar Cells on p-Type Cz-Si (pSPEER)

**Puzant Baliozian**<sup>1</sup>, Elmar Lohmüller<sup>1</sup>, Tobias Fellmeth<sup>1</sup>, Nico Wöhrle<sup>1</sup>, Ralf Preu<sup>1</sup>

<sup>1</sup> Fraunhofer ISE

11:15 A Method for Optimizing PERC Cells in Industrial Production Lines by Using Final IV Parameters, Statistical Procedures and Numerical Device Modeling

**Pietro Altermatt**<sup>1</sup>, Yang Yang<sup>1</sup>, DaMing Chen<sup>1</sup>, Yifeng Chen<sup>1</sup>, Zhiqiang Feng<sup>1</sup>, Pierre Verlinden<sup>1</sup>

<sup>1</sup> Trina Solar

11:30 Plasma Immersion Ion Implantation (PIII): New Path for Optimizing Doping Profiles of Advanced Phosphorus Emitters

**Antoine Veau**<sup>1</sup>, Thibaut Desrues<sup>1</sup>, Adeline Lanterne<sup>1</sup>, Anne Kaminski-Cachopo<sup>1</sup>, Quentin Raffay<sup>1</sup>, Frank Torregrosa<sup>2</sup>, Laurent Roux<sup>2</sup>, Sébastien Dubois<sup>1</sup>

<sup>1</sup> Univ Grenoble Alpes; <sup>2</sup> IBS

11:45 Boosting Module Power by Advanced Interconnection and p-Type Cz Silicon Solar Cell Efficiencies Exceeding 22% in Mass Production

**Ingmar Höger**

Hanwha Q CELLS GmbH

12:00 Industrially Compatible n+ polySi/SiO<sub>x</sub> Electron-Selective Conductors for High Efficiency Silicon Solar Cells

**Di Yan**<sup>1</sup>, Andres Cuevas<sup>1</sup>, Sieu Pheng Phang<sup>1</sup>, Yimao Wan<sup>1</sup>, James Bullock<sup>2</sup>, Anyao Liu<sup>1</sup>, Daniel Macdonald<sup>1</sup>

<sup>1</sup> Australian National University; <sup>2</sup> University of California

12:15 - Lunch Break  
13:15

**13:15 - Session 7: Novel Passivating Contacts**

**14:30** Chairs: Martin Bivour (Fraunhofer ISE) & Mathieu Boccard (EPFL)

13:15 Evidence of TiO<sub>x</sub> Reduction at the SiO<sub>x</sub>/TiO<sub>x</sub> Interface of Passivating Electron-Selective Contacts

**Jinyoun Cho**<sup>1</sup>, Maarten Debucquoy<sup>2</sup>, Maria Recaman Payo<sup>2</sup>, Elie Schapmans<sup>1</sup>, Ivan Gordon<sup>2</sup>, Jozef Szlufcik<sup>2</sup>, Jef Poortmans<sup>3</sup>

<sup>1</sup> KU Leuven/imec; <sup>2</sup> imec; <sup>3</sup> KU Leuven/imec/University Hasselt

- 13:30 Full Area Passivating SiO<sub>x</sub>(p)-Based Rear Contact Compatible with Co-Diffused POCl<sub>3</sub> Front Emitter  
**Philippe Wyss**<sup>1</sup>, Josua Stuckelberger<sup>1</sup>, Iris Mack<sup>1</sup>, Gizem Nogay<sup>1</sup>, Christophe Allebé<sup>2</sup>, Jörg Horzel<sup>2</sup>, Matthieu Despeisse<sup>2</sup>, Andrea Ingenito<sup>1</sup>, Franz-Josef Haug<sup>1</sup>, Philipp Löper<sup>1</sup>, Christophe Ballif<sup>1</sup>  
<sup>1</sup> EPFL; <sup>2</sup> CSEM
- 13:45 On the Hydrogenation of Poly-Si Passivating Contacts by Al<sub>2</sub>O<sub>3</sub> and SiN<sub>x</sub> Thin Films  
**Bas van de Loo**<sup>1</sup>, Manuel Schnabel<sup>2</sup>, Maciej Stodolny<sup>3</sup>, Agnes Mewe<sup>3</sup>, Paul Stradins<sup>2</sup>, David Young<sup>2</sup>, Erwin Kessels<sup>4</sup>  
<sup>1</sup> Tempres Systems; <sup>2</sup> National Renewable Energy Laboratory (NREL); <sup>3</sup> ECN Solar Energy; <sup>4</sup> Eindhoven University of Technology
- 14:00 Moly-Poly Solar Cells: Industrial Application of Novel Metal Oxide Passivating Contacts with a Starting Efficiency of 18.1%  
**Pierpaolo Spinelli**<sup>1</sup>, Eelko Hoek<sup>1</sup>, Benjamin Kikkert<sup>1</sup>, Mike Ah Sen<sup>1</sup>, Guangtao Yang<sup>2</sup>, Olindo Isabella<sup>2</sup>, Arthur Weeber<sup>1</sup>, Paula Bronsveld<sup>1</sup>  
<sup>1</sup> Energy Research Centre of the Netherlands (ECN); <sup>2</sup> Delft University of Technology
- 14:15 Formation of a Resistive SiO<sub>x</sub> Layer at the Interface of Poly-Si to Aluminium-Doped Zinc Oxide  
**Tobias Wietler**<sup>1</sup>, Dominic Tetzlaff<sup>2</sup>, Armin Feldhoff<sup>2</sup>, Yevgeniya Larionova<sup>1</sup>, Mircea Turcu<sup>1</sup>, Sina Reiter<sup>1</sup>, Byungsul Min<sup>1</sup>, Rolf Brendel<sup>1</sup>, Robby Peibst<sup>1</sup>  
Presented by Byungsul Min<sup>1</sup>  
<sup>1</sup> ISFH; <sup>2</sup> Leibniz University of Hannover
- 14:30 - 15:00 Coffee Break
- 15:00 - 16:30 Session 8: Characterization Multicrystalline Silicon and Modules**  
Chairs: Giso Hahn (University of Konstanz) & Paula Bronsveld (ECN)
- 15:00 3D Visualization and Analysis of Dislocation Clusters in Multicrystalline Si Ingot by Approach of Data Science  
**Yusuke Hayama**<sup>1</sup>, Tetsuya Matsumoto<sup>1</sup>, Tetsuro Muramatsu<sup>1</sup>, Kentaro Kutsukake<sup>1</sup>, Hiroaki Kudo<sup>1</sup>, Noritaka Usami<sup>1</sup>  
<sup>1</sup> Nagoya University
- 15:15 Investigation of Temperature and Illumination Dependencies of Carrier-Induced Defects in p-Type Multi-Crystalline Silicon  
**Shaoyang Liu**  
University of New South Wales

15:30 Atmospheric Pressure Dry Texturing Enabling > 20% Conversion Efficiency on Multicrystalline Silicon PERC Solar Cells  
**Bishal Kafle**<sup>1</sup>, Ahmed Ismail Ridoy<sup>1</sup>, Pierre Saint-Cast<sup>1</sup>, Laurent Clochard<sup>2</sup>, Edward Duffy<sup>2</sup>, Marc Hofmann<sup>1</sup>, Jochen Rentsch<sup>1</sup>  
<sup>1</sup> Fraunhofer ISE; <sup>2</sup> Nines PV

15:45 Mechanical Damage of Half-Cell Cutting Technologies in Solar Cells and Module Laminates  
**Felix Kaule**<sup>1</sup>, Matthias Pander<sup>1</sup>, Marko Turek<sup>1</sup>, Michael Grimm<sup>2</sup>, Eckehard Hofmüller<sup>3</sup>, Stephan Schoenfelder<sup>1</sup>  
<sup>1</sup> Fraunhofer CSP; <sup>2</sup> 3D-Micromac AG; <sup>3</sup> CE Cell Engineering GmbH

16:00 Investigating PID Shunting in Polycrystalline Silicon Modules via Multi-Scale, Multi-Technique Characterization  
**Mowafak Al-Jassim**  
National Renewable Energy Laboratory (NREL)

16:15 Temperature Effects of Bifacial Modules: Hot or Cool?  
**Bas Van Aken**<sup>1</sup>, Machteld Lamers<sup>1</sup>, Ebrar Ozkalay<sup>1</sup>, Sundeep Gali<sup>1</sup>, Arthur Weeber<sup>1</sup>, Gaby Janssen<sup>1</sup>, Ingrid Romijn<sup>1</sup>  
<sup>1</sup> ECN Solar Energy

**16:30 - Poster Session 2 (with Apéro)**

**18:00** The poster topics are labeled with the following letters:

- A Advanced characterization and simulation
- B Carrier selective contacts and contact formation
- C Cleaning, etching, surface morphology and surface passivation
- D High and record efficiency devices
- E Junction formation
- F Module processing and materials
- G Module reliability and production yield
- H Process integration and low-cost manufacturing
- I Si-based tandem cells, new materials and novel approaches
- J Silicon material and defect engineering
- K Wafering technologies
- nPV Posters of nPV Workshop

2-A-25 Light Scattering at Random Pyramid Textures: Effects Beyond Geometric Optics  
**Oliver Hoehn**<sup>1</sup>, Nico Tucher<sup>1</sup>, Armin Richter<sup>1</sup>, Martin Hermle<sup>1</sup>, Benedikt Blaesi<sup>1</sup>  
<sup>1</sup> Fraunhofer ISE

- 2-A-26 Microcrystalline Silicon Oxide Stacks for Silicon Heterojunction Solar Cells for Hot Climates  
**Jan Haschke**<sup>1</sup>, Raphaël Monnard<sup>1</sup>, Jean Cattin<sup>1</sup>, Amir A. Abdallah<sup>2</sup>, Brahim Aïssa<sup>2</sup>, Nouar Tabet<sup>2</sup>, Mathieu Boccard<sup>1</sup>, Christophe Ballif<sup>1</sup>  
<sup>1</sup> EPFL; <sup>2</sup> Qatar Environment and Energy Research Institute (QEERI)
- 2-A-27 Enhanced Optical Properties of Lithography Free Inverted Pyramids with Tetragonal Star Shape Surface Morphology  
**Ergi Dönerçark**<sup>1</sup>, Tahir Çolakoglu<sup>1</sup>, Musa Kurtulus Abak<sup>1</sup>, Makbule Terlemezoglu<sup>1</sup>, Alpan Bek<sup>1</sup>, Rasit Turan<sup>1</sup>  
<sup>1</sup> Middle East Technical University
- 2-A-28 Impact of Pyramid Size and Periodicity of Periodic Inverted Pyramids on Optical Properties for Silicon Heterojunction Solar Cells  
**Samia Ahmed Nadi**<sup>1</sup>, Florian Lentz<sup>1</sup>, Yael Augarten<sup>1</sup>, Karsten Bittkau<sup>1</sup>, Andreas Lambertz<sup>1</sup>, Li Ding<sup>1</sup>, Andrew Wrigley<sup>1</sup>, Kaining Ding<sup>1</sup>, Uwe Rau<sup>1</sup>  
<sup>1</sup> Forschungszentrum Jülich
- 2-E-01 Control of Boron Diffusion from APCVD BSG Layers by Interface Oxidation  
**Sebastian Meier**<sup>1</sup>, Andreas Wolf<sup>1</sup>, Sebastian Mack<sup>1</sup>, Sabrina Lohmüller<sup>1</sup>, Stefan Glunz<sup>1</sup>  
<sup>1</sup> Fraunhofer ISE
- 2-E-02 Low Temperature Epitaxial Growth of B-Doped Si Emitters: The Role of Hydrogen on Structural and Electrical Properties  
**Marta Chrostowski**<sup>1</sup>, Rafaël Peyronnet<sup>2</sup>, Wanghua Chen<sup>2</sup>, Nicolas Vaissiere<sup>3</sup>, Jose Alvarez<sup>4</sup>, Pere Roca I Cabarrocas<sup>3</sup>, Etienne Drahi<sup>1</sup>  
<sup>1</sup> Total; <sup>2</sup> IPVF; <sup>3</sup> LPICM; <sup>4</sup> GeePs - CentraleSupélec
- 2-E-03 Transfer of POCl<sub>3</sub> Diffusion Processes from Atmospheric Pressure to High Throughput Low Pressure  
**Sabrina Lohmüller (née Werner)**<sup>1</sup>, Stefan Schmidt<sup>1</sup>, Elmar Lohmüller<sup>1</sup>, Udo Belledin<sup>1</sup>, David Herrmann<sup>1</sup>, Andreas Wolf<sup>1</sup>  
<sup>1</sup> Fraunhofer ISE
- 2-F-01 New-Generation Indium-Free and UV-Transparent SmartWire Connection Technology  
**Heng-Yu Li**<sup>1</sup>, Antonin Faes<sup>1</sup>, Jonathan Champlaud<sup>1</sup>, Jordi Escarré Palou<sup>1</sup>, Fabien Debrot<sup>1</sup>, Jacques Levrat<sup>1</sup>, Laure-Emmanuelle Perret<sup>1</sup>, Matthieu Despeisse<sup>1</sup>, Christophe Ballif<sup>1</sup>, Thomas Söderström<sup>2</sup>, Yu Yao<sup>2</sup>, Maria Klinger<sup>2</sup>, Seda Beyer<sup>2</sup>  
<sup>1</sup> CSEM SA; <sup>2</sup> Meyer Burger AG

- 2-F-02      Electrically Conductive Adhesives as Cell Interconnection Material in Shingled Module Technology  
**Anja Henckens**<sup>1</sup>, Bob Willems<sup>1</sup>, Diego Tonini<sup>2</sup>, Marco Galiazzo<sup>2</sup>, Giorgio Cellere<sup>2</sup>, Jonathan Burke<sup>1</sup>  
Presented by Liesbeth Theunissen <sup>1</sup>  
<sup>1</sup> Henkel; <sup>2</sup> Applied Materials Italia Srl
- 2-F-03      Full Size IBC Module Based on Industrially Processed 95 µm Thin Cells with a CtM Power Loss < 1%  
**Jan Kroon**<sup>1</sup>, Paul Sommeling<sup>1</sup>, Nicolas Guillevin<sup>1</sup>, Lars Okel<sup>1</sup>, Frank Lenzmann<sup>1</sup>  
<sup>1</sup> ECN Solar Energy
- 2-F-04      Wave-Shaped Wires Soldered on the Finger Grid of Solar Cells: Solder Joint Stability Under Thermal Cycling  
**Li Carlos Rendler**<sup>1</sup>, Ade Putra Haryantho<sup>1</sup>, Johann Walter<sup>1</sup>, Achim Kraft<sup>1</sup>, Steffen Wiese<sup>2</sup>, Ulrich Eitner<sup>1</sup>  
<sup>1</sup> Fraunhofer ISE; <sup>2</sup> Saarland University
- 2-F-05      Mathematical Modeling of Vacuum Refining of Silicon Melt under the Conditions of Electromagnetic Stirring  
**Sergey Karabanov**  
Ryazan State Radio Engineering University
- 2-G-01      Energy Yield Considerations Based on the BO-Related Defect  
**Matthias Müller**<sup>1</sup>, Johannes Heitmann<sup>1</sup>, Michael Ehrh<sup>1</sup>  
<sup>1</sup> Technical University Bergakademie Freiberg
- 2-G-02      Reassessment of Cell to Module Gains and Losses: Accounting for the Current Boost Specific to Cells Located on the Edges  
**Olivier Dupré**<sup>1</sup>, Jacques Levrat<sup>2</sup>, Jonathan Champlaud<sup>2</sup>, Matthieu Despeisse<sup>2</sup>, Mathieu Boccard<sup>1</sup>, Christophe Ballif<sup>1</sup>  
<sup>1</sup> EPFL; <sup>2</sup> CSEM
- 2-G-03      Vertical PV Above Land and Water  
**Bas Van Aken**<sup>1</sup>, Anna Carr<sup>1</sup>, Wilem Vermeulen<sup>2</sup>, Rob Kreiter<sup>3</sup>, Harm Lok<sup>4</sup>  
<sup>1</sup> ECN Solar Energy; <sup>2</sup> Tempres Systems; <sup>3</sup> Sunfloat; <sup>4</sup> Hanze University of Applied Sciences
- 2-G-04      High Efficiency Road of Power Output by Mipro-Module  
**Shuping Wang**<sup>1</sup>, Mark Qian<sup>1</sup>, Xia Cai<sup>1</sup>  
<sup>1</sup> Talesun Technologies Co., Ltd
- 2-J-01      Firing and Gettering Dependence of Effective Defect Density in Material Exhibiting LeTID  
**Daniel Skorka**<sup>1</sup>, Annika Zuschlag<sup>1</sup>, Giso Hahn<sup>1</sup>  
<sup>1</sup> University of Konstanz



- 2-J-02      **Gettering Efficacy of Diffusion Processes Based on Doped APCVD Glasses**  
**Johannes Fichtner**<sup>1</sup>, Annika Zuschlag<sup>1</sup>, Giso Hahn<sup>1</sup>  
<sup>1</sup> University of Konstanz
- 2-J-03      **Role of Hydrogen: Regeneration and Formation of Meta-Stable Defects Due to Hydrogen in Silicon**  
**Moonyong Kim**<sup>1</sup>, Daniel Chen<sup>1</sup>, Malcolm Abbott<sup>1</sup>, Stuart Wenham<sup>1</sup>, Brett Hallam<sup>1</sup>  
<sup>1</sup> University of New South Wales
- 2-J-04      **Resistivity Profiles in Multicrystalline Silicon Ingots Featuring Gallium Co-Doping**  
**Rune Søndena**<sup>1</sup>, Halvard Haug<sup>1</sup>, Adolphus Song<sup>2</sup>, Eddie Hsueh<sup>2</sup>, Jan Ove Odde<sup>3</sup>  
<sup>1</sup> IFE (Institute for Energy Technology); <sup>2</sup> REC Solar Pte. Ltd.; <sup>3</sup> Elkem Solar AS
- 2-J-05      **About the Relevance of Defect Features in Ascut Multicrystalline Silicon Wafers on Solar Cell Performance**  
**Aditya Kovvali**<sup>1</sup>, Matthias Demant<sup>1</sup>, Jonas Haunschild<sup>1</sup>, Stefan Rein<sup>1</sup>, Theresa Troetschler<sup>1</sup>  
<sup>1</sup> Fraunhofer ISE
- 2-J-06      **Impact of Thermal History on Defects Formation in the Last Solid Fraction of n-Type Cz Silicon Ingots**  
**Adeline Lanterne**<sup>1</sup>, Guilherme Gaspar<sup>2</sup>, Bjørn Haave<sup>2</sup>, Moez Jomâa<sup>3</sup>, Rune Søndena<sup>4</sup>, Alexander Hupfer<sup>5</sup>, Yu Hu<sup>6</sup>, Marisa Di Sabatino<sup>2</sup>  
<sup>1</sup> Univ Grenoble Alpes, CEA, LITEN, DTS, INES; <sup>2</sup> NTNU, Department of Materials Science and Engineering; <sup>3</sup> SINTEF, Materials and Chemistry; <sup>4</sup> IFE (Institute for Energy Technology); <sup>5</sup> UiO, Department of Physics; <sup>6</sup> Norsun AS
- 2-J-07      **Lifetime Degradation in Multicrystalline Silicon Under Illumination at Elevated Temperature: The Role of Hydrogen**  
**Dennis Brede-meier**<sup>1</sup>, Dominic Walter<sup>1</sup>, Jan Schmidt<sup>1</sup>  
<sup>1</sup> ISFH
- 2-J-08      **8 ms Carrier Lifetime in Kerfless Epitaxial Wafers by n-Type POLO Gettering**  
**Catherin Gemmel**<sup>1</sup>, Jan Hensen<sup>1</sup>, Felix Haase<sup>1</sup>, Nils Folchert<sup>1</sup>, Robby Peibst<sup>1</sup>, Sarah Kajari-Schröder<sup>1</sup>, Rolf Brendel<sup>1</sup>  
<sup>1</sup> ISFH
- 2-J-09      **Influence of Dielectric Layers and Thermal Load on LeTID**  
**Clemens Winter**<sup>1</sup>, Daniel Skorka<sup>1</sup>, Giso Hahn<sup>1</sup>  
<sup>1</sup> University of Konstanz

- 2-J-10 Influence of Bound Hydrogen States on the Carrier-Induced Degradation in Multi-Crystalline Silicon  
**Tsun Hang Fung**  
University of New South Wales
- 2-J-11 Light-Induced Degradation Variation in Industrial Multicrystalline PERC Silicon Solar Cells  
**Jeanette Lindroos<sup>1</sup>**, Annika Zuschlag<sup>1</sup>, Jürgen Carstensen<sup>2</sup>, Giso Hahn<sup>1</sup>  
<sup>1</sup> University of Konstanz; <sup>2</sup> Christian-Albrechts-University of Kiel
- 2-J-12 Copper-Related Light Induced Degradation Activated by Firing  
**Nitin Nampalli<sup>1</sup>**, Chiara Modanese<sup>1</sup>, Jack Colwell<sup>2</sup>, Ville Vähänissi<sup>1</sup>, Alessandro Inglese<sup>1</sup>, Hannu Laine<sup>1</sup>, Michael Serué<sup>1</sup>, Henri Vahlman<sup>1</sup>, Marko Yli-Koski<sup>1</sup>, Ziv Hameiri<sup>2</sup>, Hele Savin<sup>1</sup>  
<sup>1</sup> Aalto University; <sup>2</sup> University of New South Wales
- 2-J-13 Elimination of BO-LID in Mass Production Using Illuminated Annealing in a Coupled Firing and Regeneration Tool  
**Christian Derricks<sup>1</sup>**, Axel Herguth<sup>1</sup>, Giso Hahn<sup>1</sup>, Thomas Pernau<sup>2</sup>, Olaf Romer<sup>2</sup>  
<sup>1</sup> University of Konstanz; <sup>2</sup> centrotherm international AG
- 2-J-14 Defect Engineered p-Type Heterojunction Solar Cells with Record Open Circuit Voltages >700 mV for Czochralski and >690 mV for Multicrystalline Si  
**Brett Hallam<sup>1</sup>**, Daniel Chen<sup>1</sup>, Jianwei Shi<sup>2</sup>, Moonyong Kim<sup>1</sup>, Roland Einhaus<sup>3</sup>, Zachary Holman<sup>2</sup>, Stuart Wenham<sup>1</sup>  
<sup>1</sup> UNSW Sydney; <sup>2</sup> Arizona State University; <sup>3</sup> Apollon Solar
- 2-J-15 On the Influence of Temperature on LeTID in mc-Si  
**Philipp Keller<sup>1</sup>**, Noemi Mundhaas<sup>1</sup>, David Sperber<sup>1</sup>, Axel Herguth<sup>1</sup>  
Presented by Axel Herguth<sup>1</sup>  
<sup>1</sup> University of Konstanz
- 2-J-17 Application of GC-MS Analysis to Monosilane Pyrolysis for Production of Solar Grade Silicon  
**Guro Marie Wyller<sup>1</sup>**, Thomas Preston<sup>1</sup>, Hallgeir Klette<sup>1</sup>, Ørnulf Nordseth<sup>1</sup>, Marte Skare<sup>1</sup>, Erik Marstein<sup>1</sup>  
<sup>1</sup> IFE (Institute for Energy Technology)
- 2-J-18 High-Pressure High-Temperature Synthesis: A Path Towards New Hexagonal Allotropes of Silicon  
**Silvia Pandolfi<sup>1</sup>**, Carlos Renero-Lecuna<sup>1</sup>, Yann Le Godec<sup>1</sup>, Michele Lazzeri<sup>1</sup>, Benoit Baptiste<sup>1</sup>, Christel Gervais<sup>2</sup>, Nicolas Menguy<sup>1</sup>, Kristina Spektor<sup>3</sup>, Oleksandr Kurakevych<sup>1</sup>, Wilson A. Crichton<sup>3</sup>  
<sup>1</sup> IMPMC-UPMC; <sup>2</sup> LCMCP-UPMC; <sup>3</sup> ESRF

- 2-J-19 Effect of Crystallographic Defects and Impurities on the Efficiency of Solar Cells from Different Silicon Feedstocks  
**Muhammad Tayyib**<sup>1</sup>, Jan Ove Odden<sup>2</sup>, Anne-Karin Soeiland<sup>2</sup>  
<sup>1</sup> University College Southeast Norway; <sup>2</sup> Elkem Solar AS
- 2-J-20 Impact of Copper on Light-Induced Degradation in Czochralski-Silicon PERC Solar Cells  
**Chiara Modanese**<sup>1</sup>, Matthias Wagner<sup>2</sup>, Alexander Oehlke<sup>2</sup>, Franziska Wolny<sup>2</sup>, Hannu Laine<sup>1</sup>, Alessandro Inglese<sup>1</sup>, Henri Vahlman<sup>1</sup>, Marko Yli-Koski<sup>1</sup>, Hele Savin<sup>1</sup>  
<sup>1</sup> Aalto University; <sup>2</sup> SolarWorld Industries GmbH
- 2-J-21 Minority Carrier Lifetime in Indium Doped Silicon for Photovoltaics  
**John Murphy**<sup>1</sup>, Alex Pointon<sup>1</sup>, Nicholas Grant<sup>1</sup>  
<sup>1</sup> University of Warwick
- 2-J-22 Identifying Recombination Parameters by Injection Dependent Lifetime Spectroscopy on mc-Silicon Based on PL-Imaging  
**Marie Syre Wiig**<sup>1</sup>, Halvard Haug<sup>1</sup>, Rune Søndena<sup>1</sup>, Erik S. Marstein<sup>1</sup>  
<sup>1</sup> IFE (Institute for Energy Technology)
- 2-J-23 A Novel Approach for Suppression of Oxygen Precipitation in CZ Silicon Wafers of Solar Cells by Pre-Thermal Treatment  
**Katsuto Tanahashi**<sup>1</sup>, Tetsuo Fukuda<sup>1</sup>, Katsuhiko Shirasawa<sup>1</sup>, Hidetaka Takato<sup>1</sup>  
<sup>1</sup> National Institute of Advanced Industrial Science and Technology (AIST)
- 2-J-24 Development of Recombination Junctions for Stable Hybrid (Thin Film/c-Si Wafer) Silicon Triple PV Multi-junctions for Production of High Voltages  
**Arno Smets**<sup>1</sup>, Miro Zeman<sup>1</sup>, Michael Falkenberg<sup>1</sup>, Machiel Stam<sup>1</sup>, Paula Perez-Rodrigue<sup>1</sup>  
<sup>1</sup> Delft University of Technology
- 2-J-25 Study on the Degradation of Photovoltaic Modules Exposed Over 23 Years in Hot-Dry Environment of China  
**Huan Yan**<sup>1</sup>, Huili Han<sup>1</sup>, Xian Dong<sup>2</sup>, Hui Shen<sup>1</sup>, Zongcun Liang<sup>1</sup>  
<sup>1</sup> Sun Yat-sen University; <sup>2</sup> ShunDe SYSU Institute for Solar Energy
- 2-J-26 Fabrication and Characterization of G-Doped Si Solar Cells  
**Avtandil Tavkhelidze**<sup>1</sup>, Zakhari Taliashvili<sup>2</sup>, Larissa Jangidze<sup>2</sup>, Tsothe Khikhalashvili<sup>1</sup>, Givi Skhiladze<sup>2</sup>, Doru Ursutiu<sup>3</sup>, Cornel Samoila<sup>3</sup>  
<sup>1</sup> Iliia State University; <sup>2</sup> Institute of Micro and Nano Electronics; <sup>3</sup> Transilvania University of Brasov



## Wednesday, March 21, 2018

08:00 - Registration  
08:30

*Please note that the MED building will be closed on March 21 from 10:30 to 13:30. The registration desk will be closed during this time.*

### 08:30 - Opening Session nPV

08:45

nPV Workshop Welcome

**Matthieu Despeisse**, CSEM

### 08:45 - Session 9: Silicon Materials and Defect Engineering 10:00

Chairs: Hui Shen (Sun Yat-sen University) & Mowafak Al-Jassim (NREL)

08:45

Proposal of an Improved CZ Growth Technique of Monocrystalline Silicon Crystals for High-Efficiency PV Cells

**Tetsuo Fukuda**<sup>1</sup>, Yukichi Horioka<sup>2</sup>, Nobumasa Kariya<sup>3</sup>, Kozo Fujiwara<sup>4</sup>, Katsuto Tanahashi<sup>1</sup>, Katsuhiko Shirasawa<sup>1</sup>, Hidetaka Takato<sup>1</sup>

<sup>1</sup> Renewable Energy Research Center, AIST; <sup>2</sup> Frontier Technology Business Research Institute Co. LTD.; <sup>3</sup> M. Setek Co. Ltd.; <sup>4</sup> Institute for Materials Research, Tohoku University

09:00

Efficiency Limiting Crystal Defects in Mono-Si and Their Characterization in Production

**Ferenc Korsós**<sup>1</sup>, László Roszol<sup>1</sup>, Frederic Jay<sup>1</sup>, Tamás Szarvas<sup>1</sup>, Nicolas Laurent<sup>1</sup>, Zoltán Kiss<sup>1</sup>, Jordi Veirman<sup>2</sup>, Mickael Albaric<sup>2</sup>, Abdelarim Debrouz Draoua<sup>2</sup>, István Soczó<sup>1</sup>

<sup>1</sup> Semilab Co. Ltd.; <sup>2</sup> Univ Grenoble Alpes, CEA, LITEN, DTS, INES

09:15

Taking Monocrystalline Silicon to the Ultimate Lifetime Limit

**Tim Niewelt**<sup>1</sup>, Armin Richter<sup>2</sup>, Teng Kho<sup>3</sup>, Nicholas E. Grant<sup>4</sup>, Ruy Sebastian Bonilla<sup>5</sup>, Pheng Phang<sup>3</sup>, John D. Murphy<sup>4</sup>, Martin C. Schubert<sup>2</sup>

<sup>1</sup> Freiburg Materials Research Centre; <sup>2</sup> Fraunhofer ISE; <sup>3</sup> Australian National University; <sup>4</sup> School of Engineering, University of Warwick; <sup>5</sup> Oxford University

09:30

Hydrogen Activated Recombination: A Mechanism for LeTID in n-Type Silicon

**Daniel Chen**<sup>1</sup>, Tsun Hang Fung<sup>1</sup>, Moonyong Kim<sup>1</sup>, Brett Hallam<sup>1</sup>, Malcolm Abbott<sup>1</sup>, Catherine Chan<sup>1</sup>, David Payne<sup>1</sup>, Aref Samadi<sup>1</sup>, Utkarshaa Varshney<sup>1</sup>, Stuart Wenham<sup>1</sup>

<sup>1</sup> University of New South Wales

09:45 Reassessment of Intrinsic Lifetime Limit in n-Type Crystalline Silicon and Implication on Maximum Solar Cell Efficiency

**Boris Veith-Wolf<sup>1</sup>**, Jan Schmidt<sup>1</sup>

<sup>1</sup> ISFH

10:00 - Coffee Break  
10:30

**10:30 - Session 10: Passivating Contacts**

**11:30** Chairs: Delfina Muñoz (CEA-INES) & Monica Morales Masis (EPFL)

10:30 Effect of Carrier-Induced Hydrogenation on Passivation of poly-Si/SiO<sub>x</sub>/c-Si Interface

**Yang Yang<sup>1</sup>**, YunYun Hu<sup>1</sup>, Lijuan Chen<sup>1</sup>, Pietro Altermatt<sup>1</sup>, DaMing Chen<sup>1</sup>, Guanchao Xu<sup>1</sup>, ZiGang Wang<sup>1</sup>, Phillip Hamer<sup>2</sup>, Ruy Bonilla<sup>2</sup>, Zhiqiang Feng<sup>1</sup>, Pierre Verlinden<sup>1</sup>

<sup>1</sup> Changzhou Trina Solar Energy Co., Ltd; <sup>2</sup> Oxford University

10:45 ZnO:Al/a-SiO<sub>x</sub> Front Contact for Polycrystalline-Silicon-on-Oxide (POLO) Solar Cells

**Anna Belen Morales Vilches<sup>1</sup>**, Yevgeniya Larionova<sup>2</sup>, Tobias Wietler<sup>2</sup>, Lars Korte<sup>1</sup>, Robby Peibst<sup>2</sup>, Rolf Brendel<sup>2</sup>, Bernd Stannowski<sup>1</sup>

<sup>1</sup> Helmholtz-Zentrum Berlin; <sup>2</sup> ISFH

11:00 Ultra-Thin Atomic Layer Deposited Aluminium Oxide Passivated Hole-Selective Contacts for n-Type Silicon Solar Cells

**Zheng Xin<sup>1</sup>**, Zhi Peng Ling<sup>1</sup>, Cangming Ke<sup>1</sup>, Kwan Bum Choi<sup>1</sup>, Pu Qun Wang<sup>1</sup>, Rolf Stangl<sup>1</sup>, Armin G. Aberle<sup>1</sup>

<sup>1</sup> Solar Energy Research Institute of Singapore (SERIS)

11:15 Temperature-Dependent Contact Resistance Measurements on Carrier-Selective Poly-Si on Oxide Junctions

**Nils Folchert<sup>1</sup>**, Michael Rienäcker<sup>1</sup>, Audie Adam Yeo<sup>1</sup>, Byungsul Min<sup>1</sup>, Robby Peibst<sup>1</sup>, Rolf Brendel<sup>1</sup>

<sup>1</sup> ISFH

**11:30 - Extended Talk**

**12:00** Heterojunction Technology, a New Opportunity for PV Manufacturing in Europe

**Anna Battaglia, ENEL**



*Dr. Anna Battaglia*

Anna Battaglia has a PhD in Physics and is working on materials modification induced by ion implantation. She has more than 20 years of experience in the Semiconductor Industries having worked for equipment manufacturing companies such as Lam Research Corporation, Applied Materials and Novellus Systems and covering the technology management role for all the products' applications. In 2011 she joined the PV technology arena working on industrial research on thin film silicon photovoltaic. She is the coordinator of H2020 LC£09 AMPERE project. She is author of several articles and patents in the field of semiconductor technology and PV.

**12:00 - EU Project Special Presentation**

**12:20** Anna Molinari, Uniresearch

12:20 - 12:45 Lunch Break (at the Rolex Forum)

**12:45 - Poster Session 3**

**14:15**

The poster topics are labeled with the following letters:

- A Advanced characterization and simulation
- B Carrier selective contacts and contact formation
- C Cleaning, etching, surface morphology and surface passivation
- D High and record efficiency devices
- E Junction formation
- F Module processing and materials
- G Module reliability and production yield
- H Process integration and low-cost manufacturing
- I Si-based tandem cells, new materials and novel approaches
- J Silicon material and defect engineering
- K Wafering technologies
- nPV Posters of nPV Workshop



- 3-B-01 Poly-Si and SiO<sub>2</sub> Passivation Contact on Front and Rear Sides of Si Solar Cell with 22% Efficiency  
**Chao Cheng Lin**<sup>1</sup>, Chong-Jye Huang<sup>1</sup>, Chen-Hsun Du<sup>1</sup>, Li-Yang Chuang<sup>2</sup>, Yih-Shing Lee<sup>2</sup>  
<sup>1</sup> Industrial Technology Research Institute; <sup>2</sup> Minghsin University
- 3-B-02 Applicability of Photonic Sintering and Autoclaving as Alternative Contacting Methods for Silicon Solar Cells with Passivated Contacts  
**Joerg Schube**<sup>1</sup>, Tobias Fellmeth<sup>1</sup>, Florian Maier<sup>1</sup>, Florian Clement<sup>1</sup>, Stefan Glunz<sup>1</sup>  
<sup>1</sup> Fraunhofer ISE
- 3-B-03 MoO<sub>x</sub> as Hole Selective Collector in p-Type Si Heterojunction Solar Cells  
**Marco Della Noce**<sup>1</sup>, Eugenia Bobeico<sup>1</sup>, Laura Lancellotti<sup>1</sup>, Lucia V. Mercaldo<sup>1</sup>, Iurie Usatii<sup>1</sup>, Paola Delli Veneri<sup>1</sup>  
<sup>1</sup> ENEA
- 3-B-04 A Novel Fired Silicon-Based Heterojunction for High Efficiency c-Si Solar Cells  
**Andrea Ingenito**<sup>1</sup>, Gizem Nogay<sup>1</sup>, Christophe Allebé<sup>2</sup>, Jörg Horzel<sup>2</sup>, Franz-Josef Haug<sup>1</sup>, Matthieu Despeisse<sup>2</sup>, Philipp Löper<sup>1</sup>, Christophe Ballif<sup>1</sup>  
<sup>1</sup> EPFL; <sup>2</sup> CSEM
- 3-B-05 Wet Chemical Preparation of Silicon Tunnel Oxides for Transparent Passivated Contacts in Crystalline Silicon Solar Cells  
**Malte Köhler**<sup>1</sup>, Manuel Pomaska<sup>1</sup>, Florian Lentz<sup>1</sup>, Kaining Ding<sup>1</sup>  
Presented by: Kaining Ding<sup>1</sup>  
<sup>1</sup> Forschungszentrum Jülich
- 3-B-06 Numerical Simulation of Temperature Dependence of MoO<sub>x</sub> Based SHJ Solar Cell  
**Ramachandran Ammapet Vijayan**<sup>1</sup>, Stephanie Essig<sup>2</sup>, Sangaravadivel Masilamani<sup>1</sup>, Philipp Löper<sup>3</sup>, Christophe Ballif<sup>3</sup>, Muthubalan Varadharajaperumal<sup>1</sup>  
<sup>1</sup> SASTRA University; <sup>2</sup> Sol Voltaics; <sup>3</sup> EPFL
- 3-B-07 Carrier-Selective Contacts with Different Thermal Budget for Front / Back Contacted (FBC) Solar Cells  
**Gianluca Limodio**<sup>1</sup>, Guangtao Yang<sup>1</sup>, Arthur Weeber<sup>1</sup>, Olindo Isabella<sup>1</sup>, Miro Zeman<sup>1</sup>  
<sup>1</sup> Delft University of Technology
- 3-B-08 Novel Mask-Less Plating Metallization Route for Bifacial Silicon Heterojunction Solar Cells  
**Thibaud Hatt**  
Fraunhofer ISE

- 3-B-09 Transport Losses Mitigation in Silicon Heterojunction Solar Cells Contact Stacks  
**Laurie-Lou Senaud**<sup>1</sup>, Loris Barraud<sup>1</sup>, Gabriel Christmann<sup>1</sup>, Antoine Descoedres<sup>1</sup>, Nicolas Badel<sup>1</sup>, Jonas Geissbühler<sup>1</sup>, Sylvain Nicolay<sup>1</sup>, Matthieu Despeisse<sup>1</sup>, Bertrand Paviet-Salomon<sup>1</sup>, Christophe Ballif<sup>1</sup>  
<sup>1</sup> CSEM
- 3-B-10 Improvement of the Conductivity and Surface Passivation Properties of Boron-Doped Poly-Silicon on Oxide  
**Audrey Morisset**<sup>1</sup>, Raphaël Cabal<sup>2</sup>, Bernadette Grange<sup>2</sup>, Clément Marchat<sup>3</sup>, José Alvarez<sup>4</sup>, Marie-Estelle Gueunier-Farret<sup>4</sup>, Sébastien Dubois<sup>2</sup>, Jean-Paul Kleider<sup>4</sup>  
<sup>1</sup> CEA (INES) / IPVF; <sup>2</sup> CEA Grenoble (INES); <sup>3</sup> Institut Photovoltaïque d'Île de France (IPVF); <sup>4</sup> CNRS
- 3-B-11 Realization of Passivating Contacts Using Industrial Scale PECVD Equipment  
**Jana Polzin**<sup>1</sup>, Frank Feldmann<sup>1</sup>, Bernd Steinhauser<sup>1</sup>, Jan Temmler<sup>1</sup>, Sebastian Mack<sup>1</sup>, Anamaria Moldovan<sup>1</sup>, Jochen Rentsch<sup>1</sup>, Martin Hermle<sup>1</sup>  
<sup>1</sup> Fraunhofer ISE
- 3-B-12 Increasing the Photo-Generated Current in Solar Cells with Passivating Contacts by Reducing the Poly-Si Deposition Temperature  
**Byungsul Min**<sup>1</sup>, Malte Vogt<sup>1</sup>, Tobias Wietler<sup>1</sup>, Rolf Reineke-Koch<sup>1</sup>, Bettina Wolpensinger<sup>1</sup>, Eike Köhnen<sup>2</sup>, Dominic Tetzlaff<sup>2</sup>, Carsten Schinke<sup>2</sup>, Karsten Bothe<sup>1</sup>, Rolf Brendel<sup>1</sup>, Robby Peibst<sup>1</sup>  
<sup>1</sup> ISFH; <sup>2</sup> Leibniz University of Hannover
- 3-B-13 Silicon Oxide Treatment to Promote Crystallinity of nc-Si:H (p)  
**Raphaël Monnard**<sup>1</sup>, Andrea Tomasi<sup>1</sup>, Bertrand Paviet-Salomon<sup>2</sup>, Matthieu Despeisse<sup>2</sup>, Mathieu Boccard<sup>1</sup>, Christophe Ballif<sup>1</sup>  
<sup>1</sup> EPFL; <sup>2</sup> CSEM PV-Center
- 3-B-14 In Situ X-ray Photoelectron Emission Spectroscopy Analysis of the Thermal Stability of WO<sub>x</sub> and MoO<sub>x</sub> Hole-Selective Contacts  
**Tian Zhang**<sup>1</sup>, Chang-Yeh Lee<sup>1</sup>, Bing Gong<sup>1</sup>, Stuart Wenham<sup>1</sup>, Bram Hoex<sup>1</sup>  
<sup>1</sup> UNSW Sydney
- 3-B-15 Reduction of Parasitic Absorption in PEDOT:PSS at the Rear of c-Si Solar Cells  
**Marc-Uwe Halbich**<sup>1</sup>, Dimitri Zielke<sup>1</sup>, Ralf Gogolin<sup>1</sup>, Rüdiger Sauer<sup>2</sup>, Wilfried Lövenich<sup>2</sup>, Jan Schmidt<sup>1</sup>  
<sup>1</sup> ISFH; <sup>2</sup> Heraeus Deutschland GmbH & Co. KG

- 3-B-16  $iV_{oc} > 730\text{mV}$ , and  $\rho_c < 1\text{ m}\Omega\cdot\text{cm}^2$  n+ Passivated Contacts Achieved Via Low Pressure Oxidation and LPCVD Polysilicon  
**Kean Chern Fong**<sup>1</sup>, Teng Kho Choon<sup>1</sup>, Wen Sheng Liang<sup>1</sup>, Teck Kong Chong<sup>1</sup>, Marco Ernst<sup>1</sup>, Daniel Walter<sup>1</sup>, Matthew Stocks<sup>1</sup>, Evan Franklin<sup>1</sup>, Keith McIntosh<sup>2</sup>, Blakers Andrew<sup>1</sup>  
<sup>1</sup> Australian National University; <sup>2</sup> PV Lighthouse
- 3-B-17 Passivating and Hole-Selective Metal Oxide Based Silicon Heterojunctions: A Simulation Study  
**Martin Bivour**<sup>1</sup>, Christoph Messmer<sup>1</sup>, Jonas Schön<sup>1</sup>, Martin Hermle<sup>1</sup>  
Presented by Christoph Messmer<sup>1</sup>  
<sup>1</sup> Fraunhofer ISE
- 3-B-18 Influence of ITO Sputter Deposition on Phosphorus-Doped Nanostructured Silicon Oxide Passivating Electron Contacts  
**Josua Stuckelberger**<sup>1</sup>, Philippe Wyss<sup>1</sup>, Gizem Nogay<sup>1</sup>, Christophe Allebé<sup>2</sup>, Jörg Horzel<sup>2</sup>, Matthieu Despeisse<sup>2</sup>, Andrea Ingenito<sup>1</sup>, Franz-Josef Haug<sup>1</sup>, Philipp Löper<sup>1</sup>, Christophe Ballif<sup>1</sup>  
<sup>1</sup> EPFL; <sup>2</sup> CSEM
- 3-B-19 Transparent Conductive Oxides for Passivating Rear Contacts  
**Leonard Tutsch**<sup>1</sup>, Frank Feldmann<sup>1</sup>, Martin Bivour<sup>1</sup>, Winfried Wolke<sup>1</sup>, Martin Hermle<sup>1</sup>, Jochen Rentsch<sup>1</sup>  
<sup>1</sup> Fraunhofer ISE
- 3-B-20 Controlling P and B Indiffusion During Polysilicon Formation  
**Machteld Lamers**<sup>1</sup>, Paula Bronsveld<sup>1</sup>, Ji Liu<sup>1</sup>, Arthur Weeber<sup>1</sup>  
<sup>1</sup> ECN
- 3-B-21 Band Line-Up of Indium-Tungsten-Oxide on Crystalline Silicon  
**Mathias Mews**<sup>1</sup>, Dorothee Menzel<sup>1</sup>, Lars Korte<sup>1</sup>  
<sup>1</sup> Helmholtz-Zentrum Berlin
- 3-B-22 Electron-Selective Atomic-Layer-Deposited TiO<sub>x</sub> Layers: Impact of Post-Treatments and Implementation Into n-Type Silicon Solar Cells  
**Valeriya Titova**<sup>1</sup>, Dimitrij Startsev<sup>2</sup>, Jan Schmidt<sup>1</sup>  
<sup>1</sup> Institut für Solarenergieforschung GmbH; <sup>2</sup> Leibniz University of Hannover

- 3-B-23 Silicon Heterojunction Cells with Improved Spectral Response Using n-Type  $\mu\text{-Si}$  from a Novel PECVD Approach  
**Yury Smirnov**<sup>1</sup>, Twan Bearda<sup>2</sup>, Hariharsudan Sivaramakrishnan Radhakrishnan<sup>2</sup>, Miha Filipic<sup>2</sup>, Jinyoun Cho<sup>2</sup>, Menglei Xu<sup>2</sup>, Shruti Jambaldinni<sup>2</sup>, Arsalan Razzaq<sup>2</sup>, MD Gius Uddin<sup>2</sup>, Kris Van Nieuwenhuysen<sup>2</sup>, Ivan Gordon<sup>2</sup>, Maarten Debucquoy<sup>2</sup>, Yaser Abdulraheem<sup>3</sup>, Ivan Vasil'evskii<sup>1</sup>, Jozef Szlufcik<sup>2</sup>, Jef Poortmans<sup>2</sup>  
<sup>1</sup> National Research Nuclear University MEPhI; <sup>2</sup> imec; <sup>3</sup> Kuwait University
- 3-B-24 Electron Beam Evaporated Molybdenum Oxide as Hole-Selective Contact in 6 Inch c-Si Heterojunction Solar Cells  
**Mike Tang Soo Kiong Ah Sen**<sup>1</sup>, Paula Bronsveld<sup>1</sup>, Bart Macco<sup>2</sup>, Pierpaolo Spinelli<sup>1</sup>, Benjamin Kikkert<sup>1</sup>, Eelko Hoek<sup>1</sup>  
<sup>1</sup> Energy Research Centre of the Netherlands (ECN); <sup>2</sup> Eindhoven University of Technology
- 3-B-25 Catalytic-Doping on Silicon Alloys for the Use in Silicon Heterojunction Solar Cell  
**Yong Liu**<sup>1</sup>, Weiyuan Duan<sup>1</sup>, Manuel Pomaska<sup>1</sup>, Do Yun Kim<sup>1</sup>, Malte Köhler<sup>1</sup>, Florian Lentz<sup>1</sup>, Uwe Breuer<sup>1</sup>, Kaining Ding<sup>1</sup>  
<sup>1</sup> Forschungszentrum Jülich
- 3-B-26 The Influence of Thermal Annealing on Characteristics of Tunneling Oxide Passivating Contact  
**Min Gu Kang**<sup>1</sup>, Ka-Hyun Kim<sup>1</sup>, Sungjin Choi<sup>1</sup>, Myeong Sang Jeong<sup>1</sup>, Kwan Hong Min<sup>1</sup>, Jeong In Lee<sup>1</sup>, Hee-eun Song<sup>1</sup>  
<sup>1</sup> Korea Institute of Energy Research
- 3-B-27 Characterization of Carrier-Selective Aluminum Contacts to Silicon Heterojunction Cells  
**Jonathan Bryan**<sup>1</sup>, Zachary Holman<sup>1</sup>, Jason Yu<sup>1</sup>, Ashling Leilaeiou<sup>1</sup>, Kathryn Fisher<sup>1</sup>  
<sup>1</sup> Arizona State University
- 3-B-28 Numerical Analysis of Silicon Heterostructure Solar Cell with Carrier-Selective Molybdenum Oxide and Titanium Dioxide  
**Haris Mehmood**<sup>1</sup>, Tauseef Tauqeer<sup>2</sup>, Hisham Nasser<sup>3</sup>, Firat Es<sup>3</sup>, Ragit Turan<sup>3</sup>  
Presented by Firat Es<sup>3</sup>  
<sup>1</sup> National University of Sciences and Technology; <sup>2</sup> Information Technology University (ITU); <sup>3</sup> Middle East Technical University
- 3-B-29 Towards Industrial Deposition of Metal Oxides for Passivating and Carrier Selective Contacts:  $\text{MoO}_x$  Deposited by Industrial Size Reactive DC Magnetron Sputtering and Industrial Size Linear Evaporation Source  
**Volker Linss**<sup>1</sup>, Martin Bivour<sup>2</sup>  
<sup>1</sup> VON ARDENNE GmbH; <sup>2</sup> Fraunhofer ISE

- 3-B-30 Nitride Layers as Carrier-Selective Contacts for Silicon Heterojunction Solar Cells  
**Mathieu Boccard**<sup>1</sup>, Angela Fioretti<sup>2</sup>, Andriy Zakutayev<sup>2</sup>, Adele Tamboli<sup>2</sup>, Christophe Ballif<sup>3</sup>  
<sup>1</sup> EPFL PVlab; <sup>2</sup> National Renewable Energy Laboratory (NREL); <sup>3</sup> EPFL
- 3-B-31 Quantifying Optical Losses of Silicon Solar Cells with Carrier Selective Hole Contacts  
**Bram Hoex**<sup>1</sup>, Marc Dielen<sup>1</sup>, Tian Zhang<sup>1</sup>  
<sup>1</sup> UNSW Sydney
- 3-B-32 Dopant Free MoO<sub>3</sub>/Si/TiO<sub>2</sub> Heterojunction Solar Cell Fabricated Below 100°C  
**Swasti Bhatia**<sup>1</sup>, Irfan Khorakiwala<sup>1</sup>, Pradeep R. Nair<sup>1</sup>, Aldrin Antony<sup>1</sup>  
<sup>1</sup> Indian Institute of Technology (IIT) Bombay
- 3-B-33 Optimizing TCO Layers for Bifacial Crystalline Silicon Homojunction Solar Cells Integrating Passivated Contacts  
**Elise Bruhat**<sup>1</sup>, Thibaut Desrues<sup>1</sup>, Danièle Blanc Pélissier<sup>2</sup>  
 Presented by Adeline Lanterne<sup>1</sup>  
<sup>1</sup> CEA INES; <sup>2</sup> INL
- 3-B-34 Ag and Cu Contact Formation by Using Current-Injection Method in Boron Emitter  
**Seunghyun Shin**<sup>1</sup>, Soohyun Bae<sup>1</sup>, Hae-seok Lee<sup>1</sup>, YoonMook Kang<sup>1</sup>  
<sup>1</sup> Korea University
- 3-D-01 Interdigitated Back Contact Silicon Heterojunction Solar Cells: Towards Optimised Contact Resistance for High Fill Factors  
**Johann-Christoph Stang**<sup>1</sup>, Mathias Mews<sup>1</sup>, Philipp Wagner<sup>1</sup>, Anna Belen Morales Vilches<sup>1</sup>, Bernd Stannowski<sup>1</sup>, Lars Korte<sup>1</sup>  
<sup>1</sup> Helmholtz-Zentrum Berlin
- 3-D-02 Silicon Heterojunction Solar Cells on Quasi-Mono Wafers  
**Jan Haschke**<sup>1</sup>, Jörg Horzel<sup>2</sup>, Maulid M. Kivambe<sup>3</sup>, Amir A. Abdallah<sup>3</sup>, Nouar Tabet<sup>3</sup>, Matthieu Despeisse<sup>2</sup>, Mathieu Boccard<sup>1</sup>, Christophe Ballif<sup>1</sup>  
<sup>1</sup> EPFL; <sup>2</sup> CSEM; <sup>3</sup> Qatar Environment and Energy Research Institute (QEERI)
- 3-H-01 Development and Characterization of Multifunctional PECVD SiN<sub>x</sub>:P Layers for Laser-Doped Selective Emitters  
**Mohammad Hassan Norouzi**<sup>1</sup>, Pierre Saint-Cast<sup>1</sup>, Elmar Lohmüller<sup>1</sup>, Julian Weber<sup>1</sup>, Simon Gutscher<sup>1</sup>, Sven Kluska<sup>1</sup>, Jonas Bartsch<sup>1</sup>, Sabrina Lohmüller<sup>1</sup>, Bernd Steinhauser<sup>1</sup>, Jan Benick<sup>1</sup>, Bernd Bitnar<sup>2</sup>, Phedon Palinginis<sup>3</sup>, Holger Neuhaus<sup>3</sup>, Marc Hofmann<sup>1</sup>, Andreas Wolf<sup>1</sup>  
<sup>1</sup> Fraunhofer ISE; <sup>2</sup> Infineon Technologies Dresden GmbH; <sup>3</sup> SolarWorld Industries GmbH

- 3-H-02 Towards an Industrially Feasible n-Type IBC Solar Cells Process  
**Giuseppe Galbiati**<sup>1</sup>, Florian Buchholz<sup>1</sup>, Elina Schmid<sup>1</sup>, Eckard Wefringhaus<sup>1</sup>, Dominik Rudolph<sup>1</sup>  
<sup>1</sup> ISC-Konstanz
- 3-H-03 Approach of a Fluid Dynamic Model for the Investigation of an Industrial Wet Chemical Process Bath  
**Lena Mohr**<sup>1</sup>, Martin Zimmer<sup>1</sup>, Martin Menschick<sup>2</sup>  
<sup>1</sup> Fraunhofer ISE; <sup>2</sup> SINGULUS TECHNOLOGIE AG
- 3-H-04 High Efficiency Monocrystalline Silicon PERC Solar Cell Over 21.6% Based on Annealing and Thermal-Oxidation Processes  
**Yue Yao**<sup>1</sup>, Dangping Hu<sup>1</sup>, Weifei Lian<sup>1</sup>, Junyu Lu<sup>1</sup>, Yao Zhang<sup>1</sup>, Jinyi Wang<sup>1</sup>, Shude Zhang<sup>1</sup>  
<sup>1</sup> Suzhou Talesun Solar Technologies Co., Ltd.
- 3-H-05 The Application of Different Surface Reflectance and Passivation in the Multi-Crystal Industrialization  
**Hongqiang Qian**  
Suzhou Talesun Solar Technologies Co., Ltd.
- 3-H-06 Optimization of Light Induced Degradation Regeneration of p-Type Mono PERC Solar Cell by Electrical Injection Method  
**Qingzhu Wei**  
Talesun Technologies Co., Ltd
- 3-nPV-01 Heterojunction Cells with Copper Electroplated Contacts: Process and Cell Properties  
**Agata Lachowicz**<sup>1</sup>, Loris Barraud<sup>1</sup>, Jonas Geissbühler<sup>1</sup>, Antonin Faes<sup>1</sup>, Jörg Horzel<sup>1</sup>, Christophe Ballif<sup>1</sup>, Matthieu Despeisse<sup>1</sup>  
<sup>1</sup> CSEM PV-Center
- 3-nPV-02 Bifacial Screen Printed n-Type Passivated Emitter Rear Totally Diffused Rear Junction Solar Cells  
**Corrado Comparotto**<sup>1</sup>, Jan Lossen<sup>1</sup>, Valentin Mihailetchi<sup>1</sup>  
<sup>1</sup> ISC-Konstanz
- 3-nPV-03 Study the JSC Loss of SHJ Solar Cells Caused by Edge Recombination  
**Lifei Yang**<sup>1</sup>, Xingbing Li<sup>1</sup>, Wenbin Zhang<sup>1</sup>  
<sup>1</sup> GCL System Integration Technology Co., Ltd.

**14:15 - Session 11: IBC**

**15:45** Chairs: Radovan Kopecek (ISC Konstanz) & Rolf Brendel (ISFH)

14:15 Theoretical Evaluation of Contact Stack for High Efficiency IBC-SHJ Solar Cells

**Paul Procel<sup>1</sup>**, Guangtao Yang<sup>1</sup>, Olindo Isabella<sup>1</sup>, Miro Zeman<sup>1</sup>  
<sup>1</sup> Delft University of Technology

14:30 20.7% Efficient Dopant-Free Back Contact Silicon Solar Cells Using MoO<sub>x</sub> and MgF<sub>2</sub> Films

**Weiliang Wu<sup>1</sup>**, Mathieu Boccard<sup>1</sup>, Wenjie Lin<sup>2</sup>, Zongcun Liang<sup>2</sup>,  
Christophe Ballif<sup>1</sup>, Bertrand Paviet-Salomon<sup>3</sup>  
<sup>1</sup> EPFL; <sup>2</sup> Sun Yat-Sen University; <sup>3</sup> CSEM

14:45 Laser-Induced BSF: A New Approach to Simplify IBC-SHJ Solar Cell Fabrication

**Ravi Vasudevan<sup>1</sup>**, Samuel Harrison<sup>1</sup>, Guillaume D'Alonzo<sup>1</sup>,  
Delfina Munoz<sup>1</sup>, Charles Roux<sup>1</sup>  
<sup>1</sup> CEA INES

15:00 High-Efficiency C-Si IBC Solar Cells with Poly-Si(O<sub>x</sub>) Passivating Contacts

**Guangtao Yang<sup>1</sup>**, Paul Procel<sup>2</sup>, Gianluca Limodio<sup>2</sup>, PeiQing Guo<sup>2</sup>,  
Olindo Isabella<sup>2</sup>, Miro Zeman<sup>2</sup>  
<sup>1</sup> Eindhoven University of Technology; <sup>2</sup> Delft University of Technology

15:15 Full Wafer Size IBC Cell with Polysilicon Passivating Contacts

**Agnes Mewe<sup>1</sup>**, Maciej Stodolny<sup>1</sup>, John Anker<sup>1</sup>, Martijn Lenes<sup>2</sup>,  
Xavier Pages<sup>3</sup>, Yu Wu<sup>1</sup>, Kees Tool<sup>1</sup>, Bart Geerligs<sup>1</sup>, Ingrid Romijn<sup>1</sup>  
<sup>1</sup> ECN Solar Energy; <sup>2</sup> Tempres Systems; <sup>3</sup> Levitech B.V.

15:30 Interdigitated-Back Contact Modules Based on the i-Cell Concept

**Yves Salinesi<sup>1</sup>**, Eckard Wefringhaus<sup>2</sup>, Alioune Sow<sup>1</sup>, Maria  
Hadjipanayi<sup>3</sup>, Youssouf Boye<sup>1</sup>, Eden Terraz<sup>1</sup>, Antoine Malinge<sup>1</sup>,  
Alain Straboni<sup>1</sup>  
<sup>1</sup> S'TILE; <sup>2</sup> ISC-Konstanz; <sup>3</sup> University of Cyprus

15:45 -  
16:15 Coffee Break



**16:15 - Session 12: Heterojunction and PERT**

**17:30** Chairs: Stefaan De Wolf (KAUST) & Pierre-Jean Ribeyron (CEA-INES)

16:15 Zr-Doped  $\text{In}_2\text{O}_3$ : Combining High-Doping and High-Mobility to Form an Ultra-Transparent Electrode for SHJ Solar Cells

**Monica Morales-Masis**<sup>1</sup>, Esteban Rucavado<sup>1</sup>, Raphaël Monnard<sup>1</sup>, Sylvain Dunand<sup>1</sup>, Loris Barraud<sup>2</sup>, Matthieu Despeisse<sup>2</sup>, Mathieu Boccard<sup>1</sup>, Christophe Ballif<sup>1</sup>

<sup>1</sup> EPFL; <sup>2</sup> CSEM PV-Center

16:30 The Influence of Surface Passivation on High Performance Silicon Solar Cells of Different Thicknesses

**André Augusto**<sup>1</sup>, Pradeep Balaji<sup>1</sup>, Apoorva Srinivasa<sup>1</sup>, Stuart Bowden<sup>1</sup>

<sup>1</sup> Arizona State University

16:45 Lowering the Activation Temperature of Implanted Boron Emitters by Plasma Immersion Ion Implantation

**Adeline Lanterne**<sup>1</sup>, Thibaut Desrues<sup>1</sup>, Coralie Lorfeuvre<sup>1</sup>, Marianne Coig<sup>2</sup>, Frank Torregrosa<sup>3</sup>, Frédéric Milesi<sup>2</sup>, Laurent Roux<sup>3</sup>, Sébastien Dubois<sup>4</sup>

<sup>1</sup> Univ Grenoble Alpes, CEA, LITEN, DTS, INES; <sup>2</sup> Univ Grenoble Alpes, CEA, LETI; <sup>3</sup> IBS; <sup>4</sup> CEA-INES

17:00 Beyond 21% Efficiency n-PERT Rear Junction Solar Cells with Screen Printed Al Point Back Contact

**Zih-Wei Peng**<sup>1</sup>, Thomas Buck<sup>1</sup>, Lejo Joseph Koduvelikulathu<sup>1</sup>, Masahiro Nakahara<sup>2</sup>, Radovan Kopecek<sup>1</sup>

<sup>1</sup> ISC-Konstanz; <sup>2</sup> Toyo Aluminium K.K.

17:15  $\text{BBr}_3$  Diffusion with Second Deposition for Laser-Doped Selective Emitters from Borosilicate Glass

**Elmar Lohmüller**<sup>1</sup>, Sabrina Lohmüller (née Werner)<sup>1</sup>, Udo Belledin<sup>1</sup>

<sup>1</sup> Fraunhofer ISE

**17:30 - Closing Session SiliconPV**

**18:00**

Closing SiliconPV

**Christophe Ballif**, EPFL

SiliconPV Award Ceremony for the Best 10 Abstracts

**Christophe Ballif**, EPFL

*The ceremony is sponsored by Sinton Instruments*

*Thank you!*

Announcement SiliconPV 2019



# Thursday, March 22, 2018

08:00 - Registration  
08:30

## 08:30 - Opening

08:40 Opening nPV and Highlights SiliconPV  
**Matthieu Despeisse**, CSEM

## 08:40 - Silicon Material

10:00 Chairs: Pierre-Jean Ribeyron (CEA-INES) & Arthur Weeber (ECN)

08:40 Overview of n-Type Crystalline Silicon Materials for Photovoltaic Applications  
**Jordi Veirman**, CEA INES

09:00 New Findings in PERC Cell Degradation  
**Jeanette Lindroos**, University of Konstanz

09:20 Mono Wafer Requirements for Advanced High Efficiency Silicon Solar Cells  
**YC Wang**, LONGi Solar

09:40 Cz Ingot and Wafer for High-End Solar Cells  
**Yu Hu**, Norsun AS

10:00 - Coffee Break  
10:20

## 10:20 - Passivation & Contacts

11:40 Chairs: Stefan Glunz (Fraunhofer ISE) & Jan Schmidt (ISFH)

10:20 Spectra-Dependent Stability of Surface Passivation on p- vs. n-Type Silicon Solar Cells  
**Boris Veith-Wolf**, ISFH

10:40 Latest Development of HJT Cells Using MIRROR PECVD Double Side Deposition  
**Omid Shojaei**, IndeoTEC SA

- 11:00 Boron Autodoped LPCVD Polysilicon as a Surface Passivation and Contact Passivation Layer on the Front-side of n-PERT Solar Cells  
**Ronald Naber**, Tempres
- 11:20 Current and Possible Future PVD Process Technologies in Silicon Photovoltaics  
**Eric Schneiderlöchner**, VON ARDENNE GmbH
- 11:45 - Panel Discussion**  
**12:45** Chair: Christophe Ballif (EPFL)
- 12:45 - 13:30 Lunch Break
- 13:30 - Cell Production**  
**15:10** Chairs: Delfina Munoz (CEA-INES) & Joachim John (imec)
- 13:30 2-side Contacted n-Type Cells: The Route from nPERT Towards Poly-Si Passivated Contacts  
**Filip Duerinckx**, imec
- 13:50 nPERT and nIBC Solar Cell Technology in Mass Production  
**Liu Yong**, JOLYWOOD
- 14:10 A Successful Conversion of Hevel Si Thin-Film Solar Module Production to Heterojunction Technology  
**Dmitry Andronikov**, HEVEL
- 14:30 Silicon Heterojunction Solar Cell Technologies and its Researches in GCL  
**Lifei Yang**, GCL System Integration Technology Co., Ltd.
- 14:50 Recent Progress at Trina in Large Area IBC Cells with Passivated Contacts  
**Yang Yang**, Changzhou Trina Solar Energy Co., Ltd
- 15:10 - 15:30 Coffee Break
- 15:30 - Modules & Systems**  
**17:10** Chairs: Antonin Faes (CSEM) & Radovan Kopecek (ISC Konstanz)
- 15:30 Review on Interconnection Technologies for p- and n-Type Modules  
**Jan Kroon**, ECN Solar Energy



## General Information

### Posters

See the poster plan on page 46 for more details on poster codes and their specific location. Please mount your poster before the start of the first poster session. 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.

### Speaker Information

All presentations must be handed in at the Media Upload Desk in the MED building 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 Monday at 7:45 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.

### List of Participants

Registered participants may download a list of participants on the conference website, [www.siliconpv.com](http://www.siliconpv.com). The login and password sent to you during registration will be required to gain access to the download area.

### Certificate of Attendance

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

### Conference Proceedings

The proceedings will be published with AIP, the American Institute of Physics ([www.aip.org](http://www.aip.org)), after the conference, covering papers with sufficient scientific quality. This collaboration will provide optimum visibility of the proceedings and ensure that the authors' publications remain traceable and citable. Final online papers will be accessible on the AIP website and contain an ISBN number for the conference volume as well as individual DOI numbers for each paper.

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

### Contact Participants

SiliconPV offers a contact opportunity for conference participants in its internal Download Area on the conference website, [www.siliconpv.com](http://www.siliconpv.com). Log in with your password and contact other participants by e-mail.

All participants who want to use the contact feature confirmed their admission to send and receive e-mails to and from other conference participants. The first contact will occur indirectly via the conference system in the Download Area. No personal data will be handed out.

### WiFi Access

WiFi access will be available free of charge in the whole conference area.

SSID: public-epfl

Username : x-silicon

Password : supoxa59

## Technical Tour



© EPFL: The EPFL Microcity building in Neuchâtel with its test PV power plants, next door to CSEM



© CSEM: The bi-facial heterojunction facades in front of the CSEM clean rooms

On Monday evening, March 19, the technical tour will take you to Neuchâtel (45 minutes from Lausanne), where the Photovoltaics-Laboratory (PV-Lab) of EPFL and the CSEM PV-center are located.

You'll discover part of the 2000 m<sup>2</sup> of research facilities, with various laboratory and pilot tools, from layers and solar cells made in cluster systems, to full module fabrication and characterization. The visit includes the external Innoparc module facility site (with a view of the pilot R&D lines of Meyer Burger, gold sponsor of the conference) and a tour inside the CSEM clean room facilities (including tools of Indeotec SA, gold sponsor of the conference).

**Date:** Monday, March 19, evening

**Time:** 18:00 - approx. 23:00

There will be a bus shuttle leaving from Rolex Learning Center after the poster session, at 18:00. The buses going back will arrive at Lausanne main station at approximately 22:30 and at the Rolex Learning Center at approximately 23:00. A small dinner / snacks will be included.

**Fee:** CHF 25.00 (the tour is fully booked)



## Conference Dinner

The conference dinner will take place at the famous Olympic Museum in Lausanne. Prior to the dinner it will be possible to visit the permanent exhibition free of charge.

This uniquely attractive venue will provide the ideal environment for conference participants to maximize their networking in a relaxed and convivial atmosphere.

<b>Date:</b>	Tuesday, March 20
<b>Time:</b>	18:00 Visit of the exhibition 20:00 Conference Dinner
<b>Fee:</b>	The dinner is included in all full tickets, pre-registration required.

### How to get there

Participants are asked to organize their own transport to and from the Olympic Museum. The museum is easily accessible by public transport, car or taxi.

### Address:

The Olympic Museum  
1, Quai d'Ouchy  
1006 Lausanne  
Switzerland

### Public Transport from EPFL

From the conference center / EPFL you may use the following metro and bus lines, departing approximately every 7 minutes:

**M1** EPFL ⇒ Lausanne-Flon +

**M2** Lausanne-Flon ⇒ Ouchy-Olympique

**M1** EPFL ⇒ Lausanne-Flon +

**Bus 2** Lausanne-Flon ⇒ Ouchy-Olympique

**Bus 701** EPFL ⇒ Bourdonnette +

**Bus 25** Bourdonnette ⇒ Musée Olympique

**Bus 701** EPFL ⇒ Bourdonnette +

**M1** Bourdonnette ⇒ Lausanne-Flon +

**M2** Lausanne-Flon ⇒ Ouchy- Olympique

Please have a look at the conference website for more details.



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# Poster Plan

The first digit of the poster number represents the session the poster is assigned to (1-3).

The character indicates the poster topic:

- A Advanced characterization and simulation
- B Carrier selective contacts and contact formation
- C Cleaning, etching, surface morphology and surface passivation
- D High and record efficiency devices
- E Junction formation
- F Module processing and materials
- G Module reliability and production yield
- H Process integration and low-cost manufacturing
- I Si-based tandem cells, new materials and novel approaches
- J Silicon material and defect engineering
- K Wafering technologies
- nPV Posters of nPV Workshop

