

CONFERENCE PROGRAMME

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Monday, 07 September 2020

OPENING

PLENARY SESSION AP.1 /Scientific Opening

8:30 – 09:50 INNOVATIONS IN PV TECHNOLOGIES

Chairpersons:

Jozef (Jef) Poortmans
imec, Belgium

Andreas Bett
Fraunhofer ISE, Germany

AP.1.1 State of the Art in Perovskite Photovoltaics

A. Hagfeldt
EPFL, Lausanne, Switzerland

AP.1.2 Student Awards Finalist Presentation: The Race for the Best Silicon Bottom Cell: Efficiency and Cost Evaluation of Perovskite-Silicon Tandem Solar Cells

C. Messmer, B.S. Goraya, S. Nold, J. Schön, J.C. Goldschmidt, M. Bivour & M. Hermle
Fraunhofer ISE, Freiburg, Germany

AP.1.3 Intermediate Band Solar Cells: Present and Future

I. Ramiro & A. Martí
UPM, Madrid, Spain

AP.1.4 High Performance Organic Photovoltaics

D. Baran
KAUST, Jeddah, Saudi Arabia

10:00 – 10:30 Becquerel Prize Ceremony

Chaired by:

Joachim Luther
Chair Becquerel Prize Committee

Prize delivered by:

Piotr Szymanski, European Commission, Director of the JRC Directorate C for Energy, Transport and Climate

Laudatio

Pierre Verlinden
Becquerel Prize Winner 2019
Managing Director, Amrock Pty Ltd, Australia
Consultant, Non-Executive Director to PV companies, Visiting Professor at Sun Yat-sen University (Guangzhou)

Speech of the Becquerel Prize Winner 2020

Henry Snaith
Professor of Physics in the Clarendon Laboratory,
University of Oxford, united Kingdom

10:40 – 11:30 Opening Addresses

- Nicola Pearsall
EU PVSEC General Chair
Emerita Professor of Renewable Energy in the Faculty of Engineering and Environment of Northumbria University, United Kingdom
- Elias De Keyser
Next Kraftwerke Belgium,
"How aggregation can supply 100% renewable energies based on a B2B concept"



11:40 – 12:35 Moderated Panel Discussion
Title:

The role of PV in the Green Deal and the EU Recovery Package - Perspectives and chances for a sustainable future?

Moderated by:

Heinz Ossenbrink
former European Commission Joint Research Centre

Panellists

- Walburga Hemetsberger,
SolarPower Europe, Belgium
- Gunter Erfurt,
CEO of Meyer Burger, Germany
- Marko Topič,
Chair of ETIP PV, Vision of the ETIP PV
- Paolo Rossi,
Director of AEM SA

Panellists are asked to present a three-minute intro statement, followed by a moderated panel discussion and Q&A with the audience

ORAL PRESENTATIONS 1AO.1
13:30 – 15:00 Fundamentals: Novel Device and Module Concepts
Chairpersons:

David Patrick
Western Washington University, USA

Iñigo Ramiro
UPM, Madrid

- 1AO.1.1 Nanowire Solar Cell Beating the Radiative Limit**
K. Korzun, G. Castellanos Gonzalez, E.P.A.M. Bakkers, J. Gómez Riva & J.E.M. Haverkort
Eindhoven University of Technology, Netherlands
D. de Boer
Solumineus, Amsterdam, Netherlands
- 1AO.1.2 4D Photoluminescence Imaging for Advanced Characterization of Photovoltaic Absorber**
M. Legrand, A. Bercegol, L. Lombez & D. Ory
EDF R&D, Palaiseau, France
J.-F. Guillemoles
IPVF, Palaiseau, France
- 1AO.1.3 High Resolution Linearity Measurements of Solar Cells Using Digital Light Processing Projection**
G. Koutsourakis, T. Eales & J.C. Blakesley
NPL, Teddington, United Kingdom
I. Kröger
PTB, Braunschweig, Germany
- 1AO.1.4 Complete Performance Model for Optimal Coloured Photovoltaic Module Design Based on Optic Filters for Building Integrated Applications**
J.C. Ortiz Lizcano, G. Frantzi, G. Yang, H. Ziar, M. Zeman & O. Isabella
Delft University of Technology, Netherlands
- 1AO.1.5 Engineering the Reciprocal Space for Ultra Thin GaAs Solar Cells**
J. Buencuerpo, M.A. Steiner & A.C. Tamboli
NREL, Golden, USA
J.M. Llorens & J.M. Ripalda
IMM - CSIC, Tres Cantos, Spain
- 1AO.1.6 The Reduced Graphene Oxide/Au as Back Contacts for CdTe Solar Cells**
G. Luo & W. Li
Sichuan University, Chengdu, China



ORAL PRESENTATIONS 2AO.4

13:30 – 15:00 Silicon Materials and Defect Engineering

Chairpersons:

Noritaka Usami
Nagoya University, Japan

Denis Bredemeier
ISFH, Germany

2AO.4.1 The Crystal Growth Explorer: Real-Time Navigable 3D Visualization of Silicon Grains and Defect Related Data in Cast-Mono and Multicrystalline Bricks

J. Schönauer, T. Trötschler, A.S. Kovvali, M. Demant & S. Rein
Fraunhofer ISE, Freiburg, Germany
H. Schremmer
Hennecke Systems, Zülpich, Germany

2AO.4.2 What Is the Dislocation Sources in the Growth of High-Performance Multicrystalline Si Ingots?

Y. Ohno
Tohoku University, Sendai, Japan
K. Tajima & N. Usami
Nagoya University, Japan
K. Kutsukake
RIKEN, Tokyo, Japan

2AO.4.3 Cast-Mono Silicon Wafers for a Sustainable PV Market Growth

S. Riepe, S. Nold, P. Brailovsky, L. Friedrich, S. Janz & R. Preu
Fraunhofer ISE, Freiburg, Germany

2AO.4.4 Drop Test Method for Impact Loading on Silicon Wafer Edge: Damage and Breakage

L. Carton, R. Riva, Y. Abidate & F. Coustier
CEA, Le Bourget-du-Lac, France

2AO.4.5 Student Awards Finalist Presentation: Doped Poly-Si/SiO_x Passivating Contacts: Hydrogenation and Its Mechanisms

T.N. Truong, D. Yan, A. Cuevas, D. Macdonald & H.T. Nguyen
ANU, Canberra, Australia

ORAL PRESENTATIONS 3AO.7

13:30 – 15:00 High Efficiency Tandem Solar Cells

Chairpersons:

Christopher Case
Oxford PV, United Kingdom

Benjamin Strahm
Meyer Burger Research, Germany

3AO.7.1 Introductory Oral: Perovskite/Silicon Tandem Cells: Self-Assembled Monolayer as HTL for 29.2% Efficiency and Progress in Upscaling to Large Areas

E. Köhnen, A. Al-Ashouri, M. Roß, J.A. Marquez-Prieto, P. Caprioglio, A.B. Morales-Vilches, B. Li, B. Rech, R. Schlatmann, L. Korte, T. Unold, B. Stannowski & S. Albrecht
HZB, Berlin, Germany
A. Magomedov, E. Kasparavicius, T. Malinauskas & V. Getautis
Kaunas University of Technology, Lithuania
M. Stolterfoht & D. Neher
University of Potsdam, Germany

3AO.7.2 Silicon-Based Monolithic Triple-Junction Solar Cells with Conversion Efficiency >34%

R. Müller, P. Schygulla, D. Lackner, O. Höhn, H. Hauser, B. Bläsi, F. Predan, J. Benick, M. Hermle, F. Dimroth & S.W. Glunz
Fraunhofer ISE, Freiburg, Germany

3AO.7.3 Research on Flexible Triple Junction Solar Cells with High Specific Power

H. Wang, M. Jiang, P. Gao, R. Liu & Q. Sun
Tianjin Institute of Power Sources, China

3AO.7.4 High-Efficiency All-Perovskite Tandem Solar Cells via Vacuum-Assisted Growth Control

B. Abdollahi Nejand, I.M. Hossain, M. Jakoby, S. Moghadamzadeh, U. Lemmer, B.S. Richards, I.A. Howard & U.W. Paetzold
Karlsruhe Institute of Technology, Germany

3AO.7.5 Fs-Laser Micro Machining for μ -TLM Resistivity Test Structures in TCO Top Contact Multilayers for Perovskite Heterojunction Tandem Solar Cells

S. Krause, S. Lange, V. Naumann, P.-T. Miclea & C. Hagendorf
Fraunhofer CSP, Halle (Saale), Germany
Q. Zhang, A. Richter, P.S.C. Schulze, O.S. Kabakli & J.C. Goldschmidt
Fraunhofer ISE, Freiburg, Germany



VISUAL PRESENTATIONS 4AV.1**13:30 – 15:00 Module Design Manufacture, Performance and Reliability (I)***Detailed information on this session is presented in the section entitled 'Visual Presentations'.***ORAL PRESENTATIONS 1AO.2****15:15 – 16:45 Advanced Solar Cell Architectures****Chairpersons:**Antonio Martí Vega
UPM, SpainJames Patrick Connolly
CNRS, France

- 1AO.2.1 Industrialization of Hybrid Si/III-V and Translucent Planar Micro-Tracking Modules**
G. Nardin, A.F. Aguilar, L. Anglade, M. Duchemin, D. Schuppisser, F. Gerlich, M. Ackermann & L. Coulot
Insolight, Ecublens, Switzerland
D. Petri, J. Champlaud, A. Faes, N. Badel, A. Lachowicz, M. Despeisse & J. Levrat
CSEM, Neuchâtel, Switzerland
X. Niquille & C. Ballif
EPFL, Neuchâtel, Switzerland
S. Askins, N. Jost, G. Vallerotto, C. Domínguez & I. Antón Hernández
UPM, Madrid, Spain
- 1AO.2.2 Back Surface Reflectors in Thinned III-V Gallium Arsenide Solar Cells**
J. D'Rozario, S. Polly, G. Nelson & S.M. Hubbard
Rochester Institute of Technology, USA
R. Tatavarti
MicroLink Devices, Niles, USA
- 1AO.2.3 Demonstration of GaAs-Based Energy-Transfer Ratchet Intermediate-Band Solar Cell**
T. Sogabe, C.-Y. Hung, R. Tamaki & Y. Okada
University of Tokyo, Japan
S. Tomic
University of Salford, Manchester, United Kingdom
N. Ekins-Daukes
UNSW Australia, Sydney, Australia
- 1AO.2.4 Flat Photonic Reflectors with Point Contact Approach for Cu(In,Ga)(S,Se)₂ Solar Cell Devices**
M. Balestrieri & D. Lincot
IPVF, Palaiseau, France
S. Lakhdar Chaouche, C. Jimenez & D. Bellet
CNRS, Grenoble, France
M. Foldyna & P. Roca i Cabarrocas
LPICM-CNRS, Palaiseau, France

- 1AO.2.5 Silicon Heterojunction Solar Cell Fabrication Using Nickel Oxide Hole-Selective Contact**
M. Nayak, A. Pandey & V.K. Komarala
IIT Delhi, New Dehli, India

ORAL PRESENTATIONS 2AO.5**15:15 – 16:45 Defects in Silicon****Chairpersons:**Fabian Fertig
Hanwha Q CELLS, GermanyJohn Murphy
University of Warwick, United Kingdom

- 2AO.5.1 Disappearance of Hydrogen-Boron-Pairs in Silicon during Illumination and Its Relevance to Lifetime Degradation and Regeneration Effects in Solar Cells**
D.C. Walter, D. Bredemeier & J. Schmidt
ISFH, Emmerthal, Germany
V.V. Voronkov
Global Wafers, Merano, Italy
R. Falster
Scientist, Woodstock, United Kingdom
- 2AO.5.2 Defect Reactions Responsible for Boron Oxygen Degradation in Crystalline Silicon Photovoltaics**
V. Markevich, A. Peaker, J.A. De Guzman, I. Crowe, I. Hawkins, S. Hammersley & M. Halsall
University of Manchester, United Kingdom
M. Vaquero-Contreras
UNSW Australia, Sydney, Australia
J. Coutinho & P. Santos
University of Aveiro, Portugal
- 2AO.5.3 LeTID- and (Extended) BO-Related Degradation and Regeneration in B- and Ga-Doped Monocrystalline Silicon during Dark and Illuminated Anneals**
W. Kwapil
University of Freiburg, Germany
J. Dalke, T. Niewelt & M.C. Schubert
Fraunhofer ISE, Freiburg, Germany
- 2AO.5.4 The Role of Dark Annealing in Light and Elevated Temperature Induced Degradation in p-Type Mono-Like Silicon: A New Insight to the Problem**
H.C. Sio, D. Kang & D. Macdonald
ANU, Canberra, Australia
- 2AO.5.5 Investigation of Areas with High D-Band Emission Lines D3 and D07 in Multi-Crystalline Silicon Wafers with EBSD, TEM, and Hyperspectral Photoluminescence Imaging**



A. Thøgersen, I.T. Jensen & J.S. Graff
 SINTEF, Oslo, Norway
 T. Mehl, I. Burud & E. Olsen
 NMBU, Ås, Norway
 J. Zhu, S.E. Foss & C.R. Søndena
 Institute for Energy Technology, Kjeller, Norway

- 2AO.5.6 Reducing LeTID with an Adjustment of the AlOx-SiNy:H Layer System**
 A. Schmid, C. Fischer, D. Skórka, A. Zuschlag & G. Hahn
 University of Konstanz, Germany

ORAL PRESENTATIONS 3AO.8

15:15 – 16:45 **Tandems: Material and Process Developments**

Chairpersons:

Sylvain Nicolay
 CSEM, Switzerland

Eric Schneiderlöchner
 Von Ardenne, Germany

- 3AO.8.1 Analysis and Optimization of Perovskite-Silicon Tandem Solar Cells by Full Optoelectronic Simulation**
 U. Aeberhard, R. Häusermann, A. Schiller, B. Blülle & B. Ruhstaller
 Fluxim, Winterthur, Switzerland
- 3AO.8.2 Quantifying Bottlenecks in Open-Circuit Voltage of Perovskite-Si Tandem Solar Cells**
 B.L. Williams
 Oxford PV, Yarnton, United Kingdom
- 3AO.8.3 Student Awards Finalist Presentation: High Band Gap Absorber for Monolithic Perovskite Silicon Tandem Solar Cells Reaching 25.1% Certified Efficiency and Ways Beyond**
 P.S.C. Schulze, A.J. Bett, O.S. Kabakli, K.M. Winkler, L.E. Mundt, F.M. Gerspacher, Q. Zhang, C.L.M. Hofmann, M. Bivour, M. Hermle, S.W. Glunz & J.C. Goldschmidt
 Fraunhofer ISE, Freiburg, Germany
 H. Hillebrecht
 University of Freiburg, Germany
- 3AO.8.4 2D Surface Passivation for Semi-Transparent Perovskite Solar Cells with Engineered Bandgap for 4T Tandem Photovoltaics**
 I.M. Hossain, S. Gharibzadeh, P. Fassel, A. Mertens, U. Lemmer, B.S. Richards & U.W. Paetzold
 Karlsruhe Institute of Technology, Germany
 S. Schäfer, M. Rienäcker, T. Wietler & R. Peibst
 ISFH, Emmerthal, Germany
- 3AO.8.5 Investigation of the Junction Influence on the Top-Cell in Perovskite/Silicon Tandem Solar Cells**
 A. Puaud, D. Saporì, M. Matheron, B. Marie, R. Couderc, C. Roux, N. Nguyen, M. Manceau, O. Dupré, S. Berson & D. Muñoz

CEA, Le Bourget-du-Lac, France
 G. Condorelli, M. Foti & C. Gerardi
 ENEL Green Power, Catania, Italy

- 3AO.8.6 Scaling Up Four-Terminal Bifacial Tandem**
 G. Coletti, V. Rosca, L.J. Geerligns, A.R. Burgers, L.A.G. Okel, K.M. de Groot, N.J.J. Dekker & M.J. Jansen
 TNO Energy Transition, Petten, Netherlands
 M. Najafi, D. Zhang, V. Zardetto, I. Dogan, R.A.J.M. Andriessen & S.C. Veenstra
 TNO Energy Transition, Eindhoven, Netherlands
 T. Aernouts
 imec, Genk, Belgium
 J. Hüpkes
 Forschungszentrum Jülich, Germany
 C. Burgess & M. Creatore
 Eindhoven University of Technology, Netherlands

VISUAL PRESENTATIONS 4AV.2

15:15 – 16:45 **Module Design Manufacture, Performance and Reliability (II)**

Detailed information on this session is presented in the section entitled 'Visual Presentations'.

ORAL PRESENTATIONS 1AO.3

17:00 – 18:30 **Advanced Materials and Approaches for PV-Modules**

Chairpersons:

Francesco Roca
 ENEA, Italy

Igor Konovalov
 University of Applied Sciences Jena, Germany

- 1AO.3.1 The Use of Copper in Solar Cells and Modules**
 P. Panek, K. Gawlinska-Necek & Z. Starowicz
 Polish Academy of Sciences, Cracow, Poland
 R.P. Socha & G. Putynkowski
 Research and Development Center of Technology for Industry, Warsaw, Poland
 M.K. Stodolny & B.B. Van Aken
 TNO Energy Transition, Petten, Netherlands
- 1AO.3.2 Low Temperature Lead Free Solder Pastes for Shingling Interconnection**
 N.S. Pujari & S. Sarkar
 Macdermid Alpha Electronics Solutions, Bangalore, India
 C. Bilgrien



Macdermid Alpha Electronics Solutions, New Jersey, USA

- 1AO.3.3 Encapsulant-Integrated Interconnection of Bifacial Solar Cells for BIPV Applications: Latest Results in the Twill-BIPV Project**
J. Govaerts, T. Borgers, R. Van Dyck, N. Andries, P. Meyers,
A. van der Heide, L. Vastmans, R. Moors, G. Doumen, P. Nivelle, M. Daenen,
E. Voroshazi & J. Poortmans
imec, Genk, Belgium
C. Arnett & R. Labie
imec, Leuven, Belgium
M. Van den Storme & G. Van den Storme
VdS Weaving, Oudenaarde, Belgium
M. Dekens, S. Vandebroek, P. Schroyen & K. Smeers
IPTE, Genk, Belgium
T. Vavilkin & S. Dewallef
Soltech, Tienen, Belgium
F. Abgrall & D. Jousset
Arkema, Colombes, France
- 1AO.3.4 Enabling the In-Situ Stress and Temperature Measurement by Silicon Solar Cell Integrated Stress and Temperature Sensors for Photovoltaic Modules**
A.J. Beinert, M. Imm, J. Benick, S. Seitz, M. Heinrich, S.W. Glunz, U. Eitner &
H. Neuhaus
Fraunhofer ISE, Freiburg, Germany
F. Becker & O. Paul
University of Freiburg, Germany
J. Aktaa
Karlsruhe Institute of Technology, Germany
- 1AO.3.5 Reconfigurable Modules for Higher Yields in Urban PV Systems – A Simulation Study**
A. Calcabrini, R. Weegink, M. Zeman & O. Isabella
Delft University of Technology, Netherlands
- 1AO.3.6 Spray Coating – A Versatile Technique for Thin Film Deposition in PV**
J. Bartsch, U. Heitmann, L. Jakob, R. Hermann, S. Kluska, L. Cojocar, L.
J.C. Goldschmidt, B. Bläsi, H. Hauser, S. Janz & M. Glatthaar
Fraunhofer ISE, Freiburg, Germany

ORAL PRESENTATIONS 2AO.6**17:00 – 18:30 Poly-Silicon Passivated Contacts (I)****Chairpersons:**Giso Hahn
University of Konstanz, GermanyRonald C.G. Naber
Tempress, The Netherlands

- 2AO.6.1 Towards 24% Efficiency for Industrial n-Type Bifacial Passivating-Contact Solar Cells with Homogeneous Emitter**
J. Bao, W. Wu, C. Chen, L. Ma, Z. Qiao, C. Huang, Q. Shao, C. Chen,
S. Zhan, R. Liu, Z. Liu & J. Chen
Jolywood, Taizhou, China
- 2AO.6.2 Fully Screen-Printed Silicon Solar Cells with Local Al-BSF Base Contact and a Voc of 711 mV**
F. Haase, B. Min, C. Hollemann, R. Brendel & R. Peibst
ISFH, Emmerthal, Germany
J. Krügener
Leibniz University of Hannover, Germany
- 2AO.6.3 Industrial TOPCon Solar Cells Realized by a PECVD Tube Process**
F. Feldmann, B. Steinhauser, H. Nagel, T. Fellmeth, S. Mack, D. Ourinson,
E. Lohmüller, J. Polzin, A. Moldovan, M. Bivour, F. Clement, J. Rentsch,
M. Hermle & S.W. Glunz
Fraunhofer ISE, Freiburg, Germany
T. Pernau
centrotherm international, Blaubeuren, Germany
- 2AO.6.4 POLO Back Junction: An Elegant Way to Implement Electron-Collecting Passivating Contacts in p-Type Industrial Silicon Solar Cells**
B. Min, A. Merkle, T. Brendemühl, N. Wehmeier, Y. Larionova, B. Beier,
L. David, H. Schulte-Huxel, T. Dullweber, R. Peibst & R. Brendel
ISFH, Emmerthal, Germany
- 2AO.6.5 Doping and Hydrogenation Processes for Passivating Contact Solar Cells Using Plasma Immersion Ion Implantation (PIII)**
T. Desrues, C. Oliveau, C. Seron & S. Dubois
CEA, Le Bourget-du-Lac, France
G. Borvon & F. Torregrosa
Ion Beam Services, Peynier, France
Q. Rafhay & A. Kaminski-Cachopo
IMEP-LAHC, Grenoble, France
- 2AO.6.6 Photocurrent Enhancement via Self-Aligned, Selective Area, Dry-Etching of Poly-Si/SiO₂ Passivated Contacts for High-Efficiency Silicon Solar Cells**
K. Chen, A.S. Kale & S. Agarwal
Colorado School of Mines, Golden, USA
V. LaSalvia, W. Nemeth, S. Theingi, D. Findley, H. Guthrey, M. Page,
P. Stradins & D.L. Young
NREL, Golden, USA

ORAL PRESENTATIONS 3AO.9**17:00 – 18:30 Organic PV: Efficiency, Stability, Scalability****Chairpersons:**Sjoerd Veenstra
TNO Energy Transition, The Netherlands

Invited

- 3AO.9.1 New World Record Efficiency for Organic Photovoltaic Modules**
A. Distler & H.-J. Egelhaaf
ZAE Bayern, Nuremberg, Germany
C.J. Brabec
FAU, Erlangen, Germany
- 3AO.9.2 Roll Processed Organic Solar Cells Based on P3HT:O-IDTBR**
M. Fernández Castro, E. Mazzolini, R.R. Søndergaard, M. Espindola-Rodriguez & J.W. Andreasen
Technical University of Denmark, Kgs. Lyngby, Denmark
- 3AO.9.3 Performance of Four Different Organic PV Modules According to the Energy Rating Standard Series IEC 61853**
G. Bardizza, E. Salis, A.M. Gracia Amillo & E.D. Dunlop
European Commission JRC, Ispra, Italy
- 3AO.9.4 Thermal Analysis of Organic Photovoltaic Modules as Building Elements in Long Term Outdoor Operating Conditions**
C.A. Toledo Arias, J. Abad & A. Urbina
UPCT, Cartagena, Spain
G. Bardizza & A.M. Gracia Amillo
European Commission JRC, Ispra, Italy
- 3AO.9.5 Challenges to Fully Roll-to-Roll Processed Organic Photovoltaic Devices**
M. Bertrand, D. Hau & F. Allais
ARMOR, Nantes, France
- 3AO.9.6 Extended Lifetime of Organic Solar Cells with New Non-Fullerene Acceptors**
R. López Vicente, J. Abad & A. Urbina
UPCT, Cartagena, Spain
M. Espindola-Rodriguez, M. Fernández Castro & J.W. Andreasen
Technical University of Denmark, Lyngby, Denmark

VISUAL PRESENTATIONS 4AV.3

17:00 – 18:30 Inverters, Micro-Inverters and BOS Components / Sustainability and Circular Economy

Detailed information on this session is presented in the section entitled 'Visual Presentations'.

Tuesday, 08 September 2020

ORAL PRESENTATIONS 2BO.1

08:30 – 10:00 Poly-Silicon Passivated Contacts (II)

Chairpersons:

Martin Hermle
Fraunhofer ISE, Germany

Thorsten Dullweber
ISFH, Germany

- 2BO.1.1 Plating on TOPCon as a Way to Reduce the Fabrication Costs of i-TOPCon Solar Cells**
B. Steinhauser, B. Grübel, S. Nold, V. Arya, C. Schmiga, S. Kluska, A.A. Brand, F. Feldmann & M. Glatthaar
Fraunhofer ISE, Freiburg, Germany
N. Bay, X. Gay & M. Passig
RENA, Gütenbach, Germany
- 2BO.1.2 Formation of p-Type Passivating Contacts by Short Annealing**
S. Libraro, F.-J. Haug & C. Ballif
EPFL, Neuchâtel, Switzerland
J.J. Diaz Leon, C. Allebé, S. Nicolay & A. Ingenito
CSEM, Neuchâtel, Switzerland
- 2BO.1.3 Fired-Only Passivating Poly-Si on Oxide Contacts with DC-Sputtered In-Situ Phosphorous-Doped Silicon Layers**
L. David, B. Min, C. Hollemann, R. Peibst & R. Brendel
ISFH, Emmerthal, Germany
S. Hübner, T. Dippell & P. Wohlfart
Singulus Technologies, Kahl am Main, Germany
- 2BO.1.4 Influence of Dielectric Films on the Passivation Quality of Phosphorus Doped Polysilicon Passivating Contacts Upon Firing**
D. Kang, H.C. Sio, D. Yan, J. Stuckelberger, W. Chen & D. Macdonald
ANU, Canberra, Australia
- 2BO.1.5 Assessing Performance and Limitations of Different Technologies for Poly-Si Based Passivating Contacts**
A. Ingenito, C. Allebé, J.J. Diaz Leon, G. Nogay, A. Descoedres & S. Nicolay
CSEM, Neuchâtel, Switzerland
S. Libraro & C. Ballif
EPFL, Neuchâtel, Switzerland
- 2BO.1.6 Development of Poly-Si Passivating Contacts on Textured Si Surface for Bottom c-Si Solar Cell Application**
G. Yang, S.K. Senthil Kumar, P.A. Procel Moya, Y. Zhao, C. Han, M. Singh, G. Limodio, L. Mazzarella, A.W. Weeber, M. Zeman & O. Isabella
Delft University of Technology, Netherlands



ORAL PRESENTATIONS 5BO.6**08:30 – 10:00 Solar Radiation Modelling and Instrumentation****Chairpersons:**

Elke Lorenz
Fraunhofer ISE, Germany

Ana Maria Gracia Amillo
European Commission JRC, Italy

5BO.6.1 Accurate Irradiance Simulation Approach Combining Ray Tracing and View Factors Models

A. Calcabrini, R. Cardose, P. Manganiello, M. Zeman & O. Isabella
Delft University of Technology, Netherlands

5BO.6.2 Student Awards Finalist Presentation: Quantification of the Effect of Albedo Modeling for a Floating PV System on the North Sea

S.Z. Mirbagheri Golroodbari & W.G.J.H.M. van Sark
Utrecht University, Netherlands

5BO.6.3 Method for Solar Potential Mapping of the Intra-Building over the Street Unoccupied Urban Volume

T. Santos
CICS.NOVA, Lisbon, Portugal
J. Rocha & K. Lobato
University of Lisbon, Portugal

5BO.6.4 Imputation of Missing Values in Irradiance Datasets

A. Louwen, S. Lindig & D. Moser
Eurac Research, Bolzano, Italy

5BO.6.5 The Impact of Albedo Measurements on Power Density Calculations of Bifacial Modules

E. Grommes, U. Blieske & J. Müller-Ost
Cologne University of Applied Sciences, Germany

5BO.6.6 Simulation and Validation of Bifacial Irradiance Sensor Mounting Position

M. Korevaar, P. Babal, S. van Nieuwkerk, K. Wilson & J. Mes
Kipp & Zonen, Delft, Netherlands

ORAL PRESENTATIONS 4BO.11**08:30 – 10:00 Backsheet and Encapsulation Materials****Chairpersons:**

William J. Gambogi
DuPont, USA

Gernot Oreski
PCCL, Austria

4BO.11.1 Comparability in the Ageing Behavior of Backsheets Exposed to Indoor and Outdoor Weathering

L. Castillon, C. Barretta & G. Oreski
PCCL, Leoben, Austria
D. Mansour
Fraunhofer ISE, Freiburg, Germany
S. Mitterhofer
University of Ljubljana, Slovenia

4BO.11.2 Validating Advanced Stress Testing Protocols Using Analysis of Degraded Polyvinylidene Fluoride-Based Backsheet Films

M. Owen-Bellini, D.C. Miller, D.R. Jenket & P. Hacke
NREL, Golden, USA
S.L. Moffitt & L.T. Schelhas
SLAC, Menlo Park, USA
A. Sinha
Arizona State University, Mesa, USA
A.M. Maes & J.Y. Hartley
Sandia National Laboratories, Albuquerque, USA
T. Karin
Lawrence Berkeley National Laboratory, USA
J. Tracy
DuPont, Wilmington, USA

4BO.11.3 Evolution of Microstructure in Polyvinylidene Fluoride-Based Backsheets After Aging

S.L. Moffitt, P.-C. Pan, L. Perry, D. Jacobs, L.-P. Sung, S. Watson & X. Gu
NIST, Gaithersburg, USA
M.D. Kempe
NREL, Golden, USA
J. Tracy & K. Roy Choudhury
DuPont, Wilmington, USA

4BO.11.4 More Realistic Consideration of Backsheet Coefficient of Thermal Expansion on Thermomechanics of PV Modules

P. Romer, A.J. Beinert, H. Neuhaus & M. Mittag
Fraunhofer ISE, Freiburg, Germany
G. Oreski
PCCL, Leoben, Austria

4BO.11.5 Optimisation of the Frontsheet Encapsulant for Increased Resistance of Lightweight Solar PV Modules

F. Lisco, A. Virtuani & C. Ballif
EPFL, Neuchâtel, Switzerland



- 4BO.11.6 Effect of Encapsulant Storage Conditions on the Long-Term Photo-Induced Degradation of EVA in Double-Glass Solar PV Modules**
L. Gnocchi, A. Fairbrother, A. Virtuani & C. Ballif
EPFL, Neuchâtel, Switzerland
H.-Y. Li
CSEM, Neuchâtel, Switzerland

V.D. Mihailetchi
ISC Konstanz, Germany
P. Baranek
EDF R&D, Palaiseau, France
O. Isabella & R. Santbergen
Delft University of Technology, Netherlands

ORAL PRESENTATIONS 1BO.16

08:30 – 10:00 Development and Characterization of New Solar Cell Architectures

Chairpersons:

Marin Rusu
HZB, Germany

Jean-Paul Kleider
CNRS/GeePs, France

- 1BO.16.1 Student Awards Finalist Presentation: Luminescent Characteristics of Wire-on-Well Nanostructure Solar Cells**
M. Asami, R. Yokota, K. Watanabe, Y. Nakano & M. Sugiyama
University of Tokyo, Japan
- 1BO.16.2 Measurements of Hot Carrier Temperature by Thermal Noise**
I. Konovalov & N. Bhattacharjee
University of Applied Sciences Jena, Germany
- 1BO.16.3 Tailoring Band Gap in 2D Nanolayers for Photovoltaic Applications: In₂Se₃ Films**
A.I. Shkrebtii / Chkrebti, R. Minnings & G. Perinparajah
Ontario Tech University, Oshawa, Canada
N. Arzate, S. Anderson & B. Mendoza
CIO, Guanajuato, Mexico
- 1BO.16.4 Formation of p-Type BaSi₂ Thin Film and its Application to Silicon-Based Heterojunction Solar Cells**
Y. Kimura, M. Fujiwara, K. Takahashi, Y. Nakagawa, T. Yoshino, K. Gotoh, Y. Kurokawa & N. Usami
Nagoya University, Japan
- 1BO.16.5 Wide-Bandgap UV-Selective Transparent Solar Cells Based on ZnO and Zn(O,S) Absorbers for BIPV Applications**
A.J. Lopez-Garcia, R. Fonoll Rubio, V. Izquierdo-Roca, E. Saucedo & A. Perez-Rodriguez
IREC, Barcelona, Spain
- 1BO.16.6 Recent Results on Carrier Selective Three Terminal Perovskite on Silicon-IBC Tandem Solar Cells**
J.P. Connolly, J.-P. Kleider & J. Alvarez
CNRS/GeePs, Gif-sur-Yvette, France
M.K. Nazeeruddin & H. Kanda
EPFL, Sion, Switzerland

VISUAL PRESENTATIONS 3BV.1

08:30 – 10:00 Perovskites

Detailed information on this session is presented in the section entitled 'Visual Presentations'.

ORAL PRESENTATIONS 2BO.2

10:30 – 12:00 PERX: Processes and Technologies

Chairpersons:

Barbara Terheiden
University of Konstanz, Germany

Stefan Glunz
Fraunhofer ISE, Germany

- 2BO.2.1 Comparison of LeTID in Monofacial and Bifacial Multi-Crystalline PERC Cells and Modules**
D. Zhang, B. Wan, G. Yan, J. Wu, F. Jiang, J.-N. Jaubert & G. Xing
Canadian Solar, Suzhou, China
- 2BO.2.2 Atmospheric Pressure Chemical Vapor Deposited Aluminum Oxide / Silicon Nitride Stacks for PERC and PERT Solar Cell Concepts with High Passivation Quality**
F. Geml, B. Gapp, S. Sanz Alonso, J. Engelhardt & G. Hahn
University of Konstanz, Germany
- 2BO.2.3 Simultaneous Boron Emitter Diffusion via Rapid Vapour-Phase Direct Doping and Crystallization of TOPCon Layers**
M. Drießen, A. Richter, B. Steinhauser, F. Feldmann, J.-I. Polzin, F. Sahajad, M. Ohnemus, C. Weiss, J. Benick & S. Janz
Fraunhofer ISE, Freiburg, Germany
- 2BO.2.4 Co-Plated Bifacial n-PERT Cells with 2-Sided Polysilicon Passivating Contacts**
S. Singh, P. Choulat, F. Duerinckx, M. Recaman Payo, L. Tous & J. Poortmans
imec, Leuven, Belgium
R.C.G. Naber & M. Lenes
Tempress, Vaassen, Netherlands



- 2BO.2.5 Firing-through Metallisation of PERT-Like Cells Using μ -Si(n) as Thin Rear Side Full Area Passivating Contact**
 P. Wyss, Q. Jeangros, F.-J. Haug, A. Ingenito & C. Ballif
 EPFL, Neuchâtel, Switzerland
 J.J. Diaz Leon, C. Allebé & S. Nicolay
 CSEM, Neuchâtel, Switzerland
- 2BO.2.6 New Chemical Model for the Diffusion Mechanism of Phosphorus into the Silicon Wafer during POC13 Diffusion**
 P. Jäger, V. Mertens, U. Baumann & T. Dullweber
 ISFH, Emmerthal, Germany

ORAL PRESENTATIONS 5BO.7

10:30 – 12:00 Forecasting Solar Radiation and PV Power

Chairpersons:

Manajit Sengupta
 NREL, USA

Jan Remund
 Meteotest, Switzerland

- 5BO.7.1 Cross-Location Solar Irradiance Nowcasting by Metadata-Augmented CNN-LSTM Neural Networks from Satellite Images**
 H.-F. Huang
 Thingnario, Taipei, Taiwan
 K.-Y. Lee
 UIUC, Urbana, USA
 W.H. Hsu
 NTU, Taipei, Taiwan
- 5BO.7.2 Probabilistic Forecast of All-Sky Solar Radiation Using Enhanced WRF-Solar**
 J.-H. Kim, P.A. Jimenez & J. Dudhia
 National Center for Atmospheric Research, Boulder, USA
 J. Yang, M. Sengupta & Y. Xie
 NREL, Golden, USA
- 5BO.7.3 Ensemble Based 15 Days Ahead Aggregated Photovoltaic Power Generation Forecasting at Macro Area Level**
 M. Moschella, E. Crisostomi & M. Tucci
 University of Pisa, Italy
 A. Betti, L. Gioni & C. Lanzetta
 I-EM, Livorno, Italy
- 5BO.7.4 Minute Resolution Measurement Network for Global Horizontal and Tilted Solar Irradiance for a Transmission System Control Area in Southern Germany**
 E. Lorenz, N. Holland, A. Dittmann, W. Herzberg, S. Karalus, W. Heydenreich & C. Braun
 Fraunhofer ISE, Freiburg, Germany
 P. Guthke & A. Semmig

TransnetBW, Stuttgart, Germany

- 5BO.7.5 Hybrid Modelling of PV Power Generation for Enhanced Forecasting**
 S. Theocharides, G. Makrides, M. Kynigos & G.E. Georghiou
 University of Cyprus, Nicosia, Cyprus
 M. Theristis
 Sandia National Laboratories, Albuquerque, USA
- 5BO.7.6 Using Analogs Ensembles and Genetic Algorithm to Handle Uncertainty in a Microgrid**
 F. Calderon-Obaldia & A. Migan-Dubois
 GeePs-UCR, Gif-sur-Yvette, France
 J. Badosa
 University Sorbonne, Palaiseau, France
 V. Bourdin
 LIMSI, Orsay, France

ORAL PRESENTATIONS 4BO.12

10:30 – 12:00 Induced Degradation

Chairpersons:

Christos Monokroussos
 TÜV Rheinland, China

Henning Nagel
 Fraunhofer ISE, Germany

- 4BO.12.1 The Challenge of PID with Bifaciality: Which Side Is Being Tested?**
 J. Carolus, R. Breugelmanns & M. Daenen
 Hasselt University, Genk, Belgium
 J.A. Tsanakas, A.S.H. van der Heide, E. Voroshazi & W. De Ceuninck
 imec, Genk, Belgium
- 4BO.12.2 Optimized Module Packaging for Silicon Heterojunction Solar Cells and Increased PID Resistance**
 O. Arriaga Arruti, L. Gnocchi, F. Lisco, A. Virtuani & C. Ballif
 EPFL, Neuchâtel, Switzerland
- 4BO.12.3 Extreme Testing of PID Resistive c-Si PV Modules with 1500 V System Voltage**
 P. Lechner, J. Schnepf, S. Hummel & D. Geyer
 ZSW, Stuttgart, Germany
 J. Wittfoth
 CS Wismar, Germany
 R. Merino Martínez
 STRE, Llanera, Spain
 P. Sánchez-Friera
 IDONIAL, Gijón, Spain
- 4BO.12.4 Detecting and Understanding Sodium Movement in Solar Panel Encapsulant Polymers**
 S.L. Moffitt, B.H. Hamadani & X. Gu



NIST, Gaithersburg, USA

4BO.12.5 Illumination and Encapsulant Resistivity Are Critical Factors in Polarization-Type Potential Induced Degradation on n-PERT Cells

B. Habersberger
Dow Chemical, Lake Jackson, USA
P. Hacke
NREL, Golden, USA

4BO.12.6 LeTID Impact on Bifacial and Monofacial Silicon Modules Using Accelerated Aging Tests, Quantitative Electroluminescence and PV Plant Modelling

J. Dupuis, G. El Hajje, G. Plessis, E. Lajoie-Mazenc & P. Dupeyrat
EDF R&D, Moret Loing et Orvan, France
E. Sandré & K. Radouane
EDF Renewables, Paris La Defense, France

VISUAL PRESENTATIONS 3BV.2

10:30 – 12:00 CI(G)S, CdTe and Related Thin Films / Organic and Dye-Sensitised Devices / II-V and Related Compound Semiconductors / Tandems

Detailed information on this session is presented in the section entitled 'Visual Presentations'.

ORAL PRESENTATIONS 2BO.3

13:30 – 15:00 Dopant Free Heterojunctions and TCOs

Chairpersons:

Pere Roca i Cabarrocas
CNRS, France

Jan Schmidt
ISFH, Germany

2BO.3.1 Development of Conductive SiCx:H as a New Hydrogenation Technique for Tunnel Oxide Passivated Contacts

K. Qiu, M. Pomaska, A. Gad, S. Li, A. Lambertz, W. Duan, F. Finger, U. Rau & K. Ding
Forschungszentrum Jülich, Germany
Z. Liang
Sun Yat-sen University, Guangzhou, China

2BO.3.2 Interface Treatment to Improve the (I)a-Si:H/MoOx Stack for Passivating Contact Solar Cells

L. Mazzarella, A. Alcañiz-Moya, E. Kawa, P.A. Procel Moya, Y. Zhao, C. Han, G. Yang, M. Zeman & O. Isabella
Delft University of Technology, Netherlands

2BO.3.3 Design Rules for Novel Materials to Perform as Efficient Carrier-Selective Contacts for Silicon Solar Cell

M. Boccard, A.N. Fioretti, J. Haschke & C. Ballif
EPFL, Neuchâtel, Switzerland
R. Woods-Robinson & K.A. Persson
University of California, Berkeley, USA

2BO.3.4 Student Awards Finalist Presentation: Enhancing Hole Selectivity of Passivated Contacts via Ultrathin Dielectric ALD-AIOx Tunnel Layer Exhibiting High Negative Interface Charge

G. Kaur & A. Danner
National University of Singapore, Singapore
R. Sridharan, Z. Xin & R. Stangl
SERIS, Singapore, Singapore

2BO.3.5 Atomic Layer Deposited AIOx Tunnelling Interfacial Layer for p-Type Selective Contacts for c-Si Solar Cells

M.T.S.K. Ah Sen, P.C.P. Bronsveld, E.G. Hoek, B.W.J. Kikkert & A.W. Weeber
TNO Energy Transition, Petten, Netherlands

2BO.3.6 Aiming for Fully Suitable High-Mobility TCOs for Silicon Heterojunction Solar Cells

D. Erfurt, A. Cruz Bournazou, A.B. Morales-Vilches, E.C. Wang, R. Schlatmann & B. Stannowski
HZB, Berlin, Germany
M. Dimer, R. Köhler, U. Graupner & E. Schneiderlöchner
Von Ardenne, Dresden, Germany

ORAL PRESENTATIONS 3BO.8

13:30 – 15:00 Ways to Improve Perovskite Solar Cells

Chairpersons:

Giorgio Bardizza
European Commission JRC, Italy

Wolfgang Tress
LMU Munich, Germany

3BO.8.2 Inverted Perovskite Solar Cells: Original Optimization of a Mixed-Cation Mixed-Halide Perovskite Deposition Process Upon TFB as Hole Selective Layer

T. Lemerrier, L. Perrin & E. Planès
University Savoie Mont Blanc, Grenoble, France
N. Lemaître, S. Berson & L. Flandin
CEA, Le Bourget-du-Lac, France

3BO.8.3 Synergistic Modification for Efficient and Stable Perovskite Solar Cells

B. Chen, P. Wang, R. Li, Y. Li, N. Ren, Q. Xu, L. Yan, Q. Huang, Y. Li, Y. Ding, D.K. Zhang, H. Ren, S. Xu, G. Hou, Y. Zhao & X. Zhang



Nankai University, Tianjin, China

3BO.8.4 Acetic Acid Assisted Crystallization Strategy for High Efficiency and Long-Term Stable Perovskite Solar Cell

Y. Li, J. Zheng, J. Bing, Y. Cho, S. Tang, M. Zhang, Y. Yao, C.F.J. Lau, D.S. Lee, C. Liao, M.A. Green, S. Huang & A.W.Y. Ho-Baillie
 UNSW Australia, Sydney, Australia
 J. Shi, J. Yuan & W. Ma
 Soochow University, Suzhou, China

3BO.8.6 Pb-Free Sn Perovskite Solar Cells with 13% Efficiency by Surface Passivation

K. Nishimura, M.A. Kamarudin, D. Hirotsu, S. Qing & S. Hayase
 University of Electro-Communications, Chofu, Japan
 S. Iikubo
 Kyushu Institute of Technology, Kitakyushu, Japan
 T. Minemoto
 Ritsumeikan University, Kisatus, Japan
 K. Yoshino
 University of Miyazaki, Japan

ORAL PRESENTATIONS 4BO.13**13:30 – 15:00 Outdoor Performance and Energy Rating****Chairpersons:**

Stefan Winter
 PTB, Germany

Juan Lopez-Garcia
 European Commission JRC, Italy

4BO.13.1 Annual Energy Yield Simulation of 3-Terminal Perovskite / Silicon Tandem Modules

R. Santbergen, Z. Wang, A. Nour El Din, M.R. Vogt, M. Zeman & O. Isabella
 Delft University of Technology, Netherlands

4BO.13.2 Interlaboratory Comparison of the PV Module Energy Rating Standard IEC 61853-3 and Reference Parameter Set for the PV Community

M.R. Vogt & K. Bothe
 ISFH, Emmerthal, Germany
 S. Riechelmann, E. Music & F. Plag
 PTB, Braunschweig, Germany
 A.M. Gracia Amillo
 European Commission JRC, Ispra, Italy
 A. Driesse
 PV Performance Labs, Freiburg, Germany
 A. Kokka & P. Kärhä
 Aalto University, Espoo, Finland
 C. Schinke
 Leibniz University Hannover, Germany
 J.C. Blakesley
 NPL, Teddington, United Kingdom

G. Friesen & G. Corbellini
 SUPSI, Canobbio, Switzerland
 N. Riedel-Lyngskær
 Technical University of Denmark, Roskilde, Denmark
 R.M.E. Valckenborg
 TNO, Eindhoven, Netherlands
 M. Schweiger & W. Herrmann
 TÜV Rheinland Energy, Cologne, Germany

4BO.13.3 Uncertainty of PV Module Energy Rating Caused by Spectral Effects

W. Herrmann, I. Nixdorf & J. Bonilla Castro
 TÜV Rheinland Energy, Cologne, Germany

4BO.13.4 Investigation of Field Irradiance Angular Profiles and Relation with Indoor IV Measurements for Accurate Energy Yield Predictions

M. Mungra, Y. Li & A.J. Lennon
 UNSW Australia, Sydney, Australia
 M. Pravettoni
 SERIS, Singapore, Singapore
 E. Garcia Goma
 Spire Solar - Eternal Sun, Den Haag, Netherlands

4BO.13.5 Pearl TF PV: An In-Depth Investigation on the Prediction of Long Term Performance of Thin-Film Photovoltaic Modules

M. Theelen, A. Kingma, R. Aninat & K. Bakker
 TNO/Solliance, Eindhoven, Netherlands
 T. Weber
 PI Berlin, Germany
 E.J. Achterberg, R. Verhagen & R. van Gestel
 Solar Tester, Schinnen, Netherlands
 B.E. Pieters, V. Huhn & E. Sovetkin
 Forschungszentrum Jülich, Germany
 A.W. Weeber
 Delft University of Technology, Netherlands
 K. Mack, M. Riedel & B. Rau
 HZB, Berlin, Germany
 M. Rennhofer
 AIT, Vienna, Austria
 L. Plesing
 Crystalsol, Vienna, Austria

4BO.13.6 Energy Yield Modeling of 2-D and 3-D Curved Photovoltaic Modules

S. Neven-du Mont, C. Kutter, C. Reise, M. Heinrich & D.-H. Neuhaus
 Fraunhofer ISE, Freiburg, Germany

VISUAL PRESENTATIONS 5BV.3**13:30 – 15:00 Solar Resource and Forecasting**

Detailed information on this session is presented in the section entitled 'Visual Presentations'.



ORAL PRESENTATIONS 2BO.4

15:15 – 16:45 Si-Alloy Based Functional Layers and TCOs

Chairpersons:

Matthieu Despeisse
CSEM, Switzerland

Delfina Muñoz
CEA, France

- 2BO.4.1 Multilevel Improvement in the Window Layers Stack of Silicon Heterojunction Solar Cell**
L. Antognini, V. Paratte, M. Truong, J. Cattin, J. Haschke, J. Dréon, C. Ballif & M. Boccard
EPFL, Neuchâtel, Switzerland
L.-L. Senaud, G. Christmann, S. Nicolay, B. Paviet-Salomon & M. Despeisse
CSEM, Neuchâtel, Switzerland
- 2BO.4.2 Design and Optimization of Positive-Charge Carrier Collectors Based on nc-SiOx:H for High-Efficiency Silicon Heterojunction Solar Cells**
Y. Zhao, P.A. Procel Moya, L. Mazzarella, C. Han, G. Yang, A.W. Weeber, M. Zeman & O. Isabella
Delft University of Technology, Netherlands
- 2BO.4.3 Process Influences during Atmospheric Pressure Chemical Vapor Deposition of Passivating Si-Based Doping Glasses for PERT Solar Cell Concepts**
F. Geml, J. Engelhardt, B. Gapp, L. Reinalter & G. Hahn
University of Konstanz, Germany
- 2BO.4.4 The Sputter Deposition of Low Resistive and Broadband Transparent Cerium and Hydrogen Co-Doped Indium Oxide and Its Transfer to Silicon Heterojunction Solar Cells**
L. Tutsch, M. Bivour & M. Hermle
Fraunhofer ISE, Freiburg, Germany
T. Koida, H. Sai & T. Matsui
AIST, Tsukuba, Japan
- 2BO.4.5 Benchmarking TCOs for Silicon Heterojunction Solar Cells**
A. Cruz Bournazou, D. Erfurt, E.-C. Wang, A.B. Morales-Vilches, R. Schlatmann & B. Stannowski
HZB, Berlin, Germany
B. Szyszka
Berlin University of Technology, Germany
- 2BO.4.6 Effect of Process Sequence for nc-SiOx:H (n)/nc-Si:H (n) Double Layer in Silicon Heterojunction Solar Cells**
D. Qiu, W. Duan, A. Lambertz, M. Pomaska, K. Bittkau, A. Gad & K. Ding
Forschungszentrum Jülich, Germany

ORAL PRESENTATIONS 3BO.9

15:15 – 16:45 Processing of Perovskite Solar Cells

Chairpersons:

Shuzi Hayase
University of Electro-Communications, Japan

Laura T. Schelhas
SLAC, USA

- 3BO.9.1 Drying Dynamic of Solution-Processed Perovskite Thin-Films**
S. Ternes, T. Börnhorst, J.A. Schwenzler, I.M. Hossain, H.M. Pham, T. Abzieher, T.J. Feeney, U. Lemmer, P. Scharfer, W. Schabel, B.S. Richards & U.W. Paetzold
Karlsruhe Institute of Technology, Germany
- 3BO.9.2 In-Situ Monitoring of Perovskite Thin Film Formation by High-Speed Optical Reflectance Spectroscopy**
C. Camus, C. Kaspari & V. Blank
LayTec, Berlin, Germany
J. Rappich & N. Nickel
HZB, Berlin, Germany
- 3BO.9.3 2D Materials Enable 0.5 m² Perovskite Panel Fabrication for Solar Farm: Panel Efficiency Overcoming 10% and Stable Outdoor Performance**
A. Agresti, S. Pescetelli, S. Razza, M. Pierro, C. Cornaro & A. Di Carlo
University of Rome II, Italy
E. Leonardi & L. Sorbello
Greatcell Solar Italia, Rome, Italy
S. Bellani & F. Bonaccorso
Italian Institute of Technology, Genoa, Italy
E. Kymakis
Hellenic Mediterranean University, Heraklion, Greece
- 3BO.9.4 Towards 15% Efficient Semi-Transparent Stable p-i-n Perovskite Solar Modules**
V. Zardetto, I. Dogan, L. Simurka, W. Verhees, D. Zhang, H. Fledderus, M. Najafi, Y. Galagan, P. Poodt, S.C. Veenstra & R.A.J.M. Andriessen
TNO, Eindhoven, Netherlands
A. Bracesco, A. Todinova & M. Creatore
Eindhoven University of Technology, Netherlands
A. Aguirre & T. Aernouts
imec, Genk, Belgium
- 3BO.9.5 Slot Die Coating to Upscale Perovskite PV for Manufacturing**
M. Friedrich, G. Gibson & A. Zakhidov
nTact, Dallas, USA
- 3BO.9.6 Understanding the Ablation Mechanism in the P2 Patterning of Perovskite Solar Cells by Experimental and Numerical Analysis**
C. Schultz, M. Fenske, A. Zeiser, A. Bartelt & B. Stegemann
Berlin University of Applied Sciences, Germany
J. Dagar, R. Schlatmann & E. Unger
HZB, Berlin, Germany



ORAL PRESENTATIONS 4BO.14**15:15 – 16:45 Module Design, Ageing and Degradation****Chairpersons:**

Tony Sample
European Commission JRC, Italy

Mike Van Iseghem
EDF R&D, France

4BO.14.1 Assessing the Effects of Photovoltaic Modules Long-Term Performance Degradation on Lifetime Energy Yield Predictions

I. Kaaya & K.-A. Weiß
Fraunhofer ISE, Freiburg, Germany

4BO.14.2 High Efficiency Silicon Module Degradation – from Atoms to Systems

D.C. Jordan, D.B. Sulas-Kern, S. Johnston, H.R. Moutinho, C.-S. Jiang,
C. Xiao, M. Young, A.G. Norman, C. Deline & I. Repins
NREL, Golden, USA
R. Bhoopathy, O. Kunz & Z. Hameiri
UNSW Australia, Sydney, Australia
C.L. Sainsbury
Sinton Instruments, Boulder, USA

4BO.14.4 Hotspot Susceptibility in Shingled Modules

C.E. Clement, J.P. Singh, E. Birgersson, Y. Wang & Y. S. Khoo
SERIS, Singapore, Singapore

4BO.14.5 Correlation of Peel Forces to EVA Degree of Cross Linking and Accelerated Weathering

P. Schenk, M. Pander, U. Zeller, B. Jäckel & M. Ebert
Fraunhofer CSP, Halle (Saale), Germany

4BO.14.6 Loss Analysis and Efficiency Potentials for CIGS Thin-Film PV Modules without and with Metal Grid: Experimental Results Analyzed by Simulation

R. Wächter, G. Kaune, T. Repmann & K. Orgassa
NICE Solar Energy, Schwäbisch Hall, Germany

VISUAL PRESENTATIONS 1BV.4**15:15 – 16:45 Novel Photovoltaic Conversion Systems, Characterization Approaches and Device Designs / New Materials and Concepts for Cells and Modules**

Detailed information on this session is presented in the section entitled 'Visual Presentations'.

**ORAL PRESENTATIONS 2BO.5****17:00 – 18:45 Full Silicon Heterojunction Solar Cells****Chairpersons:**

Arthur W. Weeber
TNO Energy Transition, The Netherlands

William Dauksher
Arizona State University, USA

2BO.5.1 A Simple Litho-Free Approach to Processing High Efficiency Silicon Heterojunction (SHJ) Interdigitated Back-Contacted (IBC) Solar Cells

H. Sivaramakrishnan Radhakrishna, I. Gordon & J. Poortmans
imec, Leuven, Belgium
M. Xu
Jinko Solar, Shangrao, China
M.G. Uddin
Aalto University, Finland

2BO.5.2 Improved Layer Properties Combined with Light Soaking Enabling for 23% Silicon Heterojunction Solar Cells

A. Moldovan, S. Pingel, S. Roder, L. Tutsch, J. Temmler, L. Bodlak,
A. Fischer, M. Bivour, J.-F. Nekarda & J. Rentsch
Fraunhofer ISE, Freiburg, Germany
A. Wendel, S. Hübner, T. Dippell & P. Wohlfart
Singulus Technologies, Kahl am Main, Germany

2BO.5.3 Student Awards Finalist Presentation: Illuminated Contact Resistance Measurements to Investigate the Properties of Contact Stacks in Silicon Heterojunction Solar Cells

L.-L. Senaud, G. Christmann, A. Descoedres, J. Geissbühler, N. Badel,
P. Wyss, C. Allebé, S. Nicolay, M. Despeisse & B. Paviet-Salomon
CSEM, Neuchâtel, Switzerland
P.A. Procel Moya, M. Zeman & O. Isabella
Delft University of Technology, Netherlands
M. Boccard
EPFL-STI-IMT-PVLAB, Neuchâtel, Switzerland
C. Ballif
EPFL, Neuchâtel, Switzerland

2BO.5.4 Can a Front-Side Tunnel Layer Passivated Contact Beat a Heterojunction Contact?

D. Fracasso, P. Wang, R. Tabajonda, J. Epistola, D. Perez, R. Sridharan,
M.E. Delos Santos, G. De Luna, R. Stangl & T. Mueller
SERIS, Singapore, Singapore

2BO.5.5 Challenges for Efficient Integration of SHJ Based Solar Cells in Shingle Module Configuration

S. Harrison, A. Bettinelli, B. Portaluppi, V. Giglia, P. Lefillastre & V. Barth
CEA, Le Bourget-du-Lac, France

2BO.5.6 Novel Patterning Techniques for Copper Electroplated Metallization of Heterojunction Solar Cells

A. Lachowicz, G. Andreatta, N. Blondiaux, A. Faes, C. Allebé, L. Ding,
S. Nicolay & M. Despeisse
CSEM, Neuchâtel, Switzerland
C. Fontaine & P.-H. Haumesser
CEA-Leti, Grenoble, France
J. Jourdan & D. Muñoz
CEA / INES, Le Bourget-du-Lac, France
M. Godard & M. Darnon
University of Sherbrooke, Canada
C. Ballif
EPFL, Neuchâtel, Switzerland

- 2BO.5.7 First European 25% Efficient Large Area Silicon Solar Cell: Path for European Premium PV Manufacturing is Open**
W. Favre, A. Danel, R. Varache, L. Sicot, V. Barth, A. Derrier, Y. Veschetti,
D. Muñoz, C. Roux
CEA, Le Bourget-du-Lac, France
M. Sciuto, A. Ragonesi, A. Di Mateo, D. Nicotra, F. Rametta, D. Iuvara,
M. Foti, C. Gerardi
ENEL Green Power, Catania, Italy

ORAL PRESENTATIONS 3BO.10

17:00 – 18:30 Characterizing Perovskite Solar Cell Performance and Stability

Chairpersons:

Valerio Zardetto
TNO/Solliance, The Netherlands

Xiaodan Zhang
Nankai University, China

- 3BO.10.1 Negative Capacitance in Perovskite Solar Cells**
F. Ebadi, A. Hagfeldt & W. Tress
EPFL, Lausanne, Switzerland
- 3BO.10.2 Universal Measurement Protocol for Perovskite Based Photovoltaic Devices**
G. Bardizza, H. Müllejans, D. Pavanello & E.D. Dunlop
European Commission JRC, Ispra, Italy
- 3BO.10.3 Improving Perovskite Solar Cell Stability through Modification of the p-Type Contact**
M. Dussouillez, A. Paracchino, L. Ding, S.-J. Moon, B.A. Kamino, A. Walter,
L. Lauber, G. Christmann, S. Rafizadeh, C. Ballif & S. Nicolay
CSEM, Neuchâtel, Switzerland
- 3BO.10.4 Experiences of Continuous On-Sun Performance Measurements of Perovskite Mini-Modules**
M. Norton, M. Hadjipanayi, V. Paraskeva & G.E. Georghiou
University of Cyprus, Nicosia, Cyprus
M. Kohlstädt & U. Würfel

Fraunhofer ISE, Freiburg, Germany

- 3BO.10.5 Perovskite Solar Cells Subjected to Realistic Operating Conditions: Temperature Dependence, Outdoor Monitoring, Energy Yield Modelling**
B. Lipovsek, S. Tomsic, K. Brecl & M. Topic
University of Ljubljana, Slovenia
M. Jost, A. Al-Ashouri & S. Albrecht
HZB, Berlin, Germany
- 3BO.10.6 Report of Highly Stable Perovskite Minimodules Passing Key Ageing Tests in IEC61646**
B. Yan & J. Yao
Microquanta Semiconductor, Hangzhou, China

ORAL PRESENTATIONS 5BO.15

17:00 – 18:30 Concentrators and PV for Space Applications

Chairpersons:

Ignacio Antón Hernández
UPM, Spain

Stephen Taylor
European Space Agency, Netherlands

- 5BO.15.1 ALFAMA Project: Development of a Flexible and Laminated Space Photovoltaic Array**
T. Guerin, R. Cariou, S. Noël, C. Jamin, Y. Roujol, P. Voarino & F. Chabuel
CEA, Grenoble, France
V. Khorenko
Azur Space, Heilbronn, Germany
- 5BO.15.2 Benchmark and Irradiation Tests of Terrestrial Solar Cells for Low Cost Space Solar Array**
S. Duzellier & T. Nuns
University of Toulouse, France
R. Cariou, P. Voarino & F. Chabuel
CEA-Liten, Grenoble, France
C. Aicardi
CNES, Toulouse, France
- 5BO.15.3 Optics Development and Demonstration of Line-Focus Space Concentrator Prototype Using III-V/Si Cells**
A. Bermudez-García, P. Voarino, F. Chabuel & O. Raccurt
CEA, Grenoble, France
- 5BO.15.4 Understanding the Reverse Bias Behaviour of Multijunction Solar Cells**
J.R. Gonzalez, C. Baur & E. Fernández Lisbona
ESA-ESTEC, Noordwijk, Netherlands
I. Rey-Stolle
UPM, Madrid, Spain



- 5BO.15.5 Development of an External Quantum Efficiency Method to Characterize Solar Cells with a Micro Spot: Applied to Micro-Concentrated Systems**
P. Voarino, A. Bermudez-Garcia, R. Couderc & O. Raccurt
CEA, Grenoble, France
- 5BO.15.6 Liquid Luminescent Solar Concentrator Based on Green Emission Carbon Quantum Dots**
F. Mateen & S.-K. Hong
Dongguk University, Seoul, Republic of Korea

VISUAL PRESENTATIONS 6BV.5

17:00 – 18:30 Industrial Applications / PV Driven Energy Management and System Integration

Detailed information on this session is presented in the section entitled 'Visual Presentations'.

Wednesday, 09 September 2020

ORAL PRESENTATIONS 4CO.1

08:30 – 10:00 Interconnections

Chairpersons:

Sebastian Dittmann
Anhalt University of Applied Sciences, Germany

Sener Oktik
Sisecam, Turkey

- 4CO.1.1 Introductory Oral: Toward Shingling Interconnection with SHJ Solar Cells**
V. Barth, A. Bettinelli, S. Harrison, C. Carrière & A. Derrier
CEA, Le Bourget-du-Lac, France
M. Galiazzo, A. Fecchio, A. Magon & L. Cerasti
Applied Materials, Olmi di San Biagio di Callalta, Italy
- 4CO.1.2 Investigation of Failure Modes, Mechanisms and Driving Forces for Electrically Conductive Adhesives as Interconnects in PV Modules**
N. Bosco & M. Springer
NREL, Golden, USA
- 4CO.1.3 Thermomechanical Fatigue of Solder Joint and Interconnect Ribbon: A Comparison between Glass-Glass and Glass-Foil Modules**
D. Lindholm, G. Otnes, H. Fjær & S.E. Foss
Institute for Energy Technology, Kjeller, Norway
G. Cattaneo & H.-Y. Li
CSEM, Neuchâtel, Switzerland
- 4CO.1.4 Identification of a Viable and Robust Process for BJ-BC Solar Cells Interconnection**
T. Timofte & A. Halm
ISC Konstanz, Germany
M. Pander & S. Großer
Fraunhofer CSP, Halle (Saale), Germany
- 4CO.1.5 Solderable PVD Al Back Contacts for the Module Integration of High-Efficiency c-Si Solar Cells**
H. Nagel, S. Gledhill, T. Kroyer, D. Eberlein, A. Kraft, M. Glatthaar & S.W. Glunz
Fraunhofer ISE, Freiburg, Germany
T. Fischer
teamtechnik Automation, Ludwigsburg, Germany
A. Hain & P. Wohlfart
Singulus Technologies, Kahl am Main, Germany



ORAL PRESENTATIONS 3CO.5

08:30 – 10:00 III-V and Related Compound Semiconductor Solar Cell Devices

Chairpersons:

Gerald Siefer
Fraunhofer ISE, Germany

Giovanni Flamand
imec, Belgium

- 3CO.5.1 Progress in the Development of III-V Multijunction Cells on Ge/Si Substrates**
I. Garcia, L. Barrutia, A. González, G. Hou, M. Hinojosa, L. Cifuentes, C. Algora & I. Rey-Stolle
UPM, Madrid, Spain
A.D. Johnson
IQE, Cardiff, United Kingdom
- 3CO.5.2 Next-Generation Lattice-Matched Multijunction Solar Cells Based on Dilute-Nitride III-V Compounds**
A. Aho, R. Isoaho, M. Raappana, T. Aho, A. Tukiainen, J. Reuna, V. Polojärvi, E. Anttola & M. Guina
Tampere University, Finland
- 3CO.5.3 Development of Dilute Nitride GaPN_x as a Top Cell Candidate for Three Terminal Silicon-Based Multijunction Solar Cell**
S. Murali, A. Chikhalkar, C. Zhang, M. Goryll, R.R. King & C.B. Honsberg
Arizona State University, Tempe, USA
- 3CO.5.4 Epitaxial GaAs Lift-off from Si(111) Wafer via 2D-GaSe Buffer Layer**
N. Kojima, Y.-C. Wang, Y. Ohshita & M. Yamaguchi
Toyota Technological Institute, Nagoya, Japan
- 3CO.5.5 Photon Recycling Mechanisms in Thin-Film GaAs Solar Cells**
N. Gruginskié, G.J. Bauhuis, P. Mulder, E. Vlieg & J.J. Schermer
Radboud University, Nijmegen, Netherlands
F. Cappelluti & A. Tibaldi
Polytechnic University of Turin, Italy
- 3CO.5.6 Stringing Monolithic Three Terminal III-V Tandems**
J. Buencuerpo, J.F. Geisz, T.R. Klein, W.E. McMahon, E.L. Warren & A.C. Tamboli
NREL, Golden, USA

ORAL PRESENTATIONS 5CO.9

08:30 – 10:00 Systems Design Using Bifacial Modules

Chairpersons:

Franck Al-Shakarchi
CEATECH-INES, France

Zakaria Naimi
Green Energy Park, Morocco

- 5CO.9.1 Optimizing the Electrical Architecture of Linear Vertical PV Bifacial Plants**
H. Colin, T. Le & Y. Nepal
CEA, Le Bourget-du-Lac, France
- 5CO.9.2 Optimising the Utilisation of Reflective Materials for Bifacial Plants**
O.L. Rhazi, M. Chiodetti, J. Dupuis & P. Dupeyrat
EDF R&D, Moret-sur-Loing, France
S. Benyakhlef & K. Radouane
EDF Renewables, Courbevoie, France
- 5CO.9.3 Effective Spectral Albedo from Satellite Data for Bifacial Gain Calculations of PV Systems**
J.C. Blakesley, G. Koutsourakis & S. Douglas
NPL, Teddington, United Kingdom
J.K.L. Holder, F.A. Mukadam & R.S.J. Abrams
RINA Tech UK, Brighton, United Kingdom
A. Schmid
Fraunhofer ISE, Freiburg, Germany
- 5CO.9.4 Testbed Validation of Bifacial Performance Modelling Methodology Using Ray Tracing Methods**
K. Phetdee
Mott MacDonald, Bangkok, Thailand
M. Donaldson-Balan, P. Dagres & S. Velez
Mott MacDonald, London, United Kingdom
I. Stylianou
Mott MacDonald, Brighton, United Kingdom
C. Ng & K. Larchet
Mott MacDonald, Madrid, Spain
- 5CO.9.5 Design Optimization of Bifacial Module PV Power Plants Based on Simulations and Measurements**
M. Guari Borrull & A. Scherl
Enerparc, Hamburg, Germany
T. Kampschulte
Hamburg University of Applied Sciences, Germany
- 5CO.9.6 Estimation of Maximum Current Generated by Bifacial PV Arrays for System Design**
J.S. Stein, D.S. Riley & C. Stark
Sandia National Laboratories, Albuquerque, USA



VISUAL PRESENTATIONS 2CV.1

08:00 – 10:00 Characterisation & Simulation of Si Cells / Fabrication and Production of c-Si Silicon Solar Cells and Related Processes

Detailed information on this session is presented in the section entitled 'Visual Presentations'.

PLENARY SESSION CP.1

10:30 – 12:30 INNOVATIONS FOR PV INDUSTRY AND DEPLOYMENT

Chairpersons:

Marko Topič
University of Ljubljana, Slovenia

Walburga Hemetsberger
SolarPower Europe, Belgium

CP.1.1 Final Study of MoOx Thickness Variation Influence on Partial Dopant-Free Silicon Heterojunction Solar Cells

J. Dréon, S. Zhong, J. Cattin, J. Haschke, L. Antognini, V. Paratte, C. Ballif & M. Boccard
EPFL, Neuchâtel, Switzerland

CP.1.2 Requirements of the Paris Climate Agreement for the Coming 10 Years on Investments, Technical Roadmap, and Expansion of PV Manufacturing

P.P. Altermatt, Y. Yang, Y. Chen, X. Zhang, D. Chen & Z. Feng
Trina Solar Energy, Changzhou, China

CP.1.3 FlamingoPV Project: Recent Advances towards High-Efficiency, Reliable Lightweight and Flexible Thin-Film Silicon Solar Cells and Modules

G. Limodio, D. Rajagop, S. Nawarante, E. Spaans & A.H.M. Smets
Delft University of Technology, Netherlands
D. Bartesaghi, M. Hietkamp & E.A.G. Hamers
HyET Solar, Arnhem, Netherlands

CP.1.4 Analyzing the Power Prediction by Deep Learning Algorithm Using EL-Images

C. Buerhop-Lutz, T. Pickel, T. Winkler & J. Hauch
HI ERN, Erlangen, Germany

CP.1.5 Performance of New Photovoltaic System Designs - IEA PVPS Task 13 Subtask 1.3

M. Littwin, M. Köntges, T. Ohrdes & F. Giovannetti
ISFH, Emmerthal, Germany
F.P. Baumgartner
ZHAW, Winterthur, Switzerland
C. Biba

HSR, Rapperswil, Switzerland
B. Farnung & M. Trommsdorff
Fraunhofer ISE, Freiburg, Germany
R.H. French
CWRU, Cleveland, USA
D. Gfeller, U. Muntwyler & T. Schott
BFH, Bern, Switzerland
M. Green
Lightning Electrical Engineering, Raanana, Israel
U. Jahn
TUV Rheinland Energy, Cologne, Germany
C. Messner
AIT, Vienna, Austria
D. Riley
SANDIA National Laboratories, Albuquerque, USA
D. Rivola
SUPSI, Canobbio, Switzerland
J.S. Stein
Sandia National Laboratories, Albuquerque, USA
W.G.J.H.M. van Sark
Utrecht University, Netherlands

CP.1.6 Augmented Reality Supporting the Planning Processes in PV Plants

F.P. Baumgartner, P. Staiger & F. Carigiet
ZHAW, Winterthur, Switzerland
F. Gundelsweiler
Zühlke, Schlieren, Switzerland

ORAL PRESENTATIONS 4CO.2

13:30 – 15:00 Bifacial PV Modules

Chairpersons:

Christian Camus
LayTec, Germany

Yoshihiro Hishikawa
AIST, Japan

4CO.2.1 Introductory Oral: Comprehensive Evaluation of IEC Measurement Procedures for Bifacial Solar Cells and Modules

M. Rauer, A. Schmid, F. Guo, F. Neuberger & J. Hohl-Ebinger
Fraunhofer ISE, Freiburg, Germany

4CO.2.2 Results of the Bifacial PV Cell and PV Module Power Measurement Round Robin Activity of the PV-Enerate Project

G. Koutsourakis & J.C. Blakesley
NPL, Teddington, United Kingdom
M. Rauer & A. Schmid
Fraunhofer ISE, Freiburg, Germany
G. Bellenda & R.R. Molinero



SUPSI, Canobbio, Switzerland
 T.R. Betts & M. Bliss
 Loughborough University, United Kingdom
 J. Bonilla Castro & W. Herrmann
 TÜV Rheinland Energy, Cologne, Germany
 K. Bothe & D. Hinken
 ISFH, Emmerthal, Germany
 S. Dittmann
 Anhalt University of Applied Sciences, Köthen, Germany
 J. Lopez-Garcia, R.P. Kenny & D. Pavanello
 European Commission JRC, Ispra, Italy
 S. Riechelmann, H. Sträter & S. Winter
 PTB, Braunschweig, Germany
 A. Vegas
 INTA, Madrid, Spain

4CO.2.3 Energy Yield Measurements of Bifacial PV Modules Mounted on a Cold Façade

S. Dittmann, H. Sánchez & J. Bagdahn
 Anhalt University of Applied Sciences, Köthen, Germany
 R. Gottschalg
 Fraunhofer CSP, Halle (Saale), Germany

4CO.2.4 Comparison of the Energy Yield of Vertical (E-W Orientation) and Tilted (Equator Facing) Bifacial PV Module Arrays

J. Lopez-Garcia, R.P. Kenny & T. Sample
 European Commission JRC, Ispra, Italy
 R. Urraca
 University of La Rioja, Logroño, Spain

4CO.2.5 Interconnection Technologies for High Reliable Bifacial Heterojunction Glass/Glass Photovoltaic Modules

G. Cattaneo, A. Faes, H.-Y. Li, J. Levrat & M. Despeisse
 CSEM, Neuchâtel, Switzerland
 V. Barth, A. Bettinelli & L. Sicot
 CEA, Le Bourget-du-Lac, France
 A. Richter
 Meyer Burger Technology, Gwatt (Thun), Switzerland
 F. Rametta
 3SUN, Catania, Italy
 C. Colletti
 ENEL Green Power, Catania, Italy
 M. Izzì
 ENEA, Rome, Italy
 C. Ballif
 EPFL, Neuchâtel, Switzerland

ORAL PRESENTATIONS 3CO.6

13:30 – 15:00 Characterization of High Efficiency CIGS Absorbers and Devices

Chairpersons:

Ayodhya Nath Tiwari
 EMPA, Switzerland

Stefan Paetel
 ZSW, Germany

3CO.6.1 Introductory Oral: Improvement of Interface Quality of Cd-free Cu(In,Ga)(S,Se)₂ Solar Cell by all-dry Process through Aged Absorber
 J. Chantana
 Ritsumeikan University, Shiga, Japan

3CO.6.2 Extended Oral: Design and In-Depth Characterization of Absorber/Buffer Interfaces of CIGS Solar Cells: Results of the EFFCIS Project

W. Witte, D. Hariskos, W. Hempel, S. Paetel & M. Powalla
 ZSW, Stuttgart, Germany
 M. Maiberg, S. Zahedi-Azad, P. Pistor & R. Scheer
 Martin Luther University, Halle, Germany
 D. Hauschild, V. van Maris, L. Weinhardt, X. Jin, R. Schneider, D. Gerthsen,
 J. Seeger, J. Grutke & M. Hetterich
 Karlsruhe Institute of Technology, Germany
 M. Blankenship
 University of Nevada, Las Vegas, USA
 C. Heske
 Karlsruhe Institute of Technology, Eggenstein, Germany
 J. Keutgen & O. Cojocaru-Mirédin
 RWTH Aachen University, Germany
 E. Ghorbani & K. Albe
 Technical University of Darmstadt, Germany
 A. Nikolaeva, J. Marquez-Prieto, M. Krause, S. Schäfer, D. Abou-Ras,
 T. Unold & R. Mainz
 HZB, Berlin, Germany
 P. Eraerds, T.P. Niesen, R. Lechner, T. Dalibor & J. Palm
 Avancis, Torgau, Germany
 M. Schweiger & B. Dimmler
 NICE Solar Energy, Schwäbisch Hall, Germany
 T. Henke & P. Kratzert
 Solibro, Bitterfeld-Wolfen, Germany

3CO.6.3 Electronic Structure of the CdS/Cu(In,Ga)Se₂-Interface of KF and RbF-Treated Samples by Kelvin Probe and Photoelectron Yield Spectroscopy

M. Rusu, T. Kodalle, L. Choubac, C.A. Kaufmann, R. Schlatmann & T. Unold
 HZB, Berlin, Germany
 N. Barreau
 University of Nantes, France

3CO.6.4 Surface Characterization of Polycrystalline CuIn(Ga)Se₂ Absorbers



C. Kameni Boumenou, F. Ehre, F.-S. Babbe, M. Melchiorre, S. Siebentritt & A. Redinger
 University of Luxembourg, Belvaux, Luxembourg
 A. Elizabeth & H. Mönig
 University of Muenster, Germany

ORAL PRESENTATIONS 5CO.10

13:30 – 15:00 System Modelling for Sizing and Performance

Chairpersons:

Kari Lappalainen
 Tampere University, Finland

Angele Reinders
 University of Twente, Netherlands

5CO.10.1 Generated kWh Value as Function of System Design and Daily Price Profile

B.B. Van Aken, L.H. Slooff-Hoek & I. Cesar
 TNO Energy Transition, Petten, Netherlands

5CO.10.2 Simulation of Large PV Plants Using a Continuous Radiance Distribution Model and Cell-Resolution Mismatch Calculation

M. Herrerías Azcué & H. Zhou
 HLRS, Stuttgart, Germany
 H. Capdevila
 Capdevila ite, Stuttgart, Germany

5CO.10.3 Benchmarking Yield Assessment Exercise in Different Climates within an International Collaboration Framework

D. Moser
 Eurac Research, Bolzano, Italy
 M. Herz
 TÜV Rheinland Energy, Cologne, Germany
 B. Müller
 Fraunhofer ISE, Freiburg, Germany
 I.T. Horvath, A. Schils & S. Ramesh
 imec, Genk, Belgium
 M. Green
 M.G. Lightning, Raanana, Israel
 J. Vedde & D. Barnard
 European Energy, Søborg, Denmark
 B. Herteleer
 KU Leuven, Gent, Belgium
 J.A. Tsanakas
 CEA-INES, Le Bourget-du-Lac, France

5CO.10.4 Comparison of Large Scale Bifacial PV Test Field Performance to Commercially Available Software, Research-Based and Open Source Tools

N. Riedel-Lyngskær, A.A. Protti, D. Alvarez Mira, S. Thorsteinsson & P.B. Poulsen
 Technical University of Denmark, Roskilde, Denmark

D. Berrian & J. Libal
 ISC Konstanz, Germany
 D. Barnard & J. Vedde
 European Energy, Søborg, Denmark

5CO.10.5 AHP-GIS Suitable Sites Identification for Large Scale PV Installations: a Case Study in Marrakech-Safi Region, Morocco

F.-Z. Ouchani, O. Jbahi & A. Ghennioui
 IRESEN, Benguerir, Morocco
 M. Maaroufi
 Mohammed V University, Rabat, Morocco

5CO.10.6 Characteristic Declination, a Useful Concept for Accelerating Solar Potential Calculations?

M.C. Brito & R. Amaro e Silva
 University of Lisbon, Portugal
 S.R. Freitas
 Lisboa E-Nova, Lisbon, Portugal

ORAL PRESENTATIONS 2CO.13

13:30 – 15:00 Manufacturing & Production of Si Cells

Chairpersons:

Peter Wohlfart
 Singulus Technologies, Germany

Pierre J. Verlinden
 Sun Yat-sen University, China

2CO.13.1 A Roadmap to Reach 24% Efficiency PERC Cell Based on Screen Printing for Mass Production

X. Zhang, W. Liu, Y. Chen, S. Chen, G. Xu, Y.Y. Hu, Y. Yang, D. Chen, Y. Chen, P.P. Altermatt & Z. Feng
 Trina Solar Energy, Changzhou, China
 P.J. Verlinden
 AMROCK, Surfers Paradise, Australia

2CO.13.2 Aspects of Gallium Doping for PERC Solar Cells

G. Fischer
 Zittau/Görlitz University of Applied Sciences, Germany
 F. Wolny
 SolarWorld, Freiberg, Germany
 H. Neuhaus
 Fraunhofer ISE, Freiburg, Germany
 M. Müller
 Freiberg University of Technology, Germany

2CO.13.3 Laser Enhanced Contact Optimization – A Novel Technology for Metal-Semiconductor-Contact Optimization for Crystalline Silicon Solar Cells

E. Krassowski
 CE Cell Engineering, Kabelsketal, Germany
 S. Großer & M. Turek



Fraunhofer CSP, Halle (Saale), Germany

- 2CO.13.4 TOPCon – Technology Options for Cost Efficient Industrial Manufacturing**
B. Kafle, B.S. Goraya, S. Mack, S. Nold & J. Rentsch
Fraunhofer ISE, Freiburg, Germany
- 2CO.13.5 Mastering the Defectivity: Prerequisite for High Efficiency Silicon Heterojunction Solar Cells**
R. Varache, J. Hotel, J. Dahan, W. Favre, A. Danel & C. Roux
CEA, Le Bourget-du-Lac, France
- 2CO.13.6 AMPERE: The European PV Manufacturing Ready to Compete in the Premium High Efficiency Market**
C. Colletti & C. Gerardi
ENEL Green Power, Catania, Italy
F. Bizzarri
ENEL Green Power, Rome, Italy
B. Strahm
Meyer Burger Research, Hauterive, Switzerland
A. Richter
Meyer Burger Technology, Gwatt, Switzerland
D. Muñoz
CEA, Le Bourget-du-Lac, France
M. Izzi
ENEA, Rome, Italy
J. Levrat
CSEM, Neuchâtel, Switzerland
C. Ballif
EPFL, Neuchâtel, Switzerland
O. Nielsen
NorSun, Oslo, Norway
B. Hartlin
ERM, London, United Kingdom
B. Melzer
Jonas & Redmann, Berlin, Germany
M. Tallián
SEMILAB, Budapest, Hungary
S. Lombardo
CNR, Catania, Italy
M. Balucani
RISE Technology, Ostia, Italy
J. Rentsch
Fraunhofer ISE, Freiburg, Germany

VISUAL PRESENTATIONS 6CV.2

13:30 – 15:00 Integration of Photovoltaic in Buildings, Vehicle, Infrastructure and Landscape

Detailed information on this session is presented in the section entitled 'Visual Presentations'.

ORAL PRESENTATIONS 4CO.3

15:15 – 16:45 Module Design and Qualification

Chairpersons:

Ulrike Jahn
TÜV Rheinland, Germany

Guy Beaucarne
Dow Silicones, Belgium

- 4CO.3.1 Importance of BOM Control and IEC 61215 Scope of Application**
G. Oreski, C. Barretta, L. Castillon & P. Christöfl
PCCL, Leoben, Austria
M. Köntges
ISFH, Emmerthal, Germany
- 4CO.3.2 Standardization Work of Non-Uniform Wind Loads Test on PV Module**
S.-T. Hsu
ITRI, Hsinchu, Taiwan
- 4CO.3.3 Novel Accelerated Testing Methods for Faster Evaluation of PV Modules and Materials**
A. Borne
DuPont, Geneva, Switzerland
W.J. Gambogi & K. Roy Choudhury
DuPont, Wilmington, USA
K.-A. Weiß
Fraunhofer ISE, Freiburg, Germany
- 4CO.3.4 Embrittlement and Degradation of Polymeric PV Module Materials due to Lamination**
C. Herzog, D.E. Mansour, L. Pita Bauermann, S.-J. Ernst & T. Geipel
Fraunhofer ISE, Freiburg, Germany
S. Sraisth
Robert Bürkle, Freudenstadt, Germany
- 4CO.3.5 Student Awards Finalist Presentation: Loss Analysis and Optimization of PV Module Components and Design for Desert Applications**
H. Hanifi, M. Pander, U. Zeller, K. Ilse, D. Daßler, B. Jäckel, C. Hagendorf & R. Gottschalg
Fraunhofer CSP, Halle (Saale), Germany
M. Mirza
Fraunhofer ISC, Würzburg, Germany
M.A. Bahattab
KACST, Riyadh, Saudi Arabia
J. Schneider
Fraunhofer IMW, Leipzig, Germany
- 4CO.3.6 PV Module Soiling Monitoring and Cleaning Abrasion Testing**
G. Mathiak, O. Soukari, J. Saal, L. Rimmelspacher, W. Herrmann, F. Reil & J. Althaus
TÜV Rheinland Energy, Cologne, Germany



ORAL PRESENTATIONS 3CO.7

15:15 – 16:45 **Advances in Growth Methods for CIGSe and Kesterite Absorbers**

Chairpersons:

Alex Redinger
University of Luxembourg, Luxembourg

Jakapan Chantana
Ritsumeikan University, Japan

- 3CO.7.1 (Ag,Cu)(In,Ga)Se₂ Solar Cells Grown at Low Temperature with Ag Precursor Layer Method**
S.-C. Yang, M. Ochoa, A.N. Tiwari & R. Carron
EMPA, Dübendorf, Switzerland
- 3CO.7.2 How the Absorber Thickness Affects the Formation of Reverse Bias Induced Defects in CIGS Solar Cells**
K. Bakker, A. Rasia, S. Assen, B. Ben Said Aflouat & M. Theelen
Solliance - TNO, Eindhoven, Netherlands
A.W. Weeber
TNO Energy Transition, Petten, Netherlands
- 3CO.7.3 Fabrication of Cation and Anion Alloyed CZTSe Solar Cell by Using Spray-Based Deposition**
T. Enkhbat, S. Hamim & J.H. Kim
University of Incheon, Republic of Korea
- 3CO.7.4 Growth at High Deposition Rates: CIGS and Secondary Phases**
S. Paetel
ZSW, Stuttgart, Germany
- 3CO.7.5 How Is the Back-Contact in CIGSe Thin Film Devices Affected by Heavy Alkali Treatments?**
T. Bertram, T. Kodalle, P. Reyes-Figueroa, J. Lauche, R. Klenk, R. Schlatmann & C.A. Kaufmann
HZB, Berlin, Germany
- 3CO.7.6 Mitigation of Performance Losses Upon Reduction of Absorber Layer Thickness in CIGS Solar Cells**
T. Schneider, H. Kempa, J. Tröndle, B. Fuhrmann, F. Syrowatka & R. Scheer
Martin Luther University, Halle, Germany

ORAL PRESENTATIONS 6CO.11

15:15 – 16:45 **System Integration**

Chairpersons:

Ingrid Weiss
WIP Renewable Energies, Germany

Stefan Krauter
University of Paderborn, Germany

- 6CO.11.1 Energy Balance in a System Based on Photovoltaic-Electrochemical and Storage Cells for Water Splitting**
T. Merdzhanova, S.N. Agbo, K. Welter, O. Astakhov, V. Smirnov & U. Rau
Forschungszentrum Jülich, Germany
- 6CO.11.2 Urban Solar Potential for Onboard PV-Powered Electric Vehicles**
M.C. Brito & D.M. Pera
University of Lisbon, Portugal
T. Santos
CICS NOVA, Lisbon, Portugal
F. Moura
CERIS, Lisbon, Portugal
- 6CO.11.3 PV Hosting Capacity of Medium and Low Voltage Grids Using a Geographical Information Open-Source Tool**
V. Krakowski, M. Joos & N. Lebert
HESPUL, Lyon, France
S. Poutrel & P.-E. Raoult
BURGEAP, Lyon, France
- 6CO.11.4 Data Analysis and Modelling of PV – Heat Pump Systems for Residential Energy Scenarios in the Netherlands**
C. Gerçek & A.H.M.E. Reinders
University of Twente, Enschede, Netherlands
- 6CO.11.5 The Setting-Up of a Large Collective Self-Consumption Project in Lyon, France**
B. Gaiddon
HESPUL, Lyon, France
M. Valentin, E. Vignali & A. Manelli
SPL Lyon-Confluence, France
F. Marcos
EDF, Paris, France
A. Choffez & Y. Dessup
EDF ENR, Limonest, France
- 6CO.11.6 Characteristics of Day-Ahead Residual Demand, PV Power and Demand Forecasts in a Scenario of Large Penetration of PV**
J. Gari da Silva Fonseca Jr., Y. Udagawa & K. Ogimoto
University of Tokyo, Meguro, Japan
T. Oozeki
AIST, Tsukuba, Japan



ORAL PRESENTATIONS 2CO.14

15:15 – 16:45 **Analysis of Wafers and Layers for Highly Efficient Crystalline Silicon Solar Cells**

Chairpersons:

Francesca Ferrazza
eni, Italy

Karsten Bothe
ISFH, Germany

- 2CO.14.1 Luminescence: Science and Applications in Silicon Photovoltaics**
H.T. Nguyen & D. Macdonald
ANU, Canberra, Australia
- 2CO.14.2 Review and Recent Development in Combining Photoluminescence and Electroluminescence Imaging with Carrier Lifetime Measurements via Modulated Photoluminescence at Variable Temperatures**
H. Höfler, F. Schindler, A. Brand, D. Herrmann, R. Eberle, R. Post, J. Greulich & M.C. Schubert
Fraunhofer ISE, Freiburg, Germany
- 2CO.14.3 Student Awards Finalist Presentation: In-Situ Modulated Photoluminescence of Passivated c-Si Wafers during Annealing**
A. Desthieux & J. Posada
EDF R&D, Palaiseau, France
M. Sreng
IPVF, Palaiseau, France
E. Drahi
TOTAL, Paris la Defense, France
B. Bazer-Bachi
EDF ENR PWT (Photowatt), Bourgoin Jallieu, France
F. Silva, J.-C. Vanel & P. Roca i Cabarrocas
CNRS, Palaiseau, France
- 2CO.14.4 Light and Elevated Temperature Induced Degradation in B-Ga Co-Doped Cast Mono Silicon PERC Solar Cells**
C. Zhou, F. Ji, S. Cheng & W. Wang
CAS, Beijing, China
D. Hu
Jiangsu GCL, Xuzhou, China
- 2CO.14.5 Detecting Multivalent Defect Levels Using Deep Level Transient Spectroscopy**
Z. Zhou, M.K. Juhl & F.E. Rougieux
UNSW Australia, Sydney, Australia
- 2CO.14.6 Analysis of Defect Densities in the Thin (i) a-Si:H Passivation Layer of a-Si:H/c-Si Heterojunction Solar Cells Using Temperature Dependent Planar Conductance Measurements**
S. Le Gall, A. Levchenko, R. Brüggemann & J.-P. Kleider
CNRS/GeePs, Gif-sur-Yvette, France

VISUAL PRESENTATIONS 5CV.3

15:15 – 16:45 **Operation, Performance and Maintenance of PV Systems**

Detailed information on this session is presented in the section entitled 'Visual Presentations'.

ORAL PRESENTATIONS 4CO.4

17:00 – 18:30 **PV Module Characterization and Fault Detection**

Chairpersons:

Ana Rosa Lagunas
CENER, Spain

Christian Thiel
European Commission JRC, Italy

- 4CO.4.1 Eddy-Current Analysis Method for Non-Destructive Characterization of Electrical Contacts and Solder Joints in PV Modules**
L. Neumaier, W. Mühleisen, M. Lenzhofer, P. Malago & C. Hirschl
SAL Silicon Austria Labs, Villach, Austria
- 4CO.4.2 Development of Daylight Photoluminescence Technique for Photovoltaic Modules and Investigation of Temperature Dependency**
L. Koester, A. Astigarraga, S. Lindig & D. Moser
Eurac Research, Bolzano, Italy
- 4CO.4.3 Interfacial Characterization of Positive Bias Voltage Degradation in PV Modules**
A. Sinha, S.L. Moffitt & L.T. Schelhas
SLAC, Menlo Park, USA
K. Hurst, J. Qian, D.C. Miller & P. Hacke
NREL, Golden, USA
- 4CO.4.4 Data Mining Field I-V and Weather Data for PV Module EQE and Sun-Voc**
J.L. Braid & J.S. Stein
Sandia National Laboratories, Albuquerque, USA
M. Wang
CWRU, Cleveland, USA
- 4CO.4.5 Fundamental Study on Open Fault Detection Technology of Bypass Circuit of PV Module with IR Camera**
S. Nishikawa, N. Fujita & H. Kuroda
Nihon University, Tokyo, Japan
- 4CO.4.6 Quantitative Electroluminescence Imaging of PV Modules: Case Study of a Multi MW Plant with 100% EL Coverage**
K.G. Bedrich, Y. Wang, W. Luo & Y. S. Khoo
SERIS, Singapore, Singapore
J. Chai
QE Labs, Singapore, Singapore



ORAL PRESENTATIONS 3CO.8**17:00 – 18:30 CIGSe Modules & Advances in CdTe Technology****Chairpersons:**

Wiltraud Wischmann
ZSW, Germany

Tobias Bertram
HZB, Germany

- 3CO.8.1 Introductory Oral: Large Area Screen-Printed Front Contact Metallization for Thin-Film Solar Module Production**
T. Freund, N. Zancan, G. Kaune, W. Bromenne, R. Wächter, T. Repmann & K. Orgassa
NICE Solar Energy, Schwäbisch Hall, Germany
S. Lin & H. Shan
NICE, Beijing, China
- 3CO.8.2 Transparent Back Contacts for CdTe Solar Cells: Criteria and Investigation of Oxide Materials**
R.S. Hall, D.A. Lamb, A. Pockett, S.K. Thomas, M.J. Carnie & S.J.C. Irvine
Swansea University, St. Asaph, United Kingdom
- 3CO.8.3 Performance Evaluation and Parametrization of CIGS Thin Film Solar Modules through Multilinear Regressions**
G.A. Farias Basulto, P. Reyes-Figueroa, C. Ulbrich, B. Szyszka, R. Schlatmann & R. Klenk
HZB, Berlin, Germany
- 3CO.8.4 Effects of PDT on the Low Temperature Behavior of CIGS Thin-Film Solar Cells**
D. Mücke, R. Vidal Lorbada & T. Walter
Ulm University of Applied Sciences, Germany
R. Schäffler
NICE Solar Energy, Schwäbisch Hall, Germany
- 3CO.8.5 Dispensing Technology Meets CIGS Substrates: First IV-Results with Dispensed Metal Grid on CIGS Mini-Modules**
K. Gensowski, A.M. Jimenez Cardozo, S. Tepner, M. Pospischil & F. Clement
Fraunhofer ISE, Freiburg, Germany
M. Kuchler & M. Breitenbücher
HighLine Technology, Freiburg, Germany
T. Freund, P. Köder, J. Müller & B. Dimmler
NICE Solar Energy, Schwäbisch Hall, Germany

ORAL PRESENTATIONS 2CO.15**17:00 – 18:30 Measurement and Analysis of Crystalline Silicon Solar Cells****Chairpersons:**

Makoto Konagai
Tokyo City University, Japan

Ronald Sinton
Sinton Instruments, USA

- 2CO.15.1 Inline Solar Cell Statistics Combining I-V and Quantum Efficiency**
B. Mitchell, S. Esefelder & B. Mette
Wavelabs Solar Metrology Systems, Leipzig, Germany
J. Wong
Aurora Solar Technologies, Vancouver, Canada
B.S. Tjahjono
UNSW Australia, Sydney, Australia
K.B. Choi, M.X.C. Heng, T.H. Chuah & J.W. Ho
SERIS, Singapore, Singapore
- 2CO.15.2 Contacting of Busbarless Solar Cells for Accurate I-V Measurements**
K. Bothe, C. Kruse & D. Hinken
ISFH, Emmertal, Germany
- 2CO.15.3 Impact of the Bulk Resistivity and Operation Temperature on Silicon Solar Cells**
A. Augusto, A. Srinivasa & S.G. Bowden
Arizona State University, Tempe, USA
A.H.T. Le, J.P. Seif & Z. Hameiri
UNSW Australia, Sydney, Australia
- 2CO.15.4 Student Awards Finalist Presentation: Influence of Edge Recombinations on the Performance of Half-, Shingled- and Full Silicon Heterojunction Solar Cells**
V. Giglia, J. Veirman, R. Varache, B. Portaluppi & S. Harrison
CEA, Le Bourget-du-Lac, France
E. Fourmond
INSA Lyon, Villeurbanne, France
- 2CO.15.5 Selective Contacts and Fill Factor Limitation in Heterojunction Solar Cells**
L. Serenelli, L. Martini, F. Menchini, M. Izzi & M. Tucci
ENEA, Rome, Italy
G. de Cesare
Sapienza University of Rome, Italy
G. Condorelli & C. Gerardi
ENEL Green Power, Catania, Italy
D. Muñoz
CEA, Le Bourget-du-Lac, France
- 2CO.15.6 Stress Induced Inhomogeneities in Crystalline Silicon Solar Cells: from Characterization to Advanced Electrical Modelling**
M. Kikelj, B. Lipovsek, M. Bokalic & M. Topic
University of Ljubljana, Slovenia



VISUAL PRESENTATIONS 5CV.4

17:00 – 18:30 **PV System Design and Modeling / Energy Storage / Concentrators and PV for Space Applications**

Detailed information on this session is presented in the section entitled 'Visual Presentations'.

Thursday, 10 September 2020**ORAL PRESENTATIONS 5DO.1**

08:30 – 10:00 **Soiling**

Chairpersons:

Benjamin Figgis
QEERI, Qatar

Peter Hacke
NREL, USA

- 5DO.1.1** **The Impact of Photovoltaic Soiling on the LCOE in Desert Climates**
A.A. Abdallah, A. Ali, A. Baloch, B. Figgis, M. Kivambe, N. Barth, A. Belaidi, M. Contestabile & C. Broussillou
QEERI, Doha, Qatar
K. Ali
HBKU, Doha, Qatar
- 5DO.1.2** **On the Impact of Soiling on Energy Production in the Atacama Desert, in the Frame of ATAMOSTEC**
E. Pilat & M. Amhal
CEA, Le Bourget-du-Lac, France
D. Olivares
University of Antofagasta, Chile
E. Urrejola
ATAMOSTEC, Santiago, Chile
- 5DO.1.3** **An Iterative, Self-Consistent Method to Estimate Degradation and Soiling Loss in PV Systems**
A. Skomedal, H. Haug & E.S. Marstein
Institute for Energy Technology, Kjeller, Norway
M.G. Deceglie
NREL, Golden, USA
- 5DO.1.5** **Electrodynamic Cleaning of PV Module**
D. Petri, A. Faes, J. Escarré Palou, S. Pittet, J. Champliand, B. El Roustom, M. Despeisse & C. Ballif
CSEM, Neuchâtel, Switzerland
G. McKarris
CleanFizz, Meyrin, Switzerland
- 5DO.1.6** **Estimating Snow Losses for Many Sites Using Minimal Data Sources**
M. van Noord
RISE, Stockholm, Sweden
T. Landelius & S. Andersson
SMHI, Norrköping, Sweden



ORAL PRESENTATIONS 4DO.6

08:30 – 10:00 Sustainability and Recycling

Chairpersons:

Karsten Wambach
Wambach-Consulting, Germany

Andreas Wade
First Solar, Germany

- 4DO.6.1 A Systematic Approach to Assess the Environmental Impact of New Technologies: A Case Study for CIGS Photovoltaic Laminate**
M. van der Hulst & M. Huijbregts
Radboud University, Nijmegen, Netherlands
N. van Loon & M. Theelen
TNO/Solliance, Eindhoven, Netherlands
L. Kootstra & M. Hauck
TNO, Utrecht, Netherlands
J. Bergesen
University of California, Santa Barbara, USA
- 4DO.6.2 Merging Photovoltaic Panels and Solar Thermal Collectors – How Photovoltaic Thermal (PVT) Hybrid Collectors Boost Environmental Performance**
R. Itten, S. Manatschal & M. Stucki
ZAHW, Wädenswil, Switzerland
L. Brottier
DualSun, Marseille, France
- 4DO.6.3 Remanufacturing Silicon Photovoltaics: Feasibility, Affordability and Environmental Impact Analysis**
R. Deng, M.M. Lunardi, N. Chang, J. Ji & C.M. Chong
UNSW Australia, Sydney, Australia
P. Dias
UFRGS, Porto Alegre, Brazil
- 4DO.6.4 LCA of a Photovoltaic System with Hetero-Junction Modules and Mono-Axial Tracker**
A. Danelli, A. Gargiulo & P. Girardi
RSE, Milan, Italy
- 4DO.6.5 Technico-Environmental Study of an Innovative Recycling Process to Implement a Circular Economy across the PV Value Chain**
C. Agraffeil, N. Gazbour, F. Coustier, M. Sérasset, N. Velet, A. Dégoussée & M. Benmansour
CEA, Le Bourget-du-Lac, France
C. Thommen
Easy-engineering, Bex, Switzerland
- 4DO.6.6 Single Crystalline Si Ingot by Use of Recycled Silicon as an Example for Circular Economy**
W. Palitzsch
LuxChemtech, Freiberg, Germany
I. Röver
Losler Chemie, Freiberg, Germany

Y.-J. Yook
S-TECH, Daegu, Republic of Korea
J.S. Lee
KIER, Daejeon, Republic of Korea

ORAL PRESENTATIONS 6DO.11

08:30 – 10:00 Vehicles and Infrastructures

Chairpersons:

Bianca Lim
ISFH, Germany

Heinz Ossenbrink
Band Gap, Germany

- 6DO.11.1 Potential and Challenges of Vehicle Integrated Photovoltaics for Passenger Cars**
M. Heinrich, C. Kutter, F. Basler, M. Mittag, C. Reise, T. Kroyer, H. Neuhaus & H. Wirth
Fraunhofer ISE, Freiburg, Germany
- 6DO.11.2 Environmental Impacts of Integrating Photovoltaic Modules on Electric Light Utility Vehicles**
O. Kanz & K. Ding
Forschungszentrum Jülich, Germany
J. May
Cologne University of Applied Sciences, Germany
- 6DO.11.3 Vehicle Integrated Photovoltaics - Evaluation of the Energy Yield Potential through Monitoring and Modelling**
A.J. Carr, A.R. Burgers & B.K. Newman
TNO Energy Transition, Petten, Netherlands
E. van den Tillaart & T. Köhler
TNO Traffic & Transport, Helmond, Netherlands
- 6DO.11.4 Improving the Reliability of a Solar Road PV Module**
M. Vite, A. Boulanger, D.R. Heslinga, R. De Bettignies, J. Gaume & F. Chabuel
CEA, Le Bourget-du-Lac, France
- 6DO.11.5 Photovoltaic Potential of Highways in the Netherlands Including Traffic Effect**
C. Ferri, H. Ziar, T. Nguyen, H. van Lint, M. Zeman & O. Isabella
Delft University of Technology, Netherlands
- 6DO.11.6 Integrated Lightweight, Glass-Free PV Module Technology for Box Bodies of Commercial Trucks**
C. Kutter, F. Basler, M. Heinrich, L.E. Alanis & H. Neuhaus
Fraunhofer ISE, Freiburg, Germany



VISUAL PRESENTATIONS 7DV.1

08:00 – 10:00 **Costs, Economics, Finance and Markets / Assessment, Policies and Scenarios for Renewables; Societal and Global Challenges**

Detailed information on this session is presented in the section entitled 'Visual Presentations'.

ORAL PRESENTATIONS 5DO.2

10:30 – 12:00 **Performance Assessment**

Chairpersons:

Gerhard Mütter
ALTESO, Austria

Marios Theristis
Sandia National Laboratories, USA

5DO.2.1 **Student Awards Finalist Presentation: Geographical Approach for Weather Risk Identification and PV Performance Assessment**

J. Ascencio-Vásquez, K. Brecl & M. Topic
University of Ljubljana, Slovenia

5DO.2.2 **Comparative Analysis of Module Temperature Measurements and Estimation Methods for Various Climate Zones across the Globe**

M. Braga, A.K. Vidal de Oliveira & R. Rütger
UFSC, Florianópolis, Brazil
L. Burnham
Sandia National Laboratories, Albuquerque, USA
S. Dittmann
Anhalt University of Applied Sciences, Köthen, Germany
R. Gottschalg
Fraunhofer CSP, Halle (Saale), Germany
B. Figgis
QEERI, Doha, Qatar
A. Benlarabi
IRESEN, Rabat, Morocco
T.R. Betts
CREST, Loughborough, United Kingdom
T. Reindl
SERIS, Singapore, Singapore
S.-Y. Oh
Yeungnam University, Gyeongsan, Republic of Korea
J.-H. Choi
Korea Testing Labs, Gyeongsan, Republic of Korea
K.S. Kim
KIER, Daejeon, Republic of Korea

5DO.2.4 **Guidelines for Ensuring Data Quality for Photovoltaic System Performance Assessment and Monitoring**

A. Livera, G. Makrides & G.E. Georghiou
University of Cyprus, Nicosia, Cyprus

M. Theristis & J.S. Stein
Sandia National Laboratories, Albuquerque, USA
E. Koumpli
Solarcentury, London, United Kingdom

5DO.2.5 **Improving the Quality of PV Plant Performance Analysis by Increasing Data Integrity and Reliability: a Data-Driven Approach Using Machine Learning Techniques**

G. Oviedo Hernández & P.V. Chiantore
BayWa, Rome, Italy
E. Capra
BayWa, Chieti, Italy
S. Lindig & D. Moser
Eurac Research, Bolzano, Italy

5DO.2.6 **Evaluation of Provisional Acceptance Testing Procedures for Commercial PV Plants**

S. Mau, A. Sharpe, C. Campistron, F. Canto Teixeira & N. Chouleur
Everoze, Madrid, Spain

ORAL PRESENTATIONS 4DO.7

10:30 – 12:00 **MPP-Tracking, Inverters, BOS**

Chairpersons:

Claudia Buerhop-Lutz
Helmholtz Institute ERN, Germany

Nicola Pearsall
Northumbria University, United Kingdom

4DO.7.1 **Quality Management Best Practice Guidelines**

R. Gottschalg
Fraunhofer CSP, Halle (Saale), Germany

4DO.7.2 **Micro-Inverters: an Update of Comparison of Conversion Efficiencies and Energy Yields**

S. Krauter & J. Bendfeld
University of Paderborn, Germany

4DO.7.3 **New Maximum Power Point Tracking MPPT Algorithm Based on Research of a Target Voltage Range and Its Implementation in a Commercial Inverter for Photovoltaic Systems**

A. Minuto, E. Celi & G. Timò
RSE, Piacenza, Italy
N. Panozzo
BDF DIGITAL, Vicenza, Italy

4DO.7.4 **Selective Deployment of Power Optimizers: Effect of Shade on Performance and Hotspots in PV Modules**

N.J.J. Dekker, M.J. Jansen & A.R. Burgers
TNO Energy Transition, Petten, Netherlands



M.S. Dörenkämper
TNO Energy Transition, Eindhoven, Netherlands
R. Jonkman
Heliox, Best, Netherlands
R. van der Ven
Solned, Veldhoven, Netherlands
E. Gramsbergen
RE-Source Renewable Energy, Veldhoven, Netherlands

4DO.7.5 Evaluation of the DC Bus Link Capacitors and Power Transistor Modules in the Qualification Testing of PV Inverters

P. Hacke & R. Thiagarajan
NREL, Golden, USA
D. Clemens
SMA Solar Technology, Niestetal, Germany
J. Flicker
Sandia National Laboratories, Albuquerque, USA
H. Igarashi
SolarEdge Technologies Japan, Yokohama, Japan

4DO.7.6 Aiming at Resolving Limitation of Indian Standard (IS): 2911-1-2 Regarding Calculation of Lateral Load Capacity for Short Rigid Piles of Solar Module Mounting Structure

S. Chatterjee
RGM International, Kolkata, India
S. Mukherjee
Vikram Solar, Kolkata, India

ORAL PRESENTATIONS 6DO.12

10:30 – 12:00 Building Envelope / Design, Customisation and Standardisation

Chairpersons:

Miguel C. Brito
University of Lisbon, Portugal

Michiel Ritzen
ZUYD, The Netherlands

6DO.12.1 IEC61853-Matrix Analysis of PVPS Task 15 BIPV Round-Robin for More Than One Year at Seven Test Sites over the World

R.M.E. Valckenborg
TNO, Eindhoven, Netherlands
L. Gaisberger
FH-OOE, Wels, Austria
K.A. Berger & G. Ujvári
AIT, Vienna, Austria
G.C. Eder
OFI, Vienna, Austria
P. Illich
UAS Technikum Wien, Vienna, Austria
C.S. Polo López
SUPSI, Canobbio, Switzerland

S. Boddaert
CSTB, Sophia Antipolis, France
M. Del Buono
EURAC Research, Bolzano, Italy
N. Martín Chivelet
CIEMAT, Madrid, Spain
A. Sanz Martínez
Tecnalia, Derio, Spain
J.T. Kim
Kongju National University, Gongju-si, Republic of Korea

6DO.12.2 Performance Assessment of BIPV Systems: Research on BIPV Characterization Methods

P. Bonomo, F. Parolini, F. Frontini, M. Caccivio & G. Bellenda
SUPSI, Canobbio, Switzerland
J.M. Vega de Seoane & D. Valencia
Tecnalia, San Sebastián, Spain
S. Boddaert
CSTB, Sophia Antipolis, France

6DO.12.3 Customization of BIPV Modules' Appearance by Colored Textiles (CoTex) and Their Digital Prototypes

T. Gewohn, M.R. Vogt, B. Lim & R. Brendel
ISFH, Emmerthal, Germany
C. Schinke
Leibniz University Hannover, Germany

6DO.12.4 Simulating Interior Radiant Energy for the Design and Prototyping of an Indoor Solar PV Lamp

M. Verkou, H. Ziar, M. Zeman & O. Isabella
Delft University of Technology, Netherlands

6DO.12.5 Assessment of Technical and Economical Photovoltaic Potential on Flat Roofs in Urban Area - Case of Casablanca, Morocco

H. Saadaoui, A. Ghennioui, Z. Naimi & B. Ikken
Green Energy Park, Benguerir, Morocco
H. Rhinane & D. Saifaoui
University of Hassan II, Casablanca, Morocco

6DO.12.6 New Intelligent Solar Façade for Architectural Building Integration

G. Mangherini, P. Bernardoni, M. Boschetti, A. Andreoli, M. Gjestila,
M. Bottarelli & D. Vincenzi
University of Ferrara, Italy
M. Brocato & R. Zarcone
ENSAPM, Paris, France
M. Tonezzer & P. Decarli
Powerglax, Vallelaghi, Italy

VISUAL PRESENTATIONS 2DV.2

10:30 – 12:00 Silicon Wafer Technology / Thin Film and Foil-Based Si Cells

Detailed information on this session is presented in the section entitled 'Visual Presentations'.



ORAL PRESENTATIONS 5DO.3**13:30 – 15:00 O&M and Failure Analysis****Chairpersons:**

Peter Lechner
ZSW, Germany

Killian Lobato
University of Lisbon, Portugal

- 5DO.3.1 The Influence of Thermal Signatures Observed with Infrared Thermography on Power Production in Utility Scale PV Plants**
B.L. Aarseth & M.B. Øgaard
University of Oslo, Kjeller, Norway
A. Skomedal & E.S. Marstein
Institute for Energy Technology, Kjeller, Norway
- 5DO.3.2 Machine Learning PV Module I-V Curve Predictions Based on Electroluminescence Images**
S. Rodrigues, C. Buerhop-Lutz, J. Hauch & I.M. Peters
HI ERN, Erlangen, Germany
B. Doll & C.J. Brabec
FAU Erlangen-Nürnberg, Germany
- 5DO.3.3 Student Awards Finalist Presentation: Contactless Outdoor Photoluminescence of Silicon Photovoltaic Modules with Inhomogeneous Excitation Source**
B. Doll, J. Hepp, M. Hoffmann, A. Vetter, L. Lürer & C.J. Brabec
FAU Erlangen-Nürnberg, Germany
O. Stroyuk, C. Buerhop-Lutz, J. Hauch & I.M. Peters
HI ERN, Erlangen, Germany
M. Hemsendorf
GP Inspect, Neuried, Germany
D. Tegtmeyer
Mencke & Tegtmeyer, Hameln, Germany
F. Talkenberg & M. Menz
greateyes, Berlin, Germany
- 5DO.3.4 Lessons from Operating Large-Scale Solar Generators in Australia**
L. McLeod, G. Dickeson & L. Frearson
Ekistica, Alice Springs, Australia
M. Miller
CEFC, Sydney, Australia
J. Ryan
ARENA, Canberra, Australia
- 5DO.3.5 Autonomous Monitoring and Analysis of PV Systems by Unmanned Aerial Vehicles, Internet of Things and Big Data Analytics**
M. Aghaei & A.H.M.E. Reinders
Eindhoven University of Technology, Netherlands
A. Eskandari
Amirkabir University of Technology, Tehran, Iran

5DO.3.6 PV4.0: Combining Asset Management, PV Measurement Data and the Cost Priority Number Method in a Digital Infrastructure for PV Plant O&M

A. Louwen, L. Koester, S. Lindig & D. Moser
Eurac Research, Bolzano, Italy
A. Astigarraga
Accademia Europea Bolzano, Italy

ORAL PRESENTATIONS 7DO.8**13:30 – 15:00 Accelerating Technology Innovation and Sustainable Deployment****Chairpersons:**

Nigel Taylor
European Commission JRC, Italy

Maria Getsiou
European Commission DG RTD, Belgium

- 7DO.8.1 Potential Regulatory Approaches on the Environmental Impacts of Photovoltaics: Expected Improvements and Impacts on Technological Innovation**
D. Polverini
European Commission DG GROWTH, Brussels, Belgium
N. Dodd & N. Espinosa
European Commission JRC, Seville, Spain
- 7DO.8.2 SOLAR-ERA.NET - European Network of National and Regional Research and Innovation Programmes - Latest Developments, Project Results, Lessons Learned and Outlook**
S. Nowak, M. Gutschner & T. Biel
NET Nowak Energy & Technology, St. Ursen, Switzerland
S. Oberholzer
Swiss Federal Office of Energy, Bern, Switzerland
C. Hünnekes, K. Chakanga & R. Horbelt
Forschungszentrum Jülich, Germany
M. Schulte
Project Management Organisation ETN, Jülich, Germany
D. Ruiz
FECYT, Coruña, Spain
E. Fernández
MINECO, Madrid, Spain
B. Gómez
Ministry of Science, Madrid, Spain
H. González
CDTI, Madrid, Spain
P.-J. Rigole
Swedish Energy Agency, Eskilstuna, Sweden
O. Bernsen
Netherlands Enterprise Agency, Den Haag, Netherlands
L. Polain
Public Service of Wallonia, Jambes, Belgium



G. Carchon
VLAIO, Gent, Belgium
E. Afentaki
GSRT, Athens, Greece
P. Leptos
RIF, Lefkosia, Cyprus
R. Peyronnet
ADEME, Paris, France
P. Bain
ANR, Paris, France
K. Karaösz
TUBITAK, Gebze, Turkey
A. Covello
MIUR, Rome, Italy
E. Lutter
Climate and Energy Fund, Vienna, Austria
A. Hipfinger
FFG, Vienna, Austria
G. Friedmann
Ministry of Energy, Jerusalem, Israel

7DO.8.3 Reviewing Global Projections for Long-Term Solar PV Adoption: a Data-Mining Approach

M. Jaxa-Rozen & E. Trutnevyte
University of Geneva, Switzerland

7DO.8.4 Solar Roadmapping: The Way to Open up a Broad Range of Possible Options

P. Malbranche
International Solar Alliance, Gurugram, India

7DO.8.5 Comprehensive Financial Modeling of Solar PV Systems

D. Baschieri, C.A. Magni & A. Marchioni
UNIMORE, Modena, Italy

7DO.8.6 INES.2S - A French Institute for Multilateral Industrial Research on Solar Energy

J. Merten & A. Jouini
CEA, Le Bourget-du-Lac, France
F. Lambert
CEA, Grenoble, France
F. Stork
CNR, Lyon, France
P. Raffin
Colas, Paris, France
G. Coma
Renault, Boulogne Billancourt, France
G. Duissard
2CA, Arlanc, France
F. Barruel
PFE, Le Bourget-du-Lac, France
C. Ménézou
USMB-LOCIE, Le Bourget-du-Lac, France

ORAL PRESENTATIONS 6DO.13

13:30 – 15:00 Building Envelope / Design, Simulation and Performance

Chairpersons:

Maarten Dörenkämper
TNO Energy Transition, Netherlands

Nuria Martín Chivelet
CIEMAT, Spain

6DO.13.1 BIM - A Driver for Cost Reduction within the BIPV Industry

P. Alamy
Enerbim, Seilh, France
E. Saretta & P. Bonomo
SUPSI, Canobbio, Switzerland
J. Adami
Eurac Research, Bolzano, Italy
S. Pierret
Optimal Computing, Mons, Belgium
D. Valencia
Tecnalia R&I, San Sebastian, Spain
P. Alonso
WIP Renewable Energies, Munich, Germany

6DO.13.2 Artificial Intelligence Applied to the Thermal Characterization of Building Integrated Photovoltaic Technologies

L. Serrano-Lujan & J.M. Colmenar
Rey Juan Carlos University, Madrid, Spain
C.A. Toledo Arias, J. Abad & A. Urbina
UPCT, Cartagena, Spain

6DO.13.3 Outdoor Operating Temperature of Modules in BIPV and BAPV Topologies

A. Fairbrother, A. Virtuani & C. Ballif
EPFL, Neuchâtel, Switzerland

6DO.13.4 Low Concentration and Solar Control Photovoltaic System for Building Integration: Yearly Results and Analysis of Skylight System

D. Valencia & E. Román Medina
Tecnalia Research & Innovation, San Sebastian, Spain
Y.B. Assoa & F. Burgun
CEA, Le Bourget-du-Lac, France
A. Sanz Martinez
Tecnalia, Derio, Spain
E. Rico, T. Del Caño & V. Velasco
Onyx Solar Energy, Avila, Spain
T. Reijenga
BEAR-iD, Gouda, Netherlands
P. Surguy
Film Optics, Watchfield, United Kingdom
P. Alonso & I. Weiss
WIP Renewable Energies, Munich, Germany

6DO.13.5 Development and Yearly Results of Framing System for c-Si Large Area Glass Prototype in Ventilated Facade Configuration

Y.B. Assoa, F. Burgun, P. Thony & I.A. Tsanakas



CEA, Le Bourget-du-Lac, France
 E. Rico, T. Del Caño & V. Velasco
 Onyx Solar Energy, Avila, Spain
 D. Valencia, E. Román Medina, M. Machado & A. Sanz Martinez
 Tecnalia R&I, San Sebastián, Spain
 P. Alonso & I. Weiss
 WIP Renewable Energies, Munich, Germany

- 6DO.13.6 Applying Wireless Power Transfer for Curtain Wall BIPV Elements**
 S. De Meyere & B. Minnaert
 Odisee University College of Applied Sciences, Ghent, Belgium
 S. Ravyts & J. Driesen
 KU Leuven, Genk, Belgium

VISUAL PRESENTATIONS 2DV.3

13:30 – 15:00 Crystalline Silicon Solar Cell Technologies

Detailed information on this session is presented in the section entitled 'Visual Presentations'.

ORAL PRESENTATIONS 5DO.4

15:15 – 16:45 Fault Detection

Chairpersons:

João M. Almeida Serra
 University of Lisbon, Portugal

Daniela Guida
 ENEL Green Power, Italy

- 5DO.4.1 A Data-Driven Model for Solar Inverters**
 G. Guerra & P. Mercade Ruiz
 GreenPowerMonitor, Barcelona, Spain
 L. Landberg
 DNV GL, Hellerup, Denmark
- 5DO.4.2 Anomaly Detection at Inverter Level via Machine Learning Algorithms under the Absence of O&M Logbooks**
 A.P. Talayero, N. Yildirim Yürüsen & A. Llombart Estopinan
 CIRCE, Zaragoza, Spain
 J.J. Meler Estela
 University of Zaragoza, Spain
- 5DO.4.3 Advanced Fault Detection and Diagnosis with AI Techniques**
 M. Chang & K.H. Chen
 Sinogreenenergy, Taipei, Taiwan
 J.-L. Li, Y.-S. Chen & L. Wang

Reforecast, Taipei, Taiwan

- 5DO.4.4 Early Detection of Potential Induced Degradation in the Field: Testing a New Methodology on Silicon PV Modules**
 M. Florides, G. Makrides & G.E. Georghiou
 University of Cyprus, Nicosia, Cyprus
- 5DO.4.5 Early Casualties in Five PV Plants in France: A Sustainability Perspective on Complete PV Fault Diagnostics for Revamping**
 J.A. Tsanakas, D.-L. Ha & F. Al-Shakarchi
 CEA-INES, Le Bourget-du-Lac, France

ORAL PRESENTATIONS 7DO.9

15:15 – 16:45 Energy System Modelling, Economic and Social Drivers

Chairpersons:

Philippe Malbranche
 CEA, France

Stefan Nowak
 NET Nowak Energy & Technology, Switzerland

- 7DO.9.1 Towards Country Scale Photovoltaic Energy Yield Modelling**
 A. Schils, I.T. Horvath, F. Catthoor, E. Voroshazi & M. Meuris
 imec, Genk, Belgium
 W. Clymans & I. Uljee
 Flemish Institute for Technological Research, Mol, Belgium
 F. Duchêne
 Royal Meteorological Institute of Belgium, Brussels, Belgium
 F. Meinke-Hubeny
 VITO, Genk, Belgium
- 7DO.9.2 A Framework to Assess Local Grid Impacts of PV Deployment and Load Growth, and Cost-Effective Measures to Minimise Disruption across Great Britain**
 S. Few, P. Djapic, G. Strbac, J. Nelson & C. Candelise
 Imperial College London, United Kingdom
- 7DO.9.3 Photovoltaics with Horizontal Tracking and Delta Configuration in a Decarbonized European Energy System**
 M. Victoria
 Aarhus University, Denmark
- 7DO.9.4 A Multi-Objective Optimization to Assess Economic Benefit Distribution and Impact of Energy Communities**
 V. Casalicchio, M.G. Prina & D. Moser
 Eurac Research, Bolzano, Italy
 G. Manzolini
 Polytechnic University of Milan, Italy
- 7DO.9.5 Open Database of Small-Scale Solar PV Installations: a Citizen Science Initiative**



A.B. Cristóbal & C. del Cañizo
 UPM, Madrid, Spain
 L. Barbosa & G. Revuelta
 UPF, Barcelona, Spain
 S. Haas
 Reiner Lemoine Institut, Berlin, Germany
 M. Victoria
 Aarhus University, Denmark
 M. Brocklehurst
 KempleyGreen Consultants, Gloucester, United Kingdom

7DO.9.6 SocialRES Project – Fostering Energy Democracy through Social Innovation

S. Caneva & P. Alonso
 WIP Renewable Energies, Munich, Germany
 I. Lizarralde, I. Valentin, A. Abi Akle & M. Hamwi
 ESTIA Institute of Technology, Bidart, France
 V. Kromrey, D. Vedel & A. Wotjen
 Bodensee-Stiftung, Radolfzell, Germany
 A. Schneller & L. Domröse
 Adelphi, Berlin, Germany
 A. Ferrari & C. Crippa
 Fondazione Icons, Lodigi, Italy
 E. Denny & J. Carroll
 Trinity College Dublin, Ireland
 M. Regidor & S. Mulero
 CARTIF Foundation, Valladolid, Spain
 I. Lacoste
 I-ENER, Saint-Jean-Pied-de-Port, France
 R. Ruiz
 ENERGETICA, Valladolid, Spain
 N. Brito Jorge & M. Teixeira
 GoParity, Lisbon, Portugal
 K. Harder & T. Harwood
 Abundance, London, United Kingdom
 T. Simek
 REGEA, Zagreb, Croatia
 D. Leonte & M. Policarp
 Tractebel, Bucharest, Romania

ORAL PRESENTATIONS 6DO.14

15:15 – 16:45 AgroPV and EcoPV

Chairpersons:

Alessandra Scognamiglio
 ENEA, Italy

Rutger Schlatmann
 HZB, Germany

6DO.14.1 Dutch National Measurement Standard for Biodiversity in Solar Parks: First Practical Experience

A. Schotman
 Wageningen Environmental Research, Netherlands
 M. Erberfeld
 Rijkswaterstaat, Utrecht, Netherlands
 I. Cesar
 TNO Energy Transition, Petten, Netherlands

6DO.14.2 Student Awards Finalist Presentation: Techno-Economic Study of Agrivoltaic Systems Focusing on High Value Crops

B. Willockx, B. Herteleer & J. Cappelle
 KU Leuven, Gent, Belgium

6DO.14.3 Potential Use of Organic Photovoltaic (OPV) in Greenhouse Cultivation

M. Friman-Peretz, F. Geoola, S. Ozer, A. Levi & M. Teitel
 Agricultural Research Organisation, Rishon LeZion, Israel
 I. Yehia & E. Magadley
 Triangle Research and Development Center, Kafr Qara, Israel
 S. Gantz
 Ministry of Agriculture, Bet-Dagan, Israel

6DO.14.4 Vertical Bifacial Solar Module Systems on Wild Flower Strips Combining Energy and Crops Production with Preservation of Biodiversity

J. Schneider
 Fraunhofer IMW, Halle, Germany
 N. Pannicke
 UFZ, Leipzig, Germany
 H. Haufe
 DBFZ, Leipzig, Germany
 J. Birger
 Stiftungs Kulturlandschaft Sachsen-Anhalt, Wanzleben, Germany
 N. Zwosta
 Next2Sun, Berlin, Germany
 M. Mattiza
 Terrawatt, Leipzig, Germany

6DO.14.5 Development Process of Tailormade Smart Agri-Energy PVT Laminates

R.M.E. Valckenborg, M. Koetse, B. Dai & B. van de Vorst
 TNO, Eindhoven, Netherlands
 H. den Besten
 Den Besten Service, Hoevelaken, Netherlands
 P. Happé
 Expice, Zwaag, Netherlands
 G. Verpaalen



Kameleon Solar Specials, Roosendaal, Netherlands
 H. Visscher
 Solarge, Eindhoven, Netherlands
 A. Schiebroek
 SolarTech, Eindhoven, Netherlands
 H. Lootens
 Stichting Gelijkspanning Nederland, Aalsmeer, Netherlands
 M. Roelofs
 Taylor, Eindhoven, Netherlands
 T. Verhoeven
 Van der Leegte Werkt, Eindhoven, Netherlands

6DO.14.6 Improved Healthy Growth of Basil Seedlings under LSC Filtered Illumination

D. Vincenzi, P. Bernardoni, G. Mangherini, M. Boschetti & A. Andreoli
 University of Ferrara, Italy
 C. Samà, L. Gila & S. Palmery
 Istituto Eni Donegani, Novara, Italy
 M. Tonezzer & P. Decarli
 Powerglax, Vallelaghi, Italy

VISUAL PRESENTATIONS

15:15 – 16:45 POSTER AWARDS WINNERS SESSION

Chairperson:

Julio Cárabe
 CIEMAT, Spain

Aiming to increase the visibility of poster awards winners and as a recognition to the quality of their presentation, the winners will be presented on this dedicated Poster Awards Winners session. This session will be composed of 2 parts: The above mentioned presentation of the winners, and a chat discussion in a dedicated virtual room together with the winners and interested audience.

ORAL PRESENTATIONS 5DO.5

17:00 – 18:30 Performance and Yield Investigations

Chairpersons:

Franz P. Baumgartner
 ZHAW, Switzerland

Sandy Rodrigues
 University of Lisbon, Portugal

5DO.5.1 Investigations on the Main Causes for Reduced Performances during the Early Stage of Life of Rooftop PV Systems

D. Chianese & M. Caccivio
 SUPSI, Canobbio, Switzerland

5DO.5.2 Challenges Associated with Inconsistent Photovoltaic Degradation Rate Estimations

M. Theristis, B.H. King & J.S. Stein
 Sandia National Laboratories, Albuquerque, USA
 J. Ascencio-Vásquez & M. Topic
 University of Ljubljana, Slovenia

5DO.5.3 28 Years of Operational Data for a Utility Scale 103 kWp PV Plant (1989-2017) Analysis of Degradation of PV Modules, Inverters and System Performance with Technical and Economical Comparison to the Repowered 260 kWp PV Plant (2017-2019)

T. Nordmann & T. Vontobel
 TNC Consulting, Feldmeilen, Switzerland

5DO.5.4 Performance of Roof-Top PV Systems in Selected European Countries from 2012 to 2019

J. Schardt & H. te Heesen
 Trier University of Applied Sciences, Neubrücke (Nahe), Germany

5DO.5.5 On the Impact of a Solar Eclipse across 100 PV Systems in India and Southeast Asia

A.M. Nobre, S. Karthik, R.S. Baker, A. Agarwal, S. Pranav, R. Malhotra & A. Khor
 Cleantech Solar, Singapore, Singapore

5DO.5.6 Bifacial Optical Model Validation and Performance of Static and Tracked Systems Installed in the Atacama Desert

F. Araya Rojas, T. Capelle, F. Haffner & H. Colin
 CEA-INES, Le Bourget-du-Lac, France

ORAL PRESENTATIONS 2DO.10

17:00 – 18:30 Thin Film and Foil-Based Si Cells

Chairpersons:

Paola Delli Veneri
 ENEA, Italy

Michio Kondo
 AIST, Japan

2DO.10.2 Implementation of a Monolithic Bypass Diode Concept in Amorphous Silicon Thin-Film Solar Modules

J. Reifschneider, N. Hambach, B.E. Pieters & S. Haas
 Forschungszentrum Jülich, Germany

2DO.10.4 Plasma Enhanced Chemical Vapor Deposition (PECVD) and Catalytic CVD (Hot-Wire CVD) for High-Rate Fabrication of Thin-Film Silicon Layers

S. Leszczynski, B. Leszczynska, C. Strobel, M. Albert & J.W. Bartha
 Technical University of Dresden, Germany
 F. Stahr & J. Kuske
 FAP, Dresden, Germany



- 2DO.10.5 Flexible Bifacial Amorphous Si Quintuple- and Sextuple-Junction Solar Cells for IoT Devices**
M. Konagai, H. Noge & R. Ishikawa
Tokyo City University, Setagaya-ku, Japan
- 2DO.10.6 Columnar a-Si:H Precursor Films for Laser Liquid Phase Crystallization**
M. Nuys, H. Ali & S. Haas
Forschungszentrum Jülich, Germany

ORAL PRESENTATIONS 6DO.15

17:00 – 18:30 Floating Photovoltaics

Chairpersons:

Urs Muntwyler
BUAS, Switzerland

Roland M. E. Valckenborg
TNO, The Netherlands

- 6DO.15.1 A Global Review of Hybrid Hydropower-Connected Floating PV Projects: Research, Status, Opportunities and Challenges**
S. Merlet
NTNU, Trondheim, Norway
B. Thorud
Multiconsult, Oslo, Norway
C. Paton
SERIS, Singapore, Singapore
- 6DO.15.2 Floating Photovoltaics – On-Site Measurements in Temperate Climate and Lake Influence on Module Behavior**
B. Amiot, M. Chiodetti, R. Le Berre & P. Dupeyrat
EDF R&D, Moret-sur-Loing, France
S. Giroux-Julien
INSA Lyon, Villeurbanne, France
D. Boubilil & K. Radouane
EDF Renewables, Paris La Defense, France
K. Vermeyen
EDF Luminus, Brussels, Belgium
- 6DO.15.3 Performance and Reliability of Ocean Sun's Floating PV Technology**
J.H. Selj, I.H. Lereng, P. De Paoli, G. Otnes & E.S. Marstein
Institute for Energy Technology, Kjeller, Norway
M.B. Øgaard
University of Oslo, Norway
S. Patel
Stellenbosch University, Cape Town, South Africa
- 6DO.15.4 Irradiation Analysis of Floating One-Axis Azimuthal Tracking PV Systems**
M. Dörenkämper, M.M. de Jong & W. Folkerts

TNO, Eindhoven, Netherlands

- 6DO.15.5 Innovative Floating Bifacial Photovoltaic Solutions for In-Land Water Areas**
H. Ziar, E. Garcia Goma, J. Garro Etxebarria, F. Fatih Sönmez, I. Narvaez Alavez, T. Stark, A. Calcabrini, R. Santbergen & O. Isabella
Delft University of Technology, Netherlands
B. Prudon
Waterschap Rivierenland, Tiel, Netherlands
V. Lin & B. Roeffen
Blue21, Delft, Netherlands
D. Heijkoop, D. van Tilborg, P. van der Linde & H. van Laar
Hakkers, Werkendam, Netherlands
- 6DO.15.6 On Module Temperature in Floating PV Systems**
I.M. Peters
Forschungszentrum Jülich, Erlangen, Germany
A.M. Nobre
Cleantech Solar, Singapore, Singapore



Friday, 11 September 2020

ORAL PRESENTATIONS 6EO.1**08:30 – 10:00 Industrial Application and Electric Mobility****Chairpersons:**

Hubert Aulich
SC Sustainable Concepts, Germany

Bonna Newman
TNO Energy Transition, The Netherlands

6EO.1.1 Designing Innovative Solutions for PV-Powered Electric Mobility Applications

A. Sierra & A.H.M.E. Reinders
University of Twente, Enschede, Netherlands

6EO.1.2 VIPV: Process Development of Integrated Photovoltaic Cells in a Double-Curved Composite Structure for Automotive Application

T. Duigou, F. Chabuel & J. Gaume
CEA, Grenoble, France
V. Boichon, X. Brancaz, P. Francescato & L. Tenchine
IPC, Balignat, France
M. Lagache & P. Saffre
University Savoie Mont Blanc, Annecy, France

6EO.1.3 Development of High-Efficiency and Low-Cost Solar Cells for PV-Powered Vehicles Applications

M. Yamaguchi, K. Araki, D. Sato & N. Kojima
Toyota Technological Institute, Nagoya, Japan
T. Takamoto
SHARP, Nara, Japan
T. Masuda & A. Satou
Toyota, Shizuoka, Japan
K. Yamada & T. Nakado
Toyota, Japan
M. Yamazaki
NEDO, Kawasaki, Japan

6EO.1.4 PHOTOPUR-PV Powered Process Automation of an AOP Based Water Decontamination

J. da Costa Fernandes, E. Bollin & M. Schmidt
University of Applied Sciences Offenburg, Germany
P. García-Muñoz & N. Keller
University of Strasbourg, France

6EO.1.5 An Innovative Multi-Axis Solar System for HCPV

F. Bizzarri
ENEL, Rome, Italy
L. Merlo & A. Cucuzza
ENEL, Catania, Italy
G. Lanzara, F. Ponticelli, F. Crisi & A. D'Ottavio
Solergy, Formello, Italy
Y. Banin
Solergy, Piedmont, USA

ORAL PRESENTATIONS 5EO.2**08:30 – 10:00 Energy Storage****Chairpersons:**

Francesco Dolci
European Commission JRC, The Netherlands

Florence Lambert
CEA, France

5EO.2.1 Vanadium Redox Flow Battery Modelling and PV Self-Consumption Management Strategy Optimization

A.C. Neves Foles, L.A. Fialho, M.P.I. Collares-Pereira & P.A. dos Santos Ribeiro Horta
University of Evora, Portugal

5EO.2.2 Temporal Complementarity between Wind and Solar Generation and the Role of Storage for Hybrid Plants

R.A. Campos & R. Rütger
UFSC, Florianópolis, Brazil

5EO.2.3 Student Awards Finalist Presentation: Increased PV Utilisation from DC Distribution: Quantification of Geographical Location Impact

P. Ollas & C. Markusson
RISE, Borås, Sweden
T. Thiringer
Chalmers University of Technology, Götheborg, Sweden

5EO.2.4 From Room to Field: Solar-Battery Coupling Feasibility Study

O. Astakhov, T. Merdzhanova, L.-C. Kin & U. Rau
Forschungszentrum Jülich, Germany

5EO.2.5 Influence of PV and Battery Degradations on Residential Solar Panel Systems

O. Alavi, W. De Ceuninck, M. Meuris & M. Daenen
Hasselt University, Diepenbeek, Belgium

5EO.2.6 Efficient Solar Charging of Lithium Ion Batteries Using Perovskite Solar Cells

L.-C. Kin, Z. Liu, O. Astakhov, S.N. Agbo, H. Tempel, S. Yu, H. Kungl, R.-A. Eichel, U. Rau, T. Kirchartz & T. Merdzhanova
Forschungszentrum Jülich, Germany

ORAL PRESENTATIONS 7EO.3

08:30 – 10:00 **Costs, Economics, Finance and Markets**

Chairpersons:

Silvia Caneva
WIP Renewable Energies, Germany

Thomas Nordmann
TNC Consulting, Switzerland

7EO.3.1 **A Snapshot of Global PV Markets - the Latest Survey Results on PV Markets and Policies from the IEA PVPS Programme in 2019**

G. Masson
Becquerel Institute, Brussels, Belgium
A. Jäger-Waldau
European Commission JRC, Ispra, Italy
I. Kaizuka
RTS Corporation, Tokyo, Japan
J. Lindahl
Becquerel Sweden, Stockholm, Sweden
J. Donoso Alonso
UNEF, Madrid, Spain

7EO.3.2 **The Value of Efficiency**

I.M. Peters
HI ERN, Erlangen, Germany
S. Sofia & T. Buonassisi
MIT, Cambridge, USA
C.D. Rodríguez-Gallegos
SERIS, Singapore, Singapore
J. Hepp
Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany

7EO.3.3 **Bottom-Up Analysis of Future PV System Cost Development**

E. Vartiainen
Fortum Growth, Finland
G. Masson
Becquerel Institute, Brussels, Belgium
C. Breyer
Lappeenranta University of Technology, Finland
D. Moser
Eurac Research, Bolzano, Italy
E. Román Medina
Tecnalia R&D, Derio, Spain

7EO.3.4 **Costs of Utility-Scale Photovoltaic Systems Integration in the Future Italian Energy Scenarios**

E. Veronese, M.G. Prina & D. Moser
Eurac Research, Bolzano, Italy

G. Manzolini
Polytechnic University of Milan, Italy

7EO.3.5 **First Economic Benchmark of PV Technologies for ATAMOSTEC in the Atacama Desert, Chile**

N. Gazbour, P.-J. Ribeyron & D. Muñoz
CEA, Le Bourget-du-Lac, France
E. Urrejola & M.J. Riquelme
ATAMOSTEC, Santiago, Chile
C. Gonzalez & A.M. Ruz
CORFO, Santiago, Chile

7EO.3.6 **Holistic Evaluation of the Economic Competitiveness of BIPV Solutions in Europe**

P. Macé & E. Bosch
Becquerel Institute, Brussels, Belgium

PLENARY SESSION EP.1

10:30 – 12:10 **PV IN THE ENERGY SYSTEM**

Chairpersons:

Wim C. Sinke
TNO Energy Transition, The Netherlands

Julio Cárabe
CIEMAT, Spain

EP.1.1 **Designing PV for the First Generation of Solar Electric Vehicles**

B.K. Newman, V. Rosca, N.J.J. Dekker, L.A.G. Okel & M.J.A.A. Goris
TNO Energy Transition, Petten, Netherlands
S. Regondi, D. Dijken & D. di Carlo
Lightyear, Helmond, Netherlands
A. Khabbaz Saberi, S. van Montfort & R.M.A.F. Verschuren
TNO Traffic & Transport, Helmond, Netherlands

EP.1.2 **Storage for Residential Energy Systems**

J. Juergens
LG Chem Europe GmbH, Frankfurt, Germany

EP.1.3 **Sustainability of PV for the TeraWatt Era**

G. Heath
NREL, Golden, USA



EP.1.4 Innovative Self-Consumption and Aggregation Concepts for PV**Prosumers: Results of the PV-Prosumers4Grid Project**

W.G.J.H.M. van Sark & W. Schram

Utrecht University, Netherlands

J. Radl, A. Fleischhacker & G. Lettner

Vienna University of Technology, Austria

A. Louwen

Eurac Research, Bolzano, Italy

L.A. Aguilar, M. Roos & M. Battaglia

BSW - Solar, Berlin, Germany

C. Grundner & M. Jimeno

eclareon, Berlin, Germany

D. Hendricks, J. Vollmer & P. Bancourt

EREF, Brussels, Belgium

R. Battisti

Ambiente Italia, Rome, Italy

K. Moosdorf

APESF, Aljezur, Portugal

H. Kuittinen & E. Román Medina

Tecnalia Research & Innovation, Derio, Spain

A. Joyce

LNEG, Lisbon, Portugal

G. Masson & G. Neubourg

Becquerel Institute, Brussels, Belgium

J. Donoso Alonso

UNEF, Madrid, Spain

C. Winter, N. Diewald & U. Winter

Fronius, Wels, Austria

EP.1.5 Only PV Can Deliver Enough Power to Decarbonize

R. Nordmann

Swissolar, Zurich, Switzerland

12:10 – 13:10**CONFERENCE CLOSING****Chaired by:**

Nicola Pearsall

EU PVSEC General Chair

Emerita Professor of Renewable Energy in the Faculty of Engineering and Environment, Northumbria University, UK

Moderated by:

Heinz Ossenbrink

former European Commission Joint Research Centre

Highlights of the Conference

Robert Kenny

EU PVSEC Technical Programme Chair

European Commission Joint Research Centre

Ceremony of the Student Awards

Arno Smets

EU PVSEC Student Awards Coordinator

Professor Solar Energy at Delft University of Technology

Ceremony of the Poster Awards

Julio Cárabe

EU PVSEC Poster Awards Coordinator,

CIEMAT, Spain

Announcement upcoming PV events**Representative PV SEC**

Chinho Park,

Yeungnam University, South Korea

Representative IEEE PVSC

Sylvain Marsillac

Old Dominion University, USA

Representative EU PVSEC

João M. Almeida Serra

FCUL- University of Lisbon/IDL, Portugal

What do we take home from the EU PVSEC? Farewell and Closing

Nicola Pearsall

EU PVSEC General Chair

Emerita Professor of Renewable Energy in the Faculty of Engineering and Environment, Northumbria University, UK



Visual Presentations

Monday, 07 September 2020

VISUAL PRESENTATIONS 4AV.1

13:30 – 15:00 Module Design Manufacture, Performance and Reliability (I)

Chairpersons:

Ralph Gottschalg
Fraunhofer CSP, Germany

William Gambogi
DuPont, USA

4AV.1.1 Repair Options for PV Modules with Cracked Polyamide Backsheets

Y. Voronko & G.C. Eder
OFI, Vienna, Austria
C. Breitwieser
Rembrandtin Lack, Vienna, Austria
W. Mühleisen & L. Neumaier
Silicon Austria Labs, Villach, Austria
S. Feldbacher & G. Oreski
PCCL, Leoben, Austria

4AV.1.2 Investigating the Influence of Sample Configuration on EVA Degradation Modes

C. Barretta, L. Castillon & G. Oreski
PCCL, Leoben, Austria
N. Kyranaki & T.R. Betts
CREST, Loughborough, United Kingdom
D.E. Mansour & L. Pita Bauermann
Fraunhofer ISE, Freiburg, Germany
K. Resch-Fauster
University of Leoben, Austria

4AV.1.3 Encapsulation of Flexible Cu(In,Ga)Se₂-Based Mini-Modules by Atomic Layer Deposition

S.-T. Zhang & N. Schneider
CNRS, Palaiseau, France
M. Guc, V. Izquierdo-Roca & A. Perez-Rodriguez
IREC, Barcelona, Spain
O. Salomon & R. Würz
ZSW, Stuttgart, Germany
T. Hildebrandt
EDF R&D, Palaiseau, France

4AV.1.4 Leakage Current Analysis in Respect to Potential Induced Degradation for Cadmium Telluride Thin Film Solar Modules

L. Gerstenberg, A. Oberdorfer, S. Voswinckel, P.K. Panda & V. Wesselak
Nordhausen University of Applied Sciences, Germany

4AV.1.5 Single-Step Fabrication of a Photovoltaic Module Using Encapsulants with Low Melting Temperature Metal Ribbons Embedded

D.-Y. Shin
Pukyong National University, Busan, Republic of Korea
J.-R. Lim, W.G. Shin, C.-G. Lee & G.-H. Kang
KIER, Daejeon, Republic of Korea

4AV.1.6 Delamination of c-Si Module Encapsulation: Insight into Causes and Long-Term Effects

A. Fairbrother, L. Gnocchi, A. Virtuani & C. Ballif
EPFL, Neuchâtel, Switzerland

4AV.1.7 Combined Approach for a Better Definition of Perovskite Devices Encapsulation Protocols and the Achievement of Targeted Lifetime in Standardized Conditions

S. Cros, O. Ibraikulov, C. Bal, A. Levrot, M. Manceau, C. Roux & S. Berson
CEA, Le Bourget-du-Lac, France

4AV.1.8 Encapsulant Selection for Increased PID Resistance in Modules Made with Heterojunction Solar Cells

O. Arriaga Arruti, L. Gnocchi, A. Virtuani & C. Ballif
EPFL, Neuchâtel, Switzerland

4AV.1.9 Degradation of Fielded PV Modules in Three Climates After Eight Years

D.S. Riley, C. Robinson, B.H. King & J.S. Stein
Sandia National Laboratories, Albuquerque, USA

4AV.1.10 Development of Film-Based Ultra-Compact GaAs Photovoltaic Module Using Laser-Assisted Bonding

J. Joo, G.-M. Choi, K.-S. Jang, Y.-S. Eom & K.-S. Choi
ETRI, Daejeon, Republic of Korea
H.K. Kang, S.H. Jung & H.-B. Shin
KANC, Suwon, Republic of Korea

4AV.1.11 Reliability Evaluation of Photovoltaic Modules through Artificial Corrosion Test

C. Lien, S.-H. Chen, S.-Y. Ting, K.-W. Lu, W.-L. Yang, M.-F. Lin, C.-F. Hsieh, T.-C. Wu & S.-T. Hsu
ITRI, Hsinchu, Taiwan

4AV.1.12 Investigation of Discolored Electrodes of Crystalline Silicon PV Mini-Module Degraded by High Temperature and Humidity Stress Test

Y. Ino, S. Asao, K. Shirasawa & H. Takato
AIST, Koriyama, Japan

4AV.1.14 Comparison of Long-Term Indoor and Outdoor Performance Measurement Techniques of Crystalline Silicon PV Modules to Validate Annual Degradation

F. Carigiet & F.P. Baumgartner
ZHAW, Winterthur, Switzerland
C.J. Brabec
FAU, Erlangen, Germany

4AV.1.15 Experimental Characterization of PV Solar Module Components - towards Numerical Modeling of the Lamination Process

I. Rahmoun & A. Derrier
CEA, Le Bourget-du-Lac, France
P.-O. Bouchard
CEMEF, Sophia-Antipolis, France
J.-L. Bouvard
CEMEF, Sophia Antipolis, France



- 4AV.1.16 Defect Investigation by 'Coring' for CIGS Solar Modules**
P. Yilmaz & J. Schmitz
University of Twente, Enschede, Netherlands
R. Aninat, M.G. Ott Cruz & M. Theelen
TNO/Solliance, Eindhoven, Netherlands
T. Weber
PI Berlin, Germany
- 4AV.1.17 High Refractive Index Encapsulants to Reduce Reflection Losses and Increase Cell Efficiencies in Crystalline Silicon PV**
D. Mann, R. van Zandvoort, M. Xu & P. Buskens
TNO, Eindhoven, Netherlands
- 4AV.1.18 Power Increase Benefits for Back-Contact Solar Modules Compared to Standard String Technologies**
G.J.W. Meijers, I.J. Bennett, P. di Lorenzo & P. Pasmans
DSM Advanced Solar, Geleen, Netherlands
I. Suez
Silfab Solar, Mississauga, Canada
- 4AV.1.19 Encapsulation Polymer Screening via Ultra-Fast Aging under High Irradiance UV LEDs**
N. Pinochet, J.-F. Lelièvre, R. Couderc & A. Derrier
CEA, Le Bourget-du-Lac, France
- 4AV.1.20 Studying the Impact of Infrared Spectrum on Submerged Amorphous, Mono-and Poly-crystalline Solar Cells**
P.K. Enaganti & S. Goel
BITS-Pilani, Hyderabad, India
P.K. Dwivedi
IIT Kanpur, India
A.K. Srivastava
DRDO, Kanpur, India
- 4AV.1.21 Monitoring the Moisture Ingress into PV Modules by Measuring Capacitive Characteristics**
E. Fokuhl, H. Berg, S. Stecklum, D.E. Mansour, D. Philipp & P. Gebhardt
Fraunhofer ISE, Freiburg, Germany
- 4AV.1.23 LeTID and PID Hardness of Silicon Heterojunction Modules**
R. Couderc, L. Sicot, S. Dimachkie, A. Derrier & Y. Veschetti
CEA, Le Bourget-du-Lac, France
- 4AV.1.24 Analysis of Field Aged PV Modules with PET Based Backsheets Regarding Their Mechanical Stability**
J. Schnepf, P. Lechner, H. Wirth, S. Hummel & D. Geyer
ZSW, Stuttgart, Germany
- 4AV.1.25 H2020: Solar Train MSCA Fellowship - Home-Made UV-Fluorescence Spectroscopy Measurement Device for Si-c Photovoltaic Modules**
A. Nairi, J. Bengoechea, M.J. Rodriguez & A.R. Lagunas
CENER, Sarriguren-Navarra, Spain
- 4AV.1.26 Measuring the Contact Resistivity of ECA-Based Joints**
M.I. Devoto, T. Timofte, A. Halm & D. Tune
ISC Konstanz, Constance, Germany
- 4AV.1.27 Correlation between EVA Degree of Crosslinking and Moisture Ingress into PV Laminates**
D.E. Mansour, C. Herzog, E. Fokuhl, P. Gebhardt & D. Philipp

- Fraunhofer ISE, Freiburg, Germany
S. Mitterhofer & M. Jankovec
University of Ljubljana, Slovenia
- 4AV.1.29 PV Backsheet Failure Analysis by Scanning Acoustic Microscopy**
D.E. Mansour, S. Kotterer, D. Philipp & P. Gebhardt
Fraunhofer ISE, Freiburg, Germany
- 4AV.1.30 Prediction of PID-s on the Basis of Accelerated Module Testing and Weather Data**
V. Naumann, L. Erichsen, M. Rumiantcev, B. Jäckel & C. Hagendorf
Fraunhofer CSP, Halle (Saale), Germany
- 4AV.1.31 Potential-Induced Degradation of the Shunting Type: on the Origin of Sodium in Shunt Paths**
R. Breugelmans, J. Carolus & M. Daenen
Hasselt University, Genk, Belgium
A.S.H. van der Heide & E. Voroshazi
imec, Genk, Belgium
- 4AV.1.32 Mechanical Strength Analysis of the Si-Heterojunction Modules with Different Cells and Module Designs**
V. Levitskii, K.V. Emtsev, D. Andronikov, A. Abramov, E.I. Terukov & D. Orekhov
R&D Center TFTE, St. Petersburg, Russian Federation
I. Shakhray
Avelar Solar Technology, Moscow, Russian Federation
- 4AV.1.33 PID Leakage Current Modelling by Application of Machine Learning Techniques**
D. Stellbogen, P. Lechner, J. Schnepf, S. Hummel & F. Sehnke
ZSW, Stuttgart, Germany
- 4AV.1.35 Characterization and Long Term Stability Analysis at Photovoltaic Modules with Shingled Cell Strings**
S. Wendlandt, M. Ghebrelul & L. Podlowski
PI Berlin, Germany
- 4AV.1.36 ATAMOSTEC Desert Label for PV Technologies**
E. Urrejola
ATAMOSTEC, Santiago, Chile
P.-J. Ribeyron & D. Muñoz
CEA, Le Bourget-du-Lac, France
R. Kopecek
ISC Konstanz, Germany
- 4AV.1.37 Numerical Analysis on Cell Crack Initiation due to Thermomechanical Stresses**
L. Papargyri, P. Papanastasiou & G.E. Georghiou
University of Cyprus, Nicosia, Cyprus
- 4AV.1.38 Sequential Module Testing: Results and Necessity Discussion**
M. Pander, B. Jäckel, U. Zeller & M. Ebert
Fraunhofer CSP, Halle (Saale), Germany
- 4AV.1.40 Detection of Solar Cell Cracks by Laser Line Induced Lateral Currents and Luminescence Imaging**
G.A. dos Reis Benatto, A.A. Santamaria Lancia, T.K. Hass, P.B. Poulsen & S.V. Spataru
Technical University of Denmark, Roskilde, Denmark



- 4AV.1.41 Reliability Study of Three Cell Architectures and the Degradation Induced by Moisture Ingress**
S.C. Pop
SCP SYS, San Francisco, USA
M. Bora
Lawrence Livermore National Laboratory, USA
R. Schulze
Sunrun, San Francisco, USA
M. Rowell & D. Harwood
D2 Solar, San Jose, USA
- 4AV.1.42 Failure Modes of Backsheets in Field and Laboratory Aged PV Modules**
J. Tracy, W.J. Gambogi & K. Roy Choudhury
DuPont, Wilmington, USA
R. Khatri
DuPont, Gurgaon, India
J. Xia & H. Hu
DuPont, Shanghai, China
- 4AV.1.43 Investigation on Leakage Current of PID-Affected and PID-Free Crystalline Silicon Solar Module**
H. Wang & H. Yang
Xi'an Jiaotong University, China
- 4AV.1.45 Accelerated LeTID Testing with Dark Current Voltage Characteristics Co-Measurement**
B. Kubicek, K.A. Berger & G. Ujvári
AIT, Vienna, Austria
- 4AV.1.46 Extending Module Lifetime through Development of FEA Analysis Guidelines for Micro-Crack Prediction of Silicon Cells**
Y. Yu, Y. Ni & J.-N. Jaubert
Canadian Solar, Suzhou, China
T. Metals & H. Liu
EDF R&D, Beijing, China
E. Boyère & E. Lajoie-Mazenc
EDF R&D, Paris, France
- 4AV.1.47 Backsheet Evaluation for Silicon Heterojunction Modules**
A. Abramov, D. Andronikov, K. Emtsev, D. Orekhov, E. Terukova & S. Yakovlev
R&D Center TFTE, St. Petersburg, Russian Federation
I. Shakhrai
Hevel Solar, Moscow, Russian Federation
- 4AV.1.48 Mechanical Degradation of Amorphous Silicon Solar Module**
G. Osayemwenre & E.L. Meyer
University of Fort Hare, Alice, South Africa
- 4AV.1.49 Durability of Polyolefin Encapsulation Based Modules: A Cross-Comparison of Commercially Available Solutions**
B.X.J. Yu, R. Lv, J.-N. Jaubert & G. Xing
Canadian Solar, Suzhou, China
J. Dupuis & E. Lajoie-Mazenc
EDF R&D, Moret Loing et Orvan, France
C. Dugué & G. Goaer
EDF ENR Photowatt, Bourgoin Jallieu, France
- 4AV.1.50 Ultra-Fast Imaging of Third Generation Photovoltaics**
H. Hoppe & U. Schubert
Friedrich Schiller University Jena, Germany

R. Meitzner
Friedrich-Schiller-University Jena, Germany
H. Kruschke
InfraTec, Dresden, Germany

- 4AV.1.51 Understanding Migrations and Activation Energies Effects within Photovoltaic Modules Polymer Packaging to Predict 70 Years Service Life from Accelerated Weathering Tests on Coupons and Mini-Modules**
F. Rummens
RENOLIT, Oudenaarde, Belgium
- 4AV.1.52 Performance Degradation Research of PV Module Installed in Different Climate Area**
M.-W. Chen, C.-H. Lin, C.-Y. Gao & B.-C. Kuo
TERTEC, Taoyuan, Taiwan

VISUAL PRESENTATIONS 4AV.2

15:15 – 16:45 Module Design Manufacture, Performance and Reliability (II)

Chairpersons:

Christos Monokrousos
TÜV Rheinland Energy, China

Gernot Oreski
PCCL, Austria

- 4AV.2.1 Evaluation Method of PV Module Degraded by Shunt Resistance Decrease Using I-V Curve Measured in Exposure**
T. Kohno, E. Bayu Miftahullatif, M. Fujimori, Y. Nagayama, T. Nakamura & K. Kondo
Hitachi, Tokyo, Japan
K. Banba & N. Fujii
Hitachi Power Solutions, Ibaraki, Japan
- 4AV.2.2 Operation and Evaluation of a Bifacial PV Module Test Setup**
W. Mühleisen, L. Neumaier & C. Hirschl
SAL Silicon Austria Labs, Villach, Austria
J. Löschnig
KIOTO Solar, Wies, Austria
A.R. Burgers & E.E. Bende
TNO - Solar Energy, Petten, Netherlands
S. Zamini
AIT, Vienna, Austria
- 4AV.2.3 Improving Computational Efficiency of Mechanical Finite Element Method Simulations for PV Modules**
N. Bosco, X. He & M. Springer
NREL, Golden, USA
- 4AV.2.4 Post Mortem Analysis of Bifacial PV Modules Based on n-Type Crystalline-Si Cells Using Three Different Types of Encapsulants**



- P. Sommeling & J.M. Kroon
TNO Energy Transition, Petten, Netherlands
- 4AV.2.5 Research on Photovoltaic Module Temperature Prediction Based on NWP Data**
C. Yang & Z. Chen
CMA, Wuhan, China
- 4AV.2.6 Reduction of ECA Amount for the Ribbon Interconnection of Heterojunction Solar Cells**
C. Kaiser, V. Nikitina, T. Geipel & A. Kraft
Fraunhofer ISE, Freiburg, Germany
- 4AV.2.7 Trend Tracking of Efficiency and CTM Ratio of PV Modules**
A. Tummalieh, A. Pfreundt & M. Mittag
Fraunhofer ISE, Freiburg, Germany
- 4AV.2.8 Enhancing PV Module Thermomechanical Performance and Reliability by an Innovative Mounting Solution**
A.J. Beinert
Fraunhofer ISE, Freiburg, Germany
A. Masolin
Coolback Company, Amsterdam, Netherlands
- 4AV.2.9 Characteristics of Vertically Installed 3D-Type Photovoltaics**
D. Nomura, H.-G. Kang & H. Nagaoyoshi
FUJICO, Kitakyushu, Japan
M. Hayashi & T. Nomura
CKD Corporation, Komaki, Japan
M. Nakamura
Ushio, Yokohama, Japan
S. Hayase
The University of Electro-Communications, Chofu, Japan
- 4AV.2.10 Reliability of the Industrial Shingling Module by ECA Characteristics**
J.-W. Baik, C.-S. Park, S.-H. Gong, Y.-J. Kim, J.-Y. Lim, J.-W. Kang, Y. Min, K.K Hong, E.-J. Lee, S.-O. Choi & D.-S. Kim
Shinsung Solar Energy, Jeungpyeong-gun, Republic of Korea
- 4AV.2.11 Relative Spectral Responsivity Measurements of Photovoltaic Modules with Band Pass Filter Technique**
S. Meric & O. Bazkir
TUBITAK-UME, Kocaeli, Turkey
- 4AV.2.12 Linearity Measurements of Photovoltaic Modules with Attenuating Irradiance Filter Technique**
O. Bazkir & S. Meric
TUBITAK-UME, Kocaeli, Turkey
- 4AV.2.13 The Bypass Diode – a Weakness in Today's PV Systems**
D. Gfeller, R. Neukomm & U. Muntwyler
BUAS, Burgdorf, Switzerland
- 4AV.2.14 Glass-Free Lightweight Solar Modules for Integrated Photovoltaics: the Use of Velcro as an Alternative Mounting System**
F. Lisco, A.C. Oliveira Martins, A. Virtuani & C. Ballif
EPFL, Neuchâtel, Switzerland
- 4AV.2.15 Parametric Study of PV Module Variables for Increased Efficiency**
R.I. Bourisli & B.S. Aldalali
Kuwait University, Safat, Kuwait
- 4AV.2.16 Seasonal Performance Assessment of Various PV Technologies in a Desert Climate through Device Simulations and Outdoor Measurements**
T. Katsaounis & A. Tzavaras
KAUST, Thuwal, Saudi Arabia
K. Kotsovos, I. Gereige, A. Basaheeh, M. Abdullah, A. Khayat, E. Al Habshi & A. Al-Saggaf
Saudi Aramco, Thuwal, Saudi Arabia
- 4AV.2.18 Environmental Stability of the Semi-Flexible HJT Solar Panels**
S. Yakovlev, E. Schebet, K. Emtsev, D. Andronikov, A. Abramov & D. Orekhov
R&D Center TFTE, St. Petersburg, Russian Federation
I. Shakhray
Avelar Solar Technology, Moscow, Russian Federation
- 4AV.2.19 I-V Translation Procedure for Higher Accuracy and Compliance with PERC Cell Technology Requirements**
C. Monokroussos
TUV Rheinland, Shanghai, China
H. Müllejjans
European Commission JRC, Ispra, Italy
W. Herrmann
TUV Rheinland Energy, Cologne, Germany
- 4AV.2.20 ECA Qualification Methodology for Photovoltaic Module Application**
H. Gauthier, V. Barth, P. Berthelemy, N. Benberkane & A. Derrier
CEA, Le Bourget-du-Lac, France
- 4AV.2.21 Reduction of Silver Based ECA for SHJ Module**
P. Berthelemy, B. Commault, V. Barth, A. Bettinelli, R. Soulas & A. Derrier
CEA, Le Bourget-du-Lac, France
- 4AV.2.24 411W Record 72 Half-Cells Glass Backsheet Module Using ECA Gluing Tabber Stringer**
B. Commault, P. Berthelemy, A. Bettinelli, A. Danel, B. Chambion, R. Soulas, C. Roux, A. Derrier & Y. Veschetti
CEA, Le Bourget-du-Lac, France
X. Hernandez, A. Apraiz & J.-P. Aguerre
Mondragon Assembly, Aretxabaleta, Spain
- 4AV.2.25 Apollo Large-Area Steady-State Solar Simulator as a Versatile Tool for PV Device Performance Measurements**
H. Müllejjans, E. Salis, D. Pavanello, G. Bardizza, J. Lopez-Garcia, W. Zaaiman, D. Shaw, T. Sample & E.D. Dunlop
European Commission JRC, Ispra, Italy
- 4AV.2.26 Performance of Bifacial and Monofacial Heterojunction Modules in Moderate Climatic Conditions**
A. Titov, K. Emtsev, D. Andronikov, A. Abramov & D. Orekhov
R&D Center TFTE, St. Petersburg, Russian Federation
I. Shakhray
Avelar Solar Technology, Novocheboksarsk, Russian Federation
- 4AV.2.27 Preparing IBC Module Assembly for High Volume Production: from Lab to Fab**
A. Halm, T.L. Timofte, E. Wefringhaus & R. Harney
ISC Konstanz, Germany
N. Chen
Delft University of Technology, Netherlands
J. Liu, J. Ma, Y. Guo & P. Dong



SPIC Solar Power, Xi'an, China

- 4AV.2.28 Novel PV Module Interconnection Design and Mounting Orientation to Reduce Inhomogeneous Soiling Losses in Desert Regions**
H. Hanifi, M.Z. Khan, B. Jäckel, C. Hagendorf & K. Ilse
Fraunhofer CSP, Halle (Saale), Germany
A.A. Abdallah
QEERI, Doha, Qatar
J. Schneider
Fraunhofer IMW, Leipzig, Germany
- 4AV.2.29 High Efficiency Flexible and Lightweight PV Modules Using Crystalline Silicon Solar Cells**
J. Ulbikas
Applied Research Institute for Prospective Technologies, Vilnius, Lithuania
M. Rudzikas
Center for Physical Sciences and Technology, Vilnius, Lithuania
P. Dubravskij
UAB "Modern E-Technologies", Vilnius, Lithuania
A.G. Ulyashin
SINTEF, Oslo, Norway
- 4AV.2.31 Method for Evaluating the Severity of Solar Cell Cracks in Electroluminescence Images**
S.V. Spataru, G.A. dos Reis Benatto, T.K. Hass, A.A. Santamaria Lancia, P.B. Poulsen & S. Thorsteinsson
Technical University of Denmark, Roskilde, Denmark
- 4AV.2.32 Characterisation of Angular Dependent Optical Properties of Different Coloring Technologies Employed in BIPV Products**
M. Babin, A.A. Santamaria Lancia, A. Thorseth & S. Thorsteinsson
Technical University of Denmark, Roskilde, Denmark
- 4AV.2.34 Measurement and Simulation of Moisture Ingress in PV Modules in Various Climates**
S. Mitterhofer, J. Slapšak, M. Jankovec & M. Topic
University of Ljubljana, Slovenia
A. Astigarraga & D. Moser
Eurac Research, Bolzano, Italy
G. Oviedo Hernández & P.V. Chiantore
BayWa, Rome, Italy
L. Wei
SERIS, Sigapore, Singapore
Y. S. Khoo
SERIS, Singapore, Singapore
J. Rabanal-Arabach, E. Fuentealba, M. Trigo-Gonzalez & P. Ferrada
University of Antofagasta, Chile
- 4AV.2.35 Superhydrophillic Self Cleaning SiO₂/TiO₂ Thin Film Coating for Solar Glass Cover Application**
A. Abhinav & S. Mallick
IIT Bombay, Mumbai, India
- 4AV.2.36 Comparison of Double Glass and Glass/Backsheet Bifacial Module Designs**
W.J. Gambogi, M. Demko, B.-L. Yu, S. MacMaster, S. Kurian & K. Roy Choudhury
DuPont, Wilmington, USA
A. Borne
DuPont, Geneva, Switzerland
H. Hu, Y. Hu & Z. Pan

DuPont, Shanghai, China

- 4AV.2.37 Analysis of the PV Modules Aging Mechanisms in the Moroccan Climate for the Development of a Desert PV Module**
A. Bouaichi, Z. Naimi, A. Ghennioui, H. Zitouni, A. Benazzouz, B. Ikken, S. Sarikh & A. Benlarabi
Green Energy Park, Benguerir, Morocco
A. El Amrani & C. Messaoudi
Moulay Ismail University, Meknes, Morocco
- 4AV.2.38 Characterizing Modules Light Management Potential with Existing (Structured Ribbons and Films, Multiwire) and Next Gen Materials by Means of Hemispheric IAM (HIAM) Robust Method**
M. Falsini
, Firenze, Italy
- 4AV.2.40 Module Design and Yield Evaluation of Indoor and Outdoor Measurements for Bifacial Modules**
D. Daßler, S. Malik & S. Schindler
Fraunhofer CSP, Halle (Saale), Germany
D. Berrian & J. Libal
ISC Konstanz, Germany
A. Karsenti & N. Eisenberg
SolAround, Jerusalem, Israel
- 4AV.2.41 Correlation between Imaging and Electrical Characterization Techniques of Solar Cell Cracks in Photovoltaic Modules**
S.V. Spataru, G.A. dos Reis Benatto, A.A. Santamaria Lancia, P.B. Poulsen & S. Thorsteinsson
Technical University of Denmark, Roskilde, Denmark
H.R. Parikh
Aalborg University, Denmark
- 4AV.2.42 Experimental Energy Characterization of PV Modules under Partial Shading Conditions with Two Different Bypass Diode Configurations**
W. Braga Junior, M. de Jesus dos Santos Rodrigues, P. Ferreira Torres, J. Tavares Pinho, M.A. Barros Galhardo & W. Negrao-Macedo
UFPA, Belém, Brazil
G.F. Pinto Filho & A.R. Arrifano Manito
USP, São Paulo, Brazil
- 4AV.2.43 Comparison of Power Performances for Shingled PV Module with Bifacial and p-PERC PV Modules for Floating and Marine Photovoltaics**
H.-K. Ahn
Konkuk University, Seoul, Republic of Korea
- 4AV.2.44 Active Thermography Based Performance Analysis & Defected Area Calculation of PV Modules**
M. Amin, M. Islam, G. Hasan, S. Dewan, I. Ahmed & M.M. Rahman
BRAC University, Dhaka, Bangladesh
- 4AV.2.46 Study on Output Characteristics of Shingled Photovoltaic Module According to Printability of Electrically Conductive Adhesive**
S.H. Kim & J. Moon
KETI, Gyeonggi-do, Republic of Korea
- 4AV.2.47 Bifaciality Factor and Ideality Factor of PERC Bifacial Solar Module under Different Irradiances**
H. Yang & H. Wang
Xi'an Jiaotong University, China



- 4AV.2.48 Bifacial Modules for Large Scale PV Plants: Lessons Learned and Current Limitations from a Factory Inspection Outlook**
R.J. Gómez, E. Jiménez, D. Sanz, C. Sandoval, J. Cuaresma, J.C. Vázquez, S. Rodríguez-Conde, H. Silva & V. Parra
Enertis Solar, Madrid, Spain
- 4AV.2.49 Optimization of PV Module Glass Thickness in a Desert Climate for Maximum Energy Yield**
B. Aldalali & R. Bourisli
Kuwait University, Safat, Kuwait
B. Alabdulrazzaq & A. Al-Qattan
KISR, Safat, Kuwait
I.T. Horvath & J. Poortmans
imec, Leuven, Belgium
- 4AV.2.50 Performance Analysis of Polycrystalline Module Based on Faults Causes**
L. Feng & F.U. Hamelmann
Bielefeld University of Applied Science, Minden, Germany
J. Zhang & K. Ding
Hohai University, Changzhou, China
- 4AV.2.51 Power Stabilization Methods on Thin-Film Photovoltaics: a Round-Robin Test**
A. Mittal, M. Rennhofer & G. Újvári
AIT, Vienna, Austria
T. Weber
PI Berlin, Germany
E.J. Achterberg
Solar Tester, Schinnen, Netherlands
L. Plessing
CrystalSol, Vienna, Austria
E. Sovetkin
Forschungszentrum Jülich, Germany
- 4AV.2.52 CDF Study of Hybrid Solar Panels with PCM**
D. Gonzalez-Peña, A. García-Rodríguez, D. Granados-López, M.I. Dieste-Velasco & C. Alonso-Tristán
UBU, Burgos, Spain
- 4AV.2.53 Determination of a PV Module Power Matrix with an LED Solar Simulator**
S. Riechelmann & H. Sträter
PTB, Braunschweig, Germany
- 4AV.2.55 Extending Quality and Adapting for the Future: The European Solar Test Installation Laboratory Extends Its ISO/IEC 17025:2017 Accreditation to Cover Bi-Facial Devices, Energy Rating Power Matrix and Device Linearity**
L. Castellazzi, J. Lopez-Garcia, E. Salis, D. Pavanello, D. Shaw, H. Mülleijans, G. Bardizza, R.P. Kenny, M. Field, T. Sample, W. Zaaiman & E.D. Dunlop
European Commission JRC, Ispra, Italy

VISUAL PRESENTATIONS 4AV.3

17:00 – 18:30 Inverters, Micro-Inverters and BOS Components / Sustainability and Circular Economy

Chairpersons:

Jose Luis Domínguez-García
IREC, Spain

Karsten Wambach
Wambach-Consulting, Germany

- 4AV.3.1 Design of an Integrated I-V Tracer and Maximum Power Point Tracker**
B. Dai
TNO, Eindhoven, Netherlands
M. Appelhof & B. Ozturk
3T, Eindhoven, Netherlands
- 4AV.3.2 Implementation of a MPPT Using Open Hardware FPGA**
U. Sainz Estébanez & N. Azkona
UPV/EHU, Bilbao, Spain
- 4AV.3.3 Particle Swarm Optimization with Reducing Boundaries (PSO-RB) for Maximum Power Point Tracking of Partially Shaded PV Arrays**
A. Beltran & S. Das
Kennesaw State University, Marietta, USA
- 4AV.3.4 Accurate Determination of Micro-Inverter Performance Using Electrically Biased PV Modules**
J.D. Moschner, J. Tant & J. Driesen
KU Leuven | EnergyVille, Genk, Belgium
A. Wabbes & S. Scheerlinck
ENGIE Laborelec, Linkebeek, Belgium
- 4AV.3.5 Accurate Testing Methods of Grid-Connected PV Inverters by Means of Real-Time Based Hardware-in-the-Loop (HIL) Simulation Topologies for Validation, Testing, and Grid Integration of Solar Plants**
G. Lauss, Z. Miletic, A. Banjac & C. Messner
AIT, Vienna, Austria
- 4AV.3.6 Elevated Temperatures Affecting Efficiency, Overall Performance and Energy Yield of PV Microinverters**
S. Krauter & J. Bendfeld
University of Paderborn, Germany
- 4AV.3.7 Optimal Design of Series-Parallel Differential Power Processing Converters for Photovoltaic Array Energy Systems**
M. Etarhouni, B. Chong & L. Zhang
The University of Leeds, United Kingdom
- 4AV.3.8 Module-Level Power Electronics under Indoor Performance Tests**
F.P. Baumgartner, S. Richter, C. Meier, C. Allenspach & F. Carigiet
ZHAW, Winterthur, Switzerland
- 4AV.3.10 Thermal Impact of Grid Injection Limits on Inverter Operation**
J. Despeghel, S. Ravyts & J. Driesen
KU Leuven, Heverlee, Belgium



- 4AV.3.11 Key Innovations on Power Electronics and Communications Leading to a LCOE Reduction of Solar PV**
 J.L. Domínguez-García, L. Trilla, P. Paradell & V. Izquierdo
 IREC, Barcelona, Spain
 D. Horbacauskas & J. Ulbikas
 PROTECH, Vilnius, Lithuania
 K. Khemiri
 EOLANE, Vailhauquès, France
 M. Jankovec
 University of Ljubljana, Slovenia
 D. Golob
 COSYLAB, Ljubljana, Slovenia
 J. Aime
 CEA, Le Bourget-du-Lac, France
- 4AV.3.12 Advanced Integration of Inverter and Tracker for Optimized Non-Astronomical Algorithm with Higher Yield**
 X. Gu, Y. Zheng, C. Wang, C. Gao & S. Wan
 Huawei Technologies, Madrid, Spain
- 4AV.3.13 The Impact of Tracker Structure on Bifacial PV Performance**
 F. Gross, W. Landman & M. Balz
 sbp sonne, Stuttgart, Germany
- 4AV.3.24 Bright Prospects for Solar PV End of Life Management in India**
 J.N. Malaviya
 MSEC, Pune, India
- 4AV.3.26 Reversible Adhesives for Frames and Junction Boxes**
 F. Wanghofer, A. Wolfberger & G. Oreski
 PCCL, Leoben, Austria
 L. Neumaier
 Silicon Austria Labs, Villach, Austria
- 4AV.3.28 Second Life of PV Modules – Experience and Results from the CIRCUSOL Project**
 W. Palitzsch & I. Röver
 LuxChemtech, Freiberg, Germany
 T. Rommens
 VITO, Mol, Belgium
- 4AV.3.30 Combustion Based Delamination of Si Based Glass/Glass Photovoltaic Modules**
 X. Ma, H. Bu & A.G. Ulyashin
 SINTEF, Oslo, Norway
 M. Rudzikas
 Center for Physical Sciences and Technology, Vilnius, Lithuania
 J. Denafas
 Solitek R&D, Vilnius, Lithuania
 J. Ulbikas
 UAB "Modern E-Technologies", Vilnius, Lithuania
- 4AV.3.31 End-of-Life Management of Photovoltaic Panels in Austria: Current Situation and Outlook**
 T. Dobra, M. Wellacher & R. Pomberger
 University of Leoben, Austria
- 4AV.3.33 Recovery of Raw Materials in End-of-Life Photovoltaic Modules Recycling**
 J.-P. Mai & N. Resay

JPM Silicon, Braunschweig, Germany
 R. Arafat & C. Herrmann
 TU Braunschweig, Germany
 M. Neubert
 Rovak, Wilsdruff, Germany



Tuesday, 08 September 2020

VISUAL PRESENTATIONS 3BV.1

08:30 – 10:00 Perovskites

Chairpersons:

Sjoerd Veenstra
TNO Energy Transition, Netherlands

Wolfgang Tress
EPFL, Switzerland

3BV.1.1 The Structural, Mechanical, Thermal, Electronic and Optical Properties of Halide Perovskites Cs₂TiX₆ (X=Cl,Br,I): First-Principles Investigations

Y. Nouri, B. Hartiti, A. Batan & S. Fadili
University of Hassan II, Mohammedia, Morocco
F. Reniers, C. Buess-Herman & T. Segato
Free University of Brussels, Belgium
M. Siadat & P. Thevenin
University of Lorraine, Metz, France

3BV.1.4 Preparation of Titanium Dioxide Electron Transport Material and Fabrication of Perovskite Solar Cells

N. AlJufairi
QEERI, Doha, Qatar

3BV.1.6 Optical and Electrical Characterization of Perovskites

R. Ebner, B. Kubicek, G. Ujvári, A. Mittal, N. Bansal & T. Dimopoulos
AIT, Vienna, Austria
M. Hadjipanayi, V. Paraskeva, M. Hadjikypris & G.E. Georghiou
University of Cyprus, Nicosia, Cyprus
A. Hadipour
imec, Leuven, Belgium

3BV.1.8 Epoch-Making 3D Photovoltaic with Complete Sealing

T. Nomura & M. Hayashi
CKD, Komaki, Japan
D. Nomura, H.-G. Kang & H. Nagaoyoshi
FUJICO, Kitakyushu, Japan
M. Nakamura
USHIO, Kanagawa, Japan
S. Hayase
University of Electro-Communications, Chofu, Japan

3BV.1.9 Novel Photovoltaic Devices Using Ferroelectric Material

R. Ndioukane & D. Kobor
UASZ, Ziguinchor, Senegal
L. Motte & J. Solard
University of Paris 13, France

3BV.1.11 Phase Evolution during Growth and Annealing of Co-Evaporated Perovskite Absorbers

K. Heinze, H. Kempa, J. Vaghani, T. Burwig, J. Ge, R. Scheer & P. Pistor
Martin-Luther-University, Halle (Saale), Germany

3BV.1.14 Outdoor Monitoring System with MPP Tracking for Perovskite Solar Cells

B. Glažar, G. Matic & M. Topic
University of Ljubljana, Slovenia
M. Jost
HZB, Berlin, Germany

3BV.1.15 Ultralight Perovskite Solar Cells for Low Intensity Low Temperature (LILT) Applications

J. Grandier, R.S. Kowalczyk & J. Brophy
JPL, Pasadena, USA
M.D. Kelzenberg, S. Demchyshyn, S.P. Loke, N. Vaidya & H.A. Atwater
Caltech, Pasadena, USA

3BV.1.16 Ferroic Domain and Domain Walls in Halide Perovskites

J.S. Yun, D.H. Kim & J. Seidel
UNSW Australia, Sydney, Australia

3BV.1.17 Co-Doping Strategy of C60 Toward High Efficiency Inorganic CsPbI₂Br Perovskite Solar Cells and Modules

C. Liu, Y. Yang, C. Zhang, S. Wu & Y. Mai
Jinan University, Guangzhou, China
L. Wei
CAS, Shenzhen, China

3BV.1.18 Doped Engineering Fabricated High-Crystallization Perovskite Solar Cell as MAPbI₂.95Cl_{0.05}

C.-H. Kuan, H.-J. Syu & C.-F. Lin
NTU National Taiwan University, Taipei, Taiwan

3BV.1.19 Perovskite Solar Cells under Outdoor Conditions

M. Khenkin, M. Stepanov, M. Riedel, N. Phung, A. Abate, R. Schlattmann & C. Ulbrich
HZB, Berlin, Germany
E. Katz
BGU, Midreshet Ben-Gurion, Israel

3BV.1.20 Investigations on the Formation Mechanism of Fully Vapour-Processed Perovskite Absorbers

T. Moser, K. Artuk, Y. Jiang, T. Feurer, A.N. Tiwari & F. Fu
EMPA, Dübendorf, Switzerland

3BV.1.21 Photoferroelectric and Ferrophotovoltaic Characteristics of Silicon-Perovskites Nanoparticles Heterojunction

N.C.Y. Fall, R. Ndioukane, M. Touré & D. Kobor
UASZ, Ziguinchor, Senegal
M. Pasquinelli
Aix Marseille University, France
T. Dobbins
Rowan University, Glassboro, USA

3BV.1.22 Improvements on the Stability of MAPbI₃ Thin Films Against UV Radiation by a Low Temperature Encapsulation Method That Uses Commercial Ethylene-Vinyl Acetate Sheets

L. Ocaña, C. Montes, M. Friend & M. Cendagorta
ITER, Granadilla de Abona, Spain
S. González-Pérez & B. González-Díaz
ULL, La Laguna, Spain



- 3BV.1.23 Technical Analysis of Mixed Binders Based on Epoxy Resin and Ethylene-Vinyl Acetate to Produce Conductive Inks for the Metallization of Perovskite Solar Cells via Screen Printing Technique**
C. Montes, L. Ocaña, M. Friend & M. Cendagorta
ITER, Granadilla de Abona, Spain
S. González-Pérez & B. González-Díaz
University of La Laguna, Spain
- 3BV.1.24 Optimizing for Yearly Energy Yield: Pathways for In-Coupling and Light Trapping**
R. Häusermann, M. Kamperman, U. Aeberhard, D. Braga, B. Blülle & B. Ruhstaller
Fluxim, Winterthur, Switzerland
- 3BV.1.25 Optical and Electrical Properties of Thin Film Based on Inorganic PNZ-4.5PT Perovskite Ferroelectric Deposited on ITO Glass Substrate for Photovoltaic Application**
F. Balde, M. Touré, R. Ndioukane, A.K. Diallo, N.C.Y. Fall & D. Kobor
Ziguinchor University, Senegal
- 3BV.1.26 The Key Role of Surface Defects Passivation on the Stability of Perovskite Absorber under Controlled Humidity Revealed by In Situ X-Ray Diffraction Study**
M.A. Akhavan Kazemi, A. Krishna, J.-N. Chotard, S. Gottis & F. Sauvage
University of Picardie, Amiens, France
- 3BV.1.27 Developing an Agglomerate of Graphite and Black Carbon in an Ethylene-Vinyl Acetate in Toluene Solution for Producing Electrodes for HTM-Free Perovskite Solar Cells**
C. Montes, L. Ocaña, M. Friend & M. Cendagorta
ITER, Granadilla de Abona, Spain
S. González-Pérez & B. González-Díaz
University of La Laguna, Spain
- 3BV.1.29 Synthesis of Perovskite Films for Photovoltaics: Influence of the Reagents' Ratio on the Material Properties**
V.P. Kostilyov, A.V. Sachenko, I.O. Sokolovskyi, S.D. Kobylanska, P.V. Torchyniuk, O.I. V'yunov & A.G. Belous
NAS ISP, Kiev, Ukraine
V. Vlasjuk
ISP of NASU, Kiev, Ukraine
A.I. Shkrebti / Chkrebti
Ontario Tech University, Oshawa, Canada
- 3BV.1.30 Hole Transfer NiO Layers with Enhanced Properties for All-Inorganic Perovskite Solar Cells**
E. Manidakis, E. Darivianaki & C.C. Stoumpos
University of Crete, Heraklion, Greece
M. Androulidaki, K. Tsagaraki, A. Kostopoulos, G. Michail, N.T. Pelekanos & E. Aperathitis
FORTH, Heraklion, Greece
M. Modreanu
Tyndall National Institute, Cork, Ireland
- 3BV.1.32 Synthesis of Mixed-Halide Hybrid Perovskites for Defect Characterization**
G. Fischer
Zittau/Görlitz University of Applied Sciences, Germany
M. Müller, J. Beyer & J. Heitmann
Freiberg University of Technology, Germany

- 3BV.1.33 Advanced Chemical Characterization of Perovskite Systems: XPS and GD-OES Coupling**
P. Dally, D. Messou & M. Robillard
IPVF, Palaiseau, France
A. Yaiche & J. Rousset
EDF R&D, Palaiseau, France
S. Béchu & M. Bouttemy
UVSQ, Versailles, France
- 3BV.1.34 Tailoring Perovskite Ink for Upscale Deposition by Slot-Die: Understanding the Influence of Surfactant Addition**
S. Bernard, S. Jutteau, A. Yaiche, A. Duchatelet & J. Rousset
EDF R&D, Palaiseau, France
S. Cacovich
IPVF, Palaiseau, France
F. Sauvage
University of Picardie, Amiens, France
- 3BV.1.35 Numerical Simulation of Bias Dependent Ion Re-Distribution in Perovskite Solar Cells**
D. Sivadas, S. Chandra Tirupati & P.R. Nair
IIT Bombay, Mumbai, India
- 3BV.1.36 A Practicable Way Doping Perovskite Solar Cell to Fabricate MAPb_{1-x}Cl_{3-x}**
C.-H. Kuan, H.-J. Syu, P.-T. Kuo & C.-F. Lin
NTU, Taipei, Taiwan
- 3BV.1.38 Lamination: A Versatile Route for Stable Perovskite Photovoltaics**
J. Roger, R. Schmager, J.A. Schwenzer, F. Schackmar, T. Abzieher, M. Malekshahi Byranvand, B. Abdollahi Nejand, P. Fassl, M. Worgull, B.S. Richards & U.W. Paetzold
Karlsruhe Institute of Technology, Germany
- 3BV.1.40 Effective Charge Extraction by Contact Engineering in Inverted Perovskite Solar Cells**
T. Ripolles, C. Redondo-Obispo & C. Coya
URJC, Móstoles, Spain

VISUAL PRESENTATIONS 3BV.2

10:30 – 12:00 **CI(G)S, CdTe and Related Thin Films / Organic and Dye-Sensitised Devices / II-V and Related Compound Semiconductors / Tandems**

Chairpersons:

Gianluca Coletti
TNO Energy Transition, Netherlands

Giorgio Bardizza
European Commission JRC, Italy

Volker Sittinger
Fraunhofer IST, Germany



- 3BV.2.2 Achievement of Graded Band Gap in CdTe Solar Cells through Selenization of the Absorber**
E. Artegiani, V. Kumar & A. Romeo
University of Verona, Italy
- 3BV.2.3 Study of Post Sulphurization/Selenization Processes for Solution Processed CZTS Thin Films**
P. Punathil, S. Zanetti, E. Artegiani & A. Romeo
University of Verona, Italy
- 3BV.2.5 Effects of CdCl₂ Treatment Time on the Performance of Semi-Transparent CdTe Solar Cells**
F. He, L. Wu, J. Li & L.H. Feng
Sichuan University, Chengdu, China
- 3BV.2.7 Throughout RF Magnetron Sputtering Route to Fabricate CZTS Thin-Film Solar Cell**
A.K. Sen Gupta, E.M.K.I. Ahamed, M. Quamruzzaman & M.A. Matin
Chittagong University of Engineering and Technology, Bangladesh
N. Amin
The National Energy University, Kajang, Malaysia
- 3BV.2.8 Raman Spectroscopy as a Possible in-Line Inspection Tool for CIGS Solar Cells in Comparison with Photoluminescence Measurements**
K. Harms, L. Neumaier, W. Mühleisen & C. Hirschl
SAL Silicon Austria Labs, Villach, Austria
G.V. Rao, T. Zimmermann & P. Kratzert
Solibro, Bitterfeld-Wolfen, Germany
- 3BV.2.9 P3 Structuring for Post-Monolithic Interconnections on CIGS Thin Film Solar Cells with Ultrashort Pulsed Laser Radiation at a Wavelength of 1030 nm**
N. Hambach, S. Kasper, G. Schöpe, B.E. Pieters & S. Haas
Forschungszentrum Jülich, Germany
R. Schäffler
NICE Solar Energy, Schwäbisch Hall, Germany
- 3BV.2.10 Kesterite Solar-Cells by Drop-Casting of Inorganic Sol-Gel Inks**
G. Tseberlidis, V. Trifiletti, A. Le Donne, L. Frioni, M. Acciarri & S. Binetti
University of Milan, Italy
- 3BV.2.11 CIGS Modules with Copper Plated Metallization**
A. Lachowicz, G. Christmann, S. Nicolay & C. Ballif
CSEM, Neuchâtel, Switzerland
- 3BV.2.12 Chalcogenide Solar Cells with Transparent Back Contacts for Bifacial and Tandem Applications**
I. Becerril-Romero, S. Giraldo, K. Tiwari, M. Placidi, Y. Sánchez, A. Perez-Rodriguez, E. Saucedo & Z. Jehl Li Kao
IREC, Sant Adrià de Besòs, Spain
- 3BV.2.13 Optimization of NaF Doping for Ultra-Thin CIGSe Solar Cells**
Y. Li & M. Schmid
University of Duisburg-Essen, Germany
G. Yin
Wuhan University of Technology, China

- 3BV.2.19 Integration of TiO₂ in Oxide/Metal/Oxide-Electrodes for Increased Colour Rendering of CIGS Solar Cells**
K. Gehrke, N. Neugebohrn & N. Klaassen
DLR, Oldenburg, Germany
- 3BV.2.21 Machine Learning for CIGS Process Development**
R. Hünig, F. Sehnke, S. Paetel & A. Bauer
ZSW, Stuttgart, Germany
- 3BV.2.22 Scalable Approach for Fast In-Line Thickness Assessment of Nanometric AlxO Water Barrier Layers for Encapsulation of Flexible PV Modules**
E. Grau-Luque, M. Guc, I. Becerril-Romero & V. Izquierdo-Roca
IREC, Barcelona, Spain
A. Perez-Rodriguez
University of Barcelona, Spain
P.J. Bolt & F.J. van den Bruele
TNO, Eindhoven, Netherlands
U. Rühle
Flisom, Dübendorf, Switzerland
- 3BV.2.25 Elaboration of Wide Bandgap CIGS on Silicon by Electrodeposition of Stacked Metal Precursors and Sulfur Annealing**
A. Crossay, D. Cammilleri & D. Lincot
IPVF, Palaiseau, France
A. Rebai
CNRS, Palaiseau, France
N. Barreau
University of Nantes, France
- 3BV.2.26 Studies on the Capacitance Spectroscopy of Cu₂ZnSnS₄ Typed Solar Cells Anisotype Heterojunction by SCAPS-1D**
O. Akinrinola, A.O. Awodugba, M.K. Awodele & O. Akinrinola
LAUTECH, Ogbomoso, Nigeria
M. Jain
University of The Gambia, Banjul, Gambia
A. Ibiyemi
Federal University Oye-Ekiti, Nigeria
- 3BV.2.27 Performance Enhancement of Bifacial and Semitransparent Solar Cells with Ultrathin Cu(In,Ga)Se₂ Absorber Layers Prepared by Single-Stage Co-Evaporation**
M.J. Shin, S.J. Park, A. Lee, A. Cho, K. Kim, S.K. Ahn, J.H. Park, J.S. Yoo, D. Shin, I. Jeong, J.H. Yun, J. Gwak & J.S. Cho
KIER, Daejeon, Republic of Korea
- 3BV.2.28 Effect of Sulfurization Time on the Structural Properties of SnS Films**
V.R. Minnam Reddy, S. Gedi, W.K. Kim & C. Park
Yeungnam University, Gyeongsan, Republic of Korea
K.T. Ramakrishna Reddy
Sri Venkateswara University, Tirupati, India
- 3BV.2.29 Design of Dielectric SiO₂ Nanoparticle in Solution-Processed CISSe Solar Cells**
Y. Gao & M. Schmid
University of Duisburg-Essen, Germany
- 3BV.2.30 Improving Interface of Kesterite Solar Cell by Solution-Processed Alkali-PDT Treatment**
M. He, C. Yan, J. Huang & X. Hao
UNSW Australia, Sydney, Australia



- J.H. Kim
Chonnam National University, Gwangju, Republic of Korea
- 3BV.2.31 Investigation of Band Gap and Band Tailing in (Cu_{1-x}Ag_x)₂ZnSnSe₄ Thin Films Alloys**
S. Perret, R. André & H. Mariette
CNRS, Grenoble, France
J. Bleuse, Y. Curé, F. Emieux, F. Roux & L. Grenet
CEA, Grenoble, France
- 3BV.2.33 Impedance Spectroscopy Models of CZTSe Nanolayer Ge Bi-Layers Devices**
S. Lee
Indiana State University, Terre Haute, USA
K.J. Price
Morehead State University, USA
E. Saucedo
IREC, Barcelona, Spain
- 3BV.2.34 Effect of CdS₁-XTex Intermix Layer Thickness on CdTe Solar Cell Performance**
N. Kumar Das, J. Chakrabarty & M.A. Matin
Chittagong University of Engineering and Technology, Bangladesh
S.F.U. Farhad
BCSIR Labs, Dhaka, Bangladesh
N. Amin
National University of Malaysia, Kajang, Malaysia
- 3BV.2.35 Effect of ZnO Intermediate Layer on the Properties of CZTSe Absorber Layer**
V. Kumar & U.P. Singh
KIIT University, Bhubaneswar, India
- 3BV.2.36 Alkali Post-Deposition Treatment of Cu(In,Ga)(S,Se)₂ Solar Cell Absorbers Grown under Atmospheric Pressure**
P. Reyes-Figueroa, T. Kodalle, T. Bertram, A. Villanueva-Tovar, E. Waack, R. Haberecht, C.A. Kaufmann, R. Klenk & R. Schlatmann
HZB, Berlin, Germany
- 3BV.2.37 Chemical Bath Deposition: Design and Development of Instrumentation for Growth Thin-Film Solar Cell Layers**
D.F. Bohórquez Vargas, M.F. Hurtado-Morales & C.F. Reyes Bello
Central University, Bogotá, Colombia
- 3BV.2.38 Development of High-Efficiency Cu(In,Ga)Se₂ Thin-Film Photovoltaics on Flexible Stainless Steel Substrates: Impacts of Ga Grading on Device Performances**
D. Shin, K. Kim, I. Jeong, Y.J. Eo, S. Song, A. Cho, S.K. Ahn, J.S. Cho, J.H. Park, J.S. Yoo, S.J. Ahn, J.H. Yun & J. Gwak
KIER, Daejeon, Republic of Korea
- 3BV.2.39 A Low-Temperature X-Ray Diffraction Study of the Cu₂ZnSnSe₄ Thin Films on a Mo Foil Substrate**
A.V. Stanchik, V. Chumak, V.F. Gremenok & T.V. Shoukavaya
NASB, Minsk, Belarus
S. Baraishuk
BSATU, Minsk, Belarus
- 3BV.2.48 Dynamical Monte Carlo Simulations to Investigate the Morphology Influence on Organic Solar Cell Performances**
H. Bencherif, L. Dehimi, A. Yousfi, L. Saidi, M.A. Abdi & F. Meddour

- University of Batna, Algeria
F. Pezzimenti & F.G. Della Corte
UNIRC, Reggio Calabria, Italy
- 3BV.2.49 Organic Solar Cells Based on an Anthradithiophene Conjugated Polymer**
G. Bianchi, F. Melchiorre, C. Carbonera, G. Corso, R. Barbieri & R. Po
Eni, Novara, Italy
F. Ferrazza
Eni, San Donato Milanese, Italy
F. Tinti & N. Camaioni
CNR, Bologna, Italy
A. Nitti & D. Pasini
University of Pavia, Italy
- 3BV.2.51 Improved Efficiency of Vacuum Free Bulk Hetero-Junction Solar Cells by Incorporating Gold (Au) Nanoparticles**
N.T.N. Truong, C.-D. Kim, V.H. Thai & C. Park
Yeungnam University, Gyeongsan, Republic of Korea
- 3BV.2.53 Preliminary Study of the Role of Fluorinated Phthalocyanines as Non-Fullerene Acceptors in Ternary Organic Solar Cells**
A.A.A. Torimtubeun, J. Pallarès Marzal & L.F. Marsal Garví
URV, Tarragona, Spain
J. Follana-Berná & A. Sastre-Santos
University Miguel Hernández, Elche, Spain
- 3BV.2.54 Characterization of PEDOT:PSS Functionalized by Dimethyl Sulfoxide and Triton X-100 and TiO₂ Nanoparticles**
A. Yaseen, E.S. Marstein & S.Zh. Karazhanov
Institute for Energy Technology, Kjeller, Norway
A. Vázquez-López, D. Maestre, J. Ramírez-Castellanos & A. Cremades
UCM, Madrid, Spain
- 3BV.2.55 High Efficiency Inverted Polymer Solar Cells Fabricated Based on ZnO-ETL Utilizing Spray Pyrolysis Technique**
E. Moustafa, J.G. Sánchez López, L.F. Marsal Garví & J. Pallarès Marzal
URV, Tarragona, Spain
- 3BV.2.56 Evaluation Emerging PV Performance under Energy Harvesting for Indoor Lighting Applications**
Y.-S. Long, M.-A. Tsai, T.-C. Wu & S.-T. Hsu
ITRI, Hsinchu, Taiwan
- 3BV.2.57 Student Awards Finalist Presentation: Selective NIR-Conversion in Dye-Sensitized Solar Cells: A New Generation of Fully Transparent and Colorless Photovoltaic**
W. Naim
LRCS, Amiens, France
F. Grifoni, I. Dzeba & F. Sauvage
LRCS, Amiens, France
N. Barbero & C. Barolo
University of Turin, Italy
I. Nikolinakos & S. Haacke
University of Strasbourg, France
- 3BV.2.59 Structural, Optical, Dielectrical and Electrical Properties of Aloe Vera Leaf Exudate: Novel Application in Solar Cell**
S.K. Hnawi, A. Nayad, H. Ait Dads, A. Agdad, A. Oueriagli & M. Ait Ali
Cadi Ayyad University, Marrakech, Morocco



- 3BV.2.70 Growth and Characterization of 1.0 eV GaAsBi for Photovoltaic Applications**
T. Paulauskas, V. Pacebutas, J. Devenson, R. Butkutė, B. Cechavicius, S. Stanionyte, A. Naujokaitis, M. Skapas & A. Krotkus
Center for Physical Sciences and Technology, Vilnius, Lithuania
M. Caplovicová & V. Vretenár
Slovak University of Technology, Bratislava, Slovakia
X. Li & M. Kociak
University of Paris Sud, Orsay, France
- 3BV.2.71 Reducing Voc Loss in Wafer Bonded Four-Junction Solar Cells with Improved p-GaAs/n-InP Interfaces**
G. Li, H. Lu, X. Li, W. Zhang & M. Wu
SISP, Shanghai, China
- 3BV.2.74 Scalable and Low Cost Back End of Line Technologies for Production of III-V Solar Cells**
N. Hayatiroodbari, C. Hendler, A. Wheeldon & R. Trattnig
JOANNEUM RESEARCH, Weiz, Austria
- 3BV.2.75 Limits for the Fabrication of Broadband Antireflection Coatings for Multijunction Solar Cells Using Thin Films**
G.J. Hou & I. Rey-Stolle
UPM, Madrid, Spain
- 3BV.2.76 A New Mathematical Approach for the Performance Simulation of Multijunction (MJ) Solar Cells**
G. Timò
RSE, Piacenza, Italy
L.C. Andreani
University of Pavia, Italy
- 3BV.2.77 Optimization of INSB Epitaxial Layer Growth Conditions Using MOVPE: Prospective Applications in Photovoltaic Cells**
C.C. Ahia & E.L. Meyer
University of Fort Hare, Alice, South Africa
- 3BV.2.88 How to Fabricate Low-Resistance Heterointerfaces for Tandem Cells by Direct Bonding at Low Temperatures**
Y. Ohno
Tohoku University, Sendai, Japan
J. Liang & N. Shigekawa
Osaka-City University, Japan
H. Yoshida
Osaka University, Japan
R. Miyagawa
Nagoya Institute of Technology, Japan
Y. Shimizu & Y. Nagai
Tohoku University, Ibaraki, Japan
- 3BV.2.89 Promising Materials for High Efficiency Dual Junction Solar Cell Directly Grown on Si**
D.N. Micha
Federal Center of Technological Education of Rio de Janeiro, Petrópolis, Brazil
- 3BV.2.91 Integration Challenges of a Perovskite Cell in a Monolithic Tandem: Focus on the HTM/TCO Interface**
O. Dupré, N. Nguyen, C. Roux, D. Muñoz, M. Matheron, M. Manceau & S. Berson
CEA, Le Bourget-du-Lac, France

- M. Foti, G. Condorelli & C. Gerardi
ENEL Green Power, Catania, Italy
- 3BV.2.92 Promising Properties of Zinc Oxynitride as a Top Cell Absorber in Tandem Solar Cells**
K. Karlsen, L. Vines, I.J.T. Jensen, E. Monakhov & K. Bergum
University of Oslo, Norway
- 3BV.2.93 Cesium-Containing Triple Cation Perovskites as Tandem Partners for Silicon Solar Cells**
S. Ašmontas, J. Gradauskas, A. Grigučevičienė, K. Leinartas, K. Petrauskas, A. Selskis, A. Sužiedlis & E. Širmulis
Center for Physical Sciences and Technology, Vilnius, Lithuania
- 3BV.2.95 Combined PV Device, Module and System Modelling for Predicting the Annual Energy Yield of Perovskite / Silicon Tandem Based PV Systems**
M. Singh, R. Santbergen, Z. Wang, A. Nour El Din, C.M. Ruiz Tobon, P.A. Procel Moya, M. Zeman & O. Isabella
Delft University of Technology, Netherlands
- 3BV.2.97 Tailor-Made Light Management Nano-Structures for Perovskite-Silicon Tandem Solar Cells**
J. Sutter, D. Eisenhauer, A.B. Morales-Vilches, P. Wagner, P. Tockhorn, S. Albrecht, B. Stannowski & C. Becker
HZB, Berlin, Germany
- 3BV.2.98 Research on Wafer Bonding Technique for GaInP/GaAs Dual Junction Solar Cells**
H. Wang, W. Zhang, P. Gao, H. Zhang & Q. Sun
Tianjin Institute of Power Sources, China
- 3BV.2.99 Versatile Passivating Contacts Development for High Efficiency Tandem Applications**
A. Walter, G. Nogay, B.A. Kamino, A. Paracchino, S.-J. Moon, J.J. Diaz Leon, G. Christmann, M. Dussouillez, L. Ding, S. Rafizadeh, A. Ingenito, B. Paviet-Salomon, C. Allebé, M. Despeisse, C. Ballif & S. Nicolay
CSEM, Neuchâtel, Switzerland
- 3BV.2.100 Nanostructured Photoelectrodes Based on Ytria Stabilized Zirconia: Applications to Perovskite/c-Si Tandem Solar Cells**
M.F. Vildanova, A.B. Nikolskaia, S.S. Kozlov, O.K. Karyagina, O.V. Alexeeva & O.I. Shevaleevskiy
RAS, Moscow, Russian Federation
- 3BV.2.101 Life Cycle Assessment of Perovskite on Crystalline Silicon Tandem Modules at Industrial Scale**
C. Salas Redondo
Institut Photovoltaïque d'Île-de-France, Palaiseau, France
C.F. Blanco
Leiden University, Netherlands
K. Alvino
IPVF, Palaiseau, France
W.J.G.M. Peijnenburg
National Institute of Public Health and the Environment, Bilthoven, Netherlands
L. Oberbeck
Total Gas, Paris La Défense, France
- 3BV.2.102 Sequential Silicon Surface Melting and Atmospheric Pressure Phosphorus Doping for Crystalline Tunnel Junction Formation in Silicon/Perovskite Tandem Solar Cells**



G. Gaspar, J. Canhoto Cardoso, I. Costa, A. Guerra, A. Viana, M.E.M. Jorge, D. Vilhena, D. Pera, J. Almeida Silva, A.M. Vallêra, J.M. Almeida Serra & K. Lobato
University of Lisbon, Portugal
L. Vines
University of Oslo, Norway

3BV.2.103 Optimization of IBC Silicon Bottom Solar Cell for Three Terminal Perovskite Tandem Devices

V.D. Mihailetschi, H. Chu, R. Roescu & R. Kopecek
ISC Konstanz, Germany

3BV.2.104 Optimization of Transparent Conductive Oxides for Silicon-Perovskite Tandem Solar Cells

V. Sittinger & H. King
Fraunhofer IST, Braunschweig, Germany

VISUAL PRESENTATIONS 5BV.3

13:30 – 15:00 Solar Resource and Forecasting

Chairpersons:

Wilfried van Sark
Utrecht University, Netherlands

Ana Maria Gracia Amillo
European Commission JRC, Italy

5BV.3.1 The Impact of Distance, Cardinal Direction and Time on Solar Irradiance Estimation: a Case Study

L. Visser, S. Knibbeler, T. AlSkaif & W.G.J.H.M. van Sark
Utrecht University, Netherlands

5BV.3.2 Solar Power Forecast Using Satellite Pictures

J. Esteves, N. Pinho da Silva & Y. Cao
R&D Nester, Sacavém, Portugal
R. Pestana
REN, Sacavém, Portugal

5BV.3.3 Silicon Sensors vs. Pyranometers – Review of Deviations and Conversion of Measured Values

M.J. Rivera Aguilar & C. Reise
Fraunhofer ISE, Freiburg, Germany

5BV.3.4 Field Trial of Met Station Using PV Reference Cells

M. Gostein & W. Stueve
Atonometrics, Austin, USA
R. Clark
7X Energy, Austin, USA

5BV.3.5 Modeling Tool Validation for the Yield Prediction of Bifacial East West Vertical PV System in Nordic Conditions

S. Ranta, H. Huerta, O. Huhtala & A. Heinonen
TUAS, Turku, Finland

J.S. Stein
Sandia National Laboratories, Albuquerque, USA

5BV.3.7 Irradiance Variability in Distributed Solar Photovoltaic Systems

K. Murray, D.J. Morrow & R. Best
Queen's University Belfast, United Kingdom

5BV.3.8 Meteor Norm Version 8.0

J. Remund, S.C. Müller & M. Schmutz
Meteotest, Bern, Switzerland

5BV.3.10 Analysis of Hourly Solar Irradiance Prediction Based on Meteorological Radiation Model Using Open Weather Data and Measured Solar Radiation

J. Han & W.-K. Park
ETRI, Yuseong-gu, Republic of Korea

5BV.3.12 Development of PV-Forecasting Methods: Evaluation, Applications and Economic Potentials

L. Gaisberger & R. Höller
University of Applied Sciences Upper Austria, Wels, Austria

5BV.3.14 Direct and Diffuse Components of the Solar Radiation Collected by PV Panels. Comparisons between Computations and Observations at Lille and Evora

T. Elias
HYGEOS, Lille, France
R. Salgado & F. Lopes
University of Évora, Portugal
N. Ferlay
University of Lille, Villeneuve d'Ascq, France

5BV.3.16 Potential of the Amazon Region and the Impact of Forest Fires on Photovoltaic Generation

C. Magalhães, A. Gallina, L. Lima, L. Silva & T. Lima
UFAC, Rio Branco, Brazil
V.O. da Silva, S.G. Relva & D. Peyerl
University of São Paulo, Brazil

5BV.3.17 Performance Evaluation of Cost-Effective Irradiance Sensors Versus Thermopile Pyranometer

S. Karki, H. Ziar & O. Isabella
Delft University of Technology, Netherlands
M. Korevaar & T. Bergmans
Kipp & Zonen, Delft, Netherlands

5BV.3.18 Statistical Analysis of a Rooftop PV Plant for the Validation of a Forecast Algorithm

J. Lehmann, B. Haut & S. Scheerlinck
ENGIE Laborelec, Linkebeek, Belgium

5BV.3.19 Towards Optimising the Albedo Measurement

S. Suarez, I. Fernandez, J.M. Rivas, F. Alvarez, A. Andrés, H. Muñoz, J. de la Peña & S. Rodríguez-Conde
Enertis Solar, Madrid, Spain

5BV.3.20 Cloud Motion Vectors in All-Sky Images for Forecasting Solar Irradiance

A. Boschert & M. Zehner
Rosenheim University of Applied Sciences, Germany
J. Schreder
CMS Ing. Dr. Schreder, Kirchbichl, Austria



F. Flade
Bavarian Association for the Promotion of Solar Energy, Munich, Germany

5BV.3.21 Analysis of Irradiance Enhancement and Irradiance Volatility in High-Resolution Data Sets

M. Zehner, N. Stut, F. Kaiser & A. Boschert
Rosenheim University of Applied Sciences, Germany
B. Mayer
University of Munich, Germany
F. Flade
Bavarian Association for the Promotion of Solar Energy, Munich, Germany

5BV.3.22 72-Hours Ahead Global Horizontal Irradiance Forecasting Using Artificial Neural Network, Ground Measurements and Solar Geometry Calculations

O. El Alani & A. Ghennioui
IRESEN, Benguerir, Morocco
H. Ghennioui
USMBA, Fez, Morocco
S. Sarikh
Cadi Ayyad University, Marrakech, Morocco

5BV.3.23 Forecasting Global Horizontal and Direct Normal Irradiation in the Arabian Peninsula for PV Applications: Sensitivity to the Explicit Treatment of Aerosols

L. Martín Pomares, C. Fountoukis & A.A. Abdallah
HBKU, Doha, Qatar

5BV.3.24 Real-Time Global Coverage of Satellite Based Irradiation Data – Benchmark and Applications

M. Schmutz, S.C. Müller & J. Remund
Meteotest, Bern, Switzerland

5BV.3.26 Comparing and Combining Machine Learning and Numerical Weather Prediction Models for Solar Forecasting

G. Scabbia, A. Sanfilippo, C. Fountoukis, D. Perez-Astudillo & D. Bachour
QEERI, Doha, Qatar

5BV.3.27 Evaluation of the PV Resource Dataset in Central and North America

Y. Xie & M. Sengupta
NREL, Golden, USA

5BV.3.29 Field Trial of Angled Multisensor Irradiance Decomposition (AMID) for Direct and Diffuse Irradiance Measurement

M. Gostein & B. Stueve
Atonometrics, Austin, USA
B. Bourne
Earthbound Analytics, Davis, USA
F. Farina & A. Hoffman
SunPower, Richmond, USA

5BV.3.30 Japan's Vast Renewable Energy Resources

C. Cheng, M. Stocks, R. Stocks, A. Blakers, B. Lu, D. Silalahi, A. Nadolny & L. Hayes
ANU, Canberra, Australia

5BV.3.31 Driving the Unknown towards Fuel Economy with a Sky-Imager in a Hybrid PV-Diesel System

L.-E. Boudreault & N. Schmutz
Reuniwatt, Sainte-Clotilde, Réunion
T. Mart

Reuniwatt, Wiesenthau, Germany

VISUAL PRESENTATIONS 1BV.4

15:15 – 16:45 Novel Photovoltaic Conversion Systems, Characterization Approaches and Device Designs / New Materials and Concepts for Cells and Modules

Chairpersons:

Iñigo Ramiro
UPM, Spain

Francesco Roca
ENEL, Italy

1BV.4.1 Hydrogen States in BaSi₂ by Muon Spin Rotation

Z. Xu, T. Sato & T. Suemasu
University of Tsukuba, Japan
J. Nakamura, A. Koda & K. Shimomura
KEK, Tsukuba, Japan

1BV.4.2 Hot Carrier Evidence in a Solar Cell

J. Gradauskas, S. Ašmontas, A. Sužiedlis, A. Šilenas, A. Cerškus, V. Vaicikauskas & O. Žalys
CPST, Vilnius, Lithuania
O. Masalskyi
VGTU, Vilnius, Lithuania

1BV.4.3 Modeling and Simulation of CdZnO/ZnO Heterostructure Based Multiple Quantum Wells for Photovoltaics

G. Siddharth, R. Singh & S. Mukherjee
IIT Indore, India

1BV.4.4 Novel Electro-Thermal Modeling Approach for DC and AC Solar Cell Characterization

M. Diethelm, R. Hiestand, S. Weidmann, S. Jenatsch, S. Altazin & L. Penninck
Fluxim, Winterthur, Switzerland
C. Kirsch, E. Comi, E. Knapp & B. Ruhstaller
ZHAW, Winterthur, Switzerland

1BV.4.5 ASA Software for Opto-Electrical Simulation of Silicon, CIGS and Perovskite Solar Cells

R. Santbergen, C.M. Ruiz Tobon, P.A. Procel Moya, M. Singh, N. Rezaei, A. Calcabrini, M. Zeman & O. Isabella
Delft University of Technology, Netherlands

1BV.4.6 High Frequency Modulated and Time Resolved Photoluminescence: towards a Full Temporal Characterization on III-V Semi-Conductor Materials

W. Zhao
IPVF, Palaiseau, France
C. Rakotoarimanana, A.-M. Goncalves & A. Etcheberry
CNRS/UVSQ, Versailles, France



- L. Lombez, J.-F. Guillemoles & B. Bérenguier
CNRS, Palaiseau, France
- 1BV.4.7 The Superlattice Effect on Current Increase in Graphene/Oxide/n-GaAs Schottky Solar Cells**
A.C. Varonides
University of Scranton, USA
- 1BV.4.8 Highly Stable Thin Film Organic Solar Cells Using Poly Crystallized Silver Doped LaPO₄**
M.S.G. Hamed & G.T. Mola
University of KwaZulu-Natal, Scottsville, South Africa
- 1BV.4.9 Transparent Matrix Materials for Efficient Luminescent Solar Concentrators**
M.R. Kulish, V.P. Kostilyov, A.V. Sachenko & I.O. Sokolovsky
NAS ISP, Kiev, Ukraine
A.I. Shkrebtiy / Chkrebtiy
Ontario Tech University, Oshawa, Canada
- 1BV.4.12 Analysis of the Interface of RF-Sputtered MoO_x Based Hole Selective Contact for Silicon Heterojunction Solar Cells (SHJ)**
M.I. Elsmami, J. Cho, M. Recaman, I. Gordon & J. Poortmans
imec, Leuven, Belgium
E. Tresso
Polytechnic University of Turin, Italy
N. Fatima, M. Adib & K. Sopian
SERI, Bangi, Malaysia
- 1BV.4.13 Absorption of the Solar Radiation with Arrays of Subwavelength Compound Parabolic Concentrators**
A. Prajapati, G. Marko & G. Shalev
BGU, Beer-Sheva, Israel
- 1BV.4.14 Cd_{1-x}Zn_xS Quantum Dots for Photovoltaics Application: First-Principles Study the Effects of the Metal Vacancies on the Structural, Electron and Emission Properties**
I.M. Kupchak & D.V. Korbutyak
NAS ISP, Kyiv, Ukraine
N.F. Serpak
Vinnytsia National Pirogov Medical University, Ukraine
A.I. Shkrebtiy / Chkrebtiy
Ontario Tech University, Oshawa, Canada
- 1BV.4.15 Understanding the Origins of P1-Induced Power Losses in CIGS Modules through High-Resolution Hyperspectral Luminescence**
C.O. Ramirez Quiroz, J. Müller & K. Orgassa
NICE Solar Energy, Schwäbisch Hall, Germany
L.-I. Dion-Bertrand
Photon, Montreal, Canada
C.J. Brabec
FAU, Erlangen, Germany
- 1BV.4.24 Impact of Spin Exchange Interaction on Charge Transfer in Dual Polymer Photovoltaic Composites**
V.I. Krinichnyi, E.I. Yudanova, N.N. Denisov & V.R. Bogatyrenko
Institute of Problems of Chemical Physics, Chernogolovka, Russian Federation
A.A. Konkin
Kazan Federal University, Russian Federation

- 1BV.4.25 Effect of Hydrogen Plasma Treatment on Silicon Quantum Dot Multilayers Using Amorphous SiO_x**
R. Akaishi, K. Gotoh, N. Usami & Y. Kurokawa
Nagoya University, Japan
S. Kato
Nagoya Institute of Technology, Japan
- 1BV.4.26 Analysis of Selenization Processes for Antimony Selenide Solar Cells by Vacuum Evaporation**
V. Kumar, E. Artegiani & A. Romeo
University of Verona, Italy
- 1BV.4.27 Epitaxially Grown In₂S₃:V Thin Films for Intermediate Band Solar Cell Application**
T. Jawinski, M. Lorenz, M. Grundmann & H. von Wenckstern
University of Leipzig, Germany
R. Scheer
Martin Luther University, Halle (Saale), Germany
- 1BV.4.28 Titanium Disilicide as the Only Material for Electrode in Crystalline Silicon Solar Cells**
E. Zugasti, J. Bengoechea, A. Buceta & A.R. Lagunas
CENER, Sarriguren-Navarra, Spain
- 1BV.4.29 Semi-Transparent Thin Film Solar Cells for Photovoltaic Windows**
I. Oja Acik, N. Spalatu, J.S. Eensalu, A. Katerski, E. Karber & M. Krunks
Tallinn University of Technology, Estonia
- 1BV.4.30 Plasmonic Effect of Silver Nanoparticles on Enhancing Solar Cells Light Absorption**
M.Z. Belmehdi, M. Zerdali, F. Bachiri & S. Hamzaoui
USTO, Oran, Algeria
M.A. Benali
Djillali Liabes University, Bel Abbes, Algeria
- 1BV.4.32 Bionic Leaf-Vein Architecture: High Performance Transparent Conducting Electrodes with Low Ag Consumption for Resource-Efficient Solar Cell Applications**
G. Jia, A. Dellith, C. Schmidt, J. Dellith, G. Schmidl, G. Andrä & J. Plentz
IPHT, Jena, Germany
- 1BV.4.33 Nanocrystalline 3D Homojunctions for Energy Conversion Devices**
S. Menezes
InterPhases Solar, Moorpark, USA
- 1BV.4.36 First Measurement of Lifetime of Photogenerated Current Carriers in New Material for Thin Films Solar Cells – Cu₂-NiSnSe₄ Solid Solutions**
O.Yu. Urkhanov, M.V. Gapanovich, E.V. Rabenok, B.I. Golovanov & G.F. Novikov
RAS, Chernogolovka, Russian Federation
- 1BV.4.37 Influence of Bath Composition and Temperature on the Growth Rate, Optical and Morphological Properties of ZnS Thin Films Produced by Chemical Bath Deposition**
D. Alanis, M.R.R. Menon & A.F. da Cunha
University of Aveiro, Portugal
- 1BV.4.38 Halide Processing Strategies for Efficient Antimony Selenide Thin Film Solar Cell Technology**
N. Spalatu, R. Krautmann, A. Katerski, E. Karber, J. Hiie, I. Oja Acik & M. Krunks



Tallinn University of Technology, Estonia

1BV.4.40 Upscaling R2R-Production Technologies and Low Viscous Intermittent Coating for OLEDs, OPVs and Perovskite Solar Cells

T. Kolbusch, N. Meyer, X.H. Rooms, D. Kourkoulos & K.-P. Crone
Coatema Coating Machinery, Dormagen, Germany

1BV.4.41 Fractal-Structured Solar Cell Array from Tree Shape for 25% Enhancement of Energy Production

Y.H. Sim, M.J. Yun, S.I. Cha & D.Y. Lee
KERI, Changwon, Republic of Korea

1BV.4.42 Insights by Non-Contact Eddy Current Imaging for Advanced Cell Concepts

M. Klein, M. Fischer, B. Chen & S. Adam
Suragus, Dresden, Germany

1BV.4.43 A Novel Approach to Passivate p+-Si/TiO2 Contact Efficiently by Atomic Layer Deposition

N. Mozaffari, H. Shen & K.R. Catchpole
ANU, Canberra, Australia

1BV.4.44 Metal Oxide-Based Junctions for Transparent Solar Cells and Energy Harvesting

E. Manidakis
University of Crete, Heraklion, Greece
G. Michail, A. Kostopoulos, M. Kayambaki, K. Tsagaraki, M. Androulidaki, E. Gagaoudakis, G. Kiriakidis, N.T. Pelekanos & E. Aperathitis
FORTH, Heraklion, Greece
M. Schmidt & M. Modreanu
University College Cork, Ireland

1BV.4.45 Type-II In(As)P/InGaP Quantum Dots for Intermediate Band Solar Cells

B. Vargas Rocha & P.L. Souza
PUC-Rio, Rio de Janeiro, Brazil
R. Jakomin
UFRJ, Duque de Caxias, Brazil

1BV.4.46 Optical 3D Device Simulation of BaSi2 Thin Film Solar Cells

Y. Yamashita & T. Suemasu
University of Tsukuba, Japan
R. Santbergen, C.M. Ruiz Tobon, M. Zeman & O. Isabella
Delft University of Technology, Netherlands

1BV.4.47 On the Road towards Vehicle Integration: Glass-Fibre Reinforced Encapsulation Enabling Light-Weight and Curved Modules

J. Govaerts, T. Borgers, A.S.H. van der Heide, L. Vastmans, R. Moors, G. Doumen & L. Tous
imec, Genk, Belgium
A. Bettinelli & S. Harrison
CEA, Le Bourget-du-Lac, France
B. Willems & G. Galbiati
Henkel Electronic Materials, Westerlo, Belgium
M. Gializzo & A. Fecchio
Applied Materials, Olmi di San Biagio di Callalta, Italy
J. Poortmans
imec, Leuven, Belgium

1BV.4.48 Encapsulation of Photovoltaic Modules in Composite Material through HP-RTM Process

J. Aizpurua, W. Cambarau, I. Arrizabalaga, G. Imbuluzqueta, J.M. Hernandez, N. Yurrita, O. Ollo, F.J. Cano & O. Zubillaga
Tecnalia, San Sebastian, Spain

1BV.4.49 New Developments of Transparent Plastic Materials in Frontsheets and Backsheets as Valid Alternatives to Glass

M. Manara
Coveme, San Lazzaro di Savena, Italy

1BV.4.51 Solar Cells Based on the PEDOT:PSS/Si Heterojunction with Ag Nanoparticles

S.V. Mamykin, O.S. Kondratenko, I.B. Mamontova, T.S. Lunko, N.V. Kotova & T.R. Barlas
NASU, Kiev, Ukraine

1BV.4.52 Theoretical Investigation of Some Narrow Bandgap Semi-Conductors Based on Theophene and Phenylene for Photovoltaic Application

S. Boussaidi
Ibn Zohr University, Agadir, Morocco
H. Zgou
Ibn Zohr University, Ouarzazate, Morocco

1BV.4.53 Smart Building Technology for Nano-Architectures

S.E. Sungur
Polytechnic University of Milan, Italy

1BV.4.54 Novel AlxIn1-xN (x~0-0.60) on Si (111) Heterojunctions Deposited by RF Sputtering for Solar Cells

M. Sun, R. Blasco, S. Elamrani, F.B. Naranjo & S. Valdueza-Felip
UAH, Alcalá de Henares, Spain
J. Olea
UCM, Madrid, Spain
A.F. Braña de Cal
UAM, Madrid, Spain

VISUAL PRESENTATIONS 6BV.5

17:00 – 18:30 Industrial Applications / PV Driven Energy Management and System Integration

Chairpersons:

Ingrid Weiss
WIP Renewable Energies, Germany

Hubert Aulich
SC Sustainable Concepts, Germany

6BV.5.2 Solar Energy Production and CO2 Avoidance of a 5.0 kW Solar Power Generator Integrated in a Mango Processing Facility

E.M. Querkiol & E.B. Taboada
University of San Carlos, Cebu City, Philippines

6BV.5.3 Mobile Hybrid RES Innovative Power for Irrigation and Fertigation



- B.-A. Onose, I. Murgescu & S.-A. Sontea
INCDIE ICPE-CA, Bucharest, Romania
- 6BV.5.4 Optimising Own PV Consumption with PV Energy Yield Predictions from Machine Learning Algorithms and Weather Data**
H. Heck, F. Kuonen, S. Bacha, A. Schmidt, E. Schüpbach & U. Muntwyler
BUAS, Burgdorf, Switzerland
- 6BV.5.5 Assessment of the Benefits of Adding PV Generation into Existing Wind Power Plants**
A.R. Arrifano Manito, M. Pinho Almeida, M. Cassares, K.J.F. Novaes Cândido de Souza, G. Figueiredo, J. Romel, P. Ferreira Torres, J. Tavares Pinho & R. Zilles
University of São Paulo, Brazil
- 6BV.5.6 Electric Grid Planning for a PV powered Net-Zero City**
N. Pflugradt & U. Muntwyler
BUAS, Burgdorf, Switzerland
- 6BV.5.7 Solar PV Driven Child Mortality Alleviation in the Global South**
M. Ray & B. Chakraborty
IIT Kharagpur, India
- 6BV.5.8 Design of Regional Management System for Photovoltaic Power Plants**
J. Kim, H. Choi, G. Jo, C. Lim & C. Kim
Green Energy Institute, Mokpo, Republic of Korea
D. Kwon
Green ENS, Naju, Republic of Korea
- 6BV.5.9 Triggering Demand-Side-Management: Correlation of Electricity Prices, Share of Renewables, CO₂-contents, and Grid-Frequency in the German Electricity Grid**
S. Krauter & L. Zhang
University of Paderborn, Germany
- 6BV.5.10 Reduction of Required Storage Capacities for a 100% Renewable Electricity Supply in Germany, if New PV Systems are Installed with an Increased Elevation Angle and Orientated in East-West Direction**
S. Krauter & D. Rustemovic
University of Paderborn, Germany
- 6BV.5.11 Machine Learning Driven Optimization of a Hybrid Electrical and Thermal System**
M. Dallapiccola, F. Trentin, C. Dipasquale, R. Fedrizzi & D. Moser
Eurac Research, Bolzano, Italy
- 6BV.5.12 The Potential of PV Module Tilt and Technology for Tuning Daily Energy Yield across the Year**
J. Govaerts & I.T. Horvath
imec, Genk, Belgium
P. Manganiello
Delft University of Technology, Netherlands
J. Poortmans
imec, Leuven, Belgium
- 6BV.5.13 An Optimal Agents-Based Behaviors Model for Peer-to-Peer Energy Trading Linked to Blockchain**
M. Sajjad, A. Boumaiza & A. Sanfilippo
QEERI, Doha, Qatar

- 6BV.5.14 Optimization of a 4.6-kW Residential Hybrid Solar Photovoltaic (PV) System - A Case Study**
M. Viljoen & J. Bekker
Vaal University of Technology, Vanderbijlpark, South Africa
- 6BV.5.15 Convolutional Neural Networks Applied to Sky Images for Short-Term Solar Irradiance Forecasting**
Q. Paletta & J. Lasenby
University of Cambridge, United Kingdom
- 6BV.5.16 Integration of Photovoltaic with Wind Power in Kuwait: Evaluation and Results**
H. Alduaij, M. Al-Khayat & M. Al-Rasheedi
KISR, Kuwait, Kuwait
- 6BV.5.17 First Steps towards Energy-Positive Territorial Collectivities in the French Overseas Departments: Optimal Mix of Electric Mobility, Photovoltaics and Energy Storage in Reunion Island**
A. Guérin de Montgareuil
CEA, St-Paul-lez-Durance, France
I. Ingar
Department of Reunion, Saint-Denis, Réunion
- 6BV.5.18 Towards a Simple and Robust Probabilistic Solar Variability Analysis Based on Transition Probability between Variability Classes of Sky State**
F. Zhuang, Y.-M. Saint-Drenan & P. Blanc
MINES ParisTech, Sophia Antipolis, France
J.-P. Mangione & P. Salvado
SPIE, Serres-Castet, France
- 6BV.5.19 Application of a Smart Energy Management System for a 250 kWp Solar Plant in Benguerir, Morocco**
I. Ait Abdelmoula, A. Benazzouz, A. Rochd, Z. Naimi, B. Ikken & A. Ghennioui
Green Energy Park, Benguerir, Morocco
R. Lebreton & A. Degland
Solveo Energie, Fenouillet, France
- 6BV.5.20 Agents-Based Modeling for a Transactive Energy Trading Blockchain Framework**
A. Boumaiza, M. Sajjad & A. Sanfilippo
QEERI, Doha, Qatar
- 6BV.5.21 Design and Implementation of an AI-Based and IoT-Enabled Home Energy Management System under Smart Grid Paradigm**
A. Rochd, A. Benazzouz, I. Ait Abdelmoula, Z. Naimi, B. Ikken & A. Ghennioui
Green Energy Park, Benguerir, Morocco
- 6BV.5.22 Energy Model for a Rural Region in Germany - Methodology**
M.-C. Leonhard & H. te Heesen
Trier University of Applied Sciences, Neubrücke (Nahe), Germany
- 6BV.5.23 Power Electronics System Topologies Recommender for PV/Battery Project Applications**
B. Bourachdi & M. Salhi
Moulay Ismail University, Meknes, Morocco
- 6BV.5.24 Firm PV Power Forecasts – Step One to Least-Cost Ultra-High PV Penetration**



M.J.R. Perez, A. Atkins, P. Keelin & S. Dise
Clean Power Research, Napa, USA
R.R. Perez
SUNY, Albany, USA
M. Pierro
University of Rome Tor Vergata, Italy

- 6BV.5.25 Leveraging Electric Load Data and Grid Features to Design High-PV Penetration in Rural and Urban Settings in Portugal**
G. Luz & R. Amaro e Silva
University of Lisbon, Portugal
S.R. Freitas
Energy and Environment Agency of Lisbon, Portugal
- 6BV.5.26 Demand Informed Business Models for a Shared PV System Among Multiple Households: Search for Effective, Profitable and Fair Micro-Grids Using Agent-Based Modeling**
M. Lovati, P. Huang, C. Olsmats & X. Zhang
Dalarna University, Falun, Sweden
L. Maturi
Eurac Research, Bolzano, Italy
- 6BV.5.27 A Technological Framework for Optimising the Design of Photovoltaic Plants for Prosumers**
J. Murta Pina, F. Monteiro, T. Pereira, S. Moraes, L. Romba Jorge, R. Lopes, J. Martins, A. Damas Mora & S. Correia
NOVA School of Science and Technology, Caparica, Portugal
F. Oliveira & H. Vieira
Digitalmente, Caparica, Portugal
M. Santos
Engibase, Caparica, Portugal
- 6BV.5.29 Domestic Load Management with Renewable Energy Integration**
I. Hammou Ou Ali & M. Maaroufi
Mohammed V University, Rabat, Morocco
- 6BV.5.30 Residential PV Self-Consumption: Real Savings in a Spanish Household**
H.-J. Rodríguez San Segundo
Edhuna Consulting, Madrid, Spain
N. López
University of Madrid, Spain
- 6BV.5.31 Experimental Analysis of a Photovoltaic DHW Heat Pump**
F.J. Aguilar Valero & P.G.V. Quiles
University Miguel Hernández, Elche, Spain
- 6BV.5.32 Charging Efficacy of an Off-Grid Solar EV Carport in Airport Long-Stay Carparks**
E. Heath, R. Ghotge & A.J.M. van Wijk
Technical University of Delft, Netherlands
- 6BV.5.33 Load Profile Simulation Device for Solar PV Power Systems**
O.K. Overen & E.L. Meyer
University of Fort Hare, Alice, South Africa
- 6BV.5.34 A Free Online Tool for the Simulation of Collective Self-Consumption in Belgium**
J. Leloux & J. Robledo
LuciSun, Sart-Dames-Avelines, Belgium
Z. Zhao & P. Hendrick
Free University of Brussels, Belgium

- 6BV.5.35 Optimization of Continuous Power Supply: Experimental Models of BIPV Systems with Hydrogen Storage**
G. Mantescu, N. Olariu & D. Let
Valahia University of Targoviste, Romania
V.T. Petcu
Millenia Advisory, Bucharest, Romania
H.M. Schuster
Arena Innovation, Stuttgart, Germany



Wednesday, 09 September 2020

VISUAL PRESENTATIONS 2CV.1

08:30 – 10:00 **Characterisation & Simulation of Si Cells / Fabrication and Production of c-Si Silicon Solar Cells and Related Processes**

Chairpersons:

Francesca Ferrazza
Eni, Italy

Peter Wohlfart
SINGULUS, Germany

- 2CV.1.1 Fitting Current-Voltage Curves of Solar Cells with Artificial Neural Networks**
A. Herguth
University of Konstanz, Germany
- 2CV.1.2 Long-Term Stability of HJT Solar Cells under Illumination and UV Exposure**
T. Luka, K. Sporleder, D. Hevisov, S. Eiternick & M. Turek
Fraunhofer CSP, Halle (Saale), Germany
J. Bauer
University of Leipzig, Germany
- 2CV.1.3 Temperature-Dependent Suns-Voc and Suns-iVoc for Advanced c-Si-Based Solar Cell Characterization**
J.P. Seif, A.H.T. Le, M.F. Zhang & Z. Hameiri
UNSW Australia, Sydney, Australia
T.G. Allen
KAUST, Thuwal, Saudi Arabia
R. Basnet
ANU, Canberra, Australia
- 2CV.1.4 Accurate Performance Measurement of c-Si Solar Cells Adopting Advanced Metallization Technologies**
S.K. Ahn, K. Kim, J.H. Yun, A. Cho, Y.J. Eo, J.S. Cho, S.J. Ahn, J.H. Park, J.S. Yoo, D. Shin, I. Jung, S. Lee, S. Song, A. Lee & J. Gwak
KIER, Daejeon, Republic of Korea
- 2CV.1.5 High Efficiency Crystalline Silicon Solar Cell Assessment for Tandem Architecture**
S. Pouliquen
Air Liquide, Palaiseau, France
S. Jutteau
EDF, Palaiseau, France
E. Drahi
TOTAL, Palaiseau, France
- 2CV.1.6 Spectral Multi-Scale Characterization to Assess the Impact of Metallization Bleeding**
S. Großer, S. Eiternick, S. Richter & M. Turek
Fraunhofer CSP, Halle (Saale), Germany

- 2CV.1.7 Rapid Assessment of Optical Properties of Solar Cell Surfaces Using LED Solar-Simulators**
K. Sporleder, D. Hevisov & M. Turek
Fraunhofer CSP, Halle (Saale), Germany
- 2CV.1.8 Simulation of Doping Profile Trade-Off in Thin Emitter Architectures**
B. Arunachalam, Q. Rafhay & A. Kaminski-Cachopo
IMEP-LAHC, Grenoble, France
A. Veau, T. Desrues & S. Dubois
CEA, Le Bourget-du-Lac, France
- 2CV.1.9 EL and LBIC Characterization of Cut Edge Recombination in IBC Solar Cells**
M. Bokalic, M. Kikelj, K. Brecl, M. Jankovec & M. Topic
University of Ljubljana, Slovenia
F. Buchholz & V.D. Mihailetchi
ISC Konstanz, Germany
- 2CV.1.10 New Device for Accurate Measurement of Busbarless Bifacial Solar Cells by Using N.I.C.E.™ Technology**
D. Reinwand, P. Wiechers & D. Kray
Offenburg University of Applied Sciences, Germany
- 2CV.1.11 Comparing Microwave Detected Photoconductance, Quasi Steady State Photoconductance and Photoluminescence Imaging for Iron Analysis in Silicon Wafers**
M. Pengerla, V. Kuruganti, J. Haunschild & S. Rein
Fraunhofer ISE, Freiburg, Germany
N. Schüler & K. Dornich
Freiburg Instruments, Germany
- 2CV.1.12 6 Decades Research on Photovoltaic Technologies and Characterization in Republic of Serbia**
I. Batas Bjelic
Institute of Technical Sciences of SASA, Belgrade, Serbia
- 2CV.1.13 Measuring and Mitigating Edge Recombination in Modules Employing Laser Cut Cells**
D. Tune, F. Buchholz & A. Halm
ISC Konstanz, Germany
- 2CV.1.14 Influence of Injection Level and Wafer Resistivity on Series Resistance of Silicon Heterojunction Solar Cells**
L. Basset, W. Favre & O. Bonino
CEA, Le Bourget-du-Lac, France
J.-P. Vilcot
CNRS-IEMN, Villeneuve d'Ascq, France
- 2CV.1.16 Computational Optical Analysis of 3D Modeled Crystalline Silicon Substrates Randomly Textured**
D.M. Pera, J. Canhoto Cardoso, D. Vilhena, G. Gaspar, K. Lobato, I. Costa, J.M. Almeida Serra & J. Almeida Silva
University of Lisbon, Portugal
- 2CV.1.17 Study of the Doping and Voltage Dependence of the Series Resistance of a-Si:H/c-Si Heterojunction (SHJ) Solar Cells under Illumination**
M.Y. Ghannam & Y. Abdurraheem
Kuwait University, Safat, Kuwait
H.S.R. Sivaramakrishnan Radhakrishna & I. Gordon
imec, Leuven, Belgium



- 2CV.1.19 Assessment of Influencing Factors on Lifetime-Based Defect Analysis**
R. Post & W. Kwapil
University of Freiburg, Germany
T. Niewelt & M.C. Schubert
Fraunhofer ISE, Freiburg, Germany
- 2CV.1.20 A Simplified Double Diode Model for Modeling I-V Characteristic of Si Solar Cells**
J. Zhang, J. Wu, K. Ding & X. Chen
Hohai University, Changzhou, China
L. Feng & F.U. Hamelmann
University of Applied Sciences Bielefeld, Minden, Germany
- 2CV.1.22 Spectroscopic Investigation of BO-Related Light-Induced Degradation Defect in Czochralski Silicon**
A. Meyer, P.C. Taylor & S. Agarwal
Colorado School of Mines, Golden, USA
M. Page, D.L. Young & P. Stradins
NREL, Golden, USA
- 2CV.1.23 Revealing the Nano-Scale Structure and Properties of Pinholes in SiO_x Layers for POLO Contacts**
H. Guthrey, W. Nemeth, M. Page, D.L. Young, M.M. Al-Jassim & P. Stradins
NREL, Golden, USA
A. Kale, C. Lima Salles de Souza & S. Agarwal
Colorado School of Mines, Golden, USA
- 2CV.1.32 Investigation of Bifacial PERC Cells Based on Rear Side SiO_xN_y Passivation**
C.-W. Kuo, T.-M. Kuan, W.-L. Chueh, L.-G. Wu, S.-C. Lin & C.-Y. Yu
TSEC, Hsinchu, Taiwan
- 2CV.1.33 Innovative Process Control on Premium Technology Photovoltaic Cell and Module Manufacturing Line**
F. Rametta, C. Colletti, C. Gerardi & D. Iuvara
ENEL, Catania, Italy
F. Bizzarri
ENEL, Rome, Italy
V. Barth, D. Muñoz & W. Favre
CEA, Le Bourget-du-Lac, France
M. Izzi
ENEA, Rome, Italy
- 2CV.1.34 Improvement of mc-Si Wafers Quality for the Manufacture of Silicon Heterojunction Solar Cells**
R. Barrio Martin, N. González Peñalba, I. Torres, J. Cárabe & J.J. Gandía
CIEMAT, Madrid, Spain
- 2CV.1.37 The Influence of Pyramid Shapes on the Texturing Quality of Alkaline Etching Processes**
A. El Jaouhari, F. Schoerg & R.-C. Brachvogel
RENA, Berg, Germany
B. Bläsi
Fraunhofer ISE, Freiburg, Germany
H. Kühnlein
RENA, Freiburg im Breisgau, Germany
- 2CV.1.38 Ultrasonic-Assisted Chemical Etching (USACE) of Monocrystalline Silicon Wafer with HF-HCl-CI₂ Mixtures**
A. Stapf, B. Neubert, K. Halbfaß & E. Kroke
Freiburg University of Technology, Germany

- 2CV.1.39 Advanced Light-Trapping Structures for Back-Contact Solar Cells Produced by Metal-Assisted Chemical Etching**
D.M. Pera, A. Frota, I. Costa, D. Vilhena, J. Canhoto Cardoso, G. Gaspar, K. Lobato, J.M. Almeida Serra & J. Almeida Silva
University of Lisbon, Portugal
- 2CV.1.40 Macroscopic Numerical Simulation of the Ozone-Based Wet Chemical Emitter Etch Back for Alkaline Textured Si-Wafers**
T. Dannenberg, L. Mohr & M. Zimmer
Fraunhofer ISE, Freiburg, Germany
- 2CV.1.42 Emitter Formation on n-Type Crystalline Silicon Rear Side Using Aluminum Firing and Etching**
M. Zolfaghari Borra, E. Semiz, O. Aydin, H. Nasser, I. Pavlov, F. Es & R. Turan
METU, Ankara, Turkey
- 2CV.1.43 BBr₃ Diffusion: Process Optimization for High-Quality Emitters with Industrial Cycle Times**
E. Lohmüller, M. Glatz, S. Lohmüller, U. Belledin, S. Mack, T. Fellmeth & A. Wolf
Fraunhofer ISE, Freiburg, Germany
R.C.G. Naber
Tempress, Vaassen, Netherlands
- 2CV.1.44 High Throughput Low Energy Industrial Emitter Diffusion and Oxidation**
M. Meßmer, S. Nold, J. Weber, S. Lohmüller, J. Horzel & A. Wolf
Fraunhofer ISE, Freiburg, Germany
A. Piechulla
centrotherm international, Blaubeuren, Germany
- 2CV.1.45 POC13-Based Emitter Diffusion Process with Lower Recombination Current Density and Homogeneous Sheet Resistance for Nanotextured Monocrystalline Silicon with Atmospheric Pressure Dry Etching**
N.W. Khan, A.I. Ridoy, B. Kafle, M. Klitzke, S. Schmidt, A. Wolf, M. Hofmann & J. Rentsch
Fraunhofer ISE, Freiburg, Germany
L. Clochard
Nines Photovoltaics, Dublin, Ireland
- 2CV.1.46 The Effect of Different Laser Wavelength on Bifacial Plated Laser Doped Selective Emitter Solar Cells**
Y.-C. Chang, S. Wang, R. Deng, J. Ji & C.M. Chong
UNSW Australia, Sydney, Australia
S. Li
Kunming University of Science and Technology, China
- 2CV.1.47 Self-Aligned Selective Emitter for PERC Based on Inkjettable UV-Polymer**
R. Éfinger, B. Kafle, K. Demel, T. Ellahi, M. Jahn, M. Meßmer, J. Horzel, M. Zimmer, S. Kluska, S. Lohmüller, E. Lohmüller & R. Keding
Fraunhofer ISE, Freiburg, Germany
W. Shepherd & M. Pickrell
SunChemical, Midsomer Norton, United Kingdom
J. Hermans
Meyer Burger, Eindhoven, Netherlands
- 2CV.1.48 Above 700 mV Implied Open Circuit Voltages from Thin ALD Al₂O₃ Films Capped by PECVD SiN_x on p Type Cz-Si Wafers for PERC Solar Cells**



G. Kökbudak, H. Nasser, A.E. Keçeci & R. Turan
GÜNAM, Ankara, Turkey
M. Zolfaghari Borra
METU, Ankara, Turkey

2CV.1.49 Field Effect Passivation of Plasma Oxidized SiO_x Layer Using SiH₄/N₂ on Boron Doped Emitter Surface by PECVD

M.Q. Khokhar, D. Oh, D.P. Pham, S. Lee, Y. Kim, E.-C. Cho & J. Yi
University of Sungkyunkwan, Suwon, Republic of Korea

2CV.1.50 Newly Developed High-Throughput PECVD Source and Platform for Industrial Production of PERC and TOPCon Silicon Solar Cells

M. Dörr, F. May, T. Dippell & P. Wohlfart
Singulus Technologies, Kahl am Main, Germany

2CV.1.51 Laser Assisted Separation Processes for Bifacial pSPEER Shingle Solar Cells

A. Münzer, P. Baliozian, K. Ahmed, A. Nair, E. Lohmüller, T. Fellmeth & R. Preu
Fraunhofer ISE, Freiburg, Germany

2CV.1.52 Interface Properties of Nickel Seed Layer Deposited by Electroless and Light-Induced Plating and Its Effect on Solar Cell Performance

D. Priyadarshani, A. Kottantharayil & M. Neergat
IIT Bombay, Mumbai, India

2CV.1.53 Project "Rock-Star" – High-Speed Rotary Printing for Solar Cell Metallization: From Vision to Reality

A. Lorenz, K. Zengerle, M. Linse, S. Tepner, F. Clement & R. Preu
Fraunhofer ISE, Freiburg, Germany

J. Röth
ASYS Automationssysteme, Dornstadt, Germany
N. Wirth, R. Greutmann, S. Gombert & H. Brocker
Gallus Ferd. Rüesch, St. Gallen, Switzerland
M. Lehner

Lehner Engineering, Engelburg, Switzerland
A. Senne & D. Reukauf

ContiTech, Northeim, Germany

A. Mette
Hanwha Q CELLS, Bitterfeld-Wolfen, Germany

F. Hage & M. Drews
ASYS, Dornstadt, Germany

J. Rohde
Zecher, Paderborn, Germany

E. Dörsam
Technical University of Darmstadt, Germany

2CV.1.55 Lifetime Analysis of Bifacial-Ready Contacting of Busbarless and Multibusbar Solar Cells for Industrial Mass Production

P. Waleska, K. Ramspeck & M. Meixner
h.a.l.m. elektronik, Frankfurt am Main, Germany

2CV.1.56 Evaluation of Inline High Intensity Illumination Treatments Against LeTID

H. Vahlman, S. Roder, J.-F. Nekarda & S. Rein
Fraunhofer ISE, Freiburg, Germany

K. Krauß
Rehm Thermal Systems, Blaubeuren, Germany

2CV.1.57 Upgrade Technologies for Silicon Photovoltaics – Part I: Industrial Solution to Minimize the Negative Impact of Light Induced Degradation

T. Pernau
centrotherm international, Blaubeuren, Germany
C. Derricks, G. Hahn & A. Herguth
University of Konstanz, Germany
L. Helmich, J. Schmidt & D. Walter
ISFH, Emmerthal, Germany

2CV.1.58 Investigation of the Accelerated Degradation and Regeneration Testing for p-Type PERC Cells

M.-A. Tsai, Y.-C. Lee, C.-W. Kuo, T.-M. Kuan, H.-H. Hsieh, C.-Y. Yu & T.-C. Wu
ITRI, Hsinchu, Taiwan

2CV.1.59 The International Technology Roadmap for Photovoltaics and the Significance of Its Decade-Long Projections

P. Baliozian, S. Tepner, K. Gensowski, F. Clement, S. Nold & R. Preu
Fraunhofer ISE, Freiburg, Germany

M. Fischer
Hanwha Q CELLS, Bitterfeld-Wolfen, Germany

J. Trube & S. Herritsch
VDMA, Frankfurt am Main, Germany

2CV.1.60 Efficient Deployment of Deep Neural Networks for Quality Inspection of Solar Cells Using Smart Labeling

P. Kunze, J. Greulich & M. Demant
Fraunhofer ISE, Freiburg, Germany

K. Ramspeck
h.a.l.m. elektronik, Frankfurt am Main, Germany

M. Hemsendorf & A. Vetter
GP Inspect, Neuried, Germany

2CV.1.61 Screen Utility Simulation - Explaining the Evolution and Future of Screen Printed Metallization of Si-Solar Cells

S. Tepner, L. Ney, M. Singler, M. Linse, A. Lorenz, M. Pospischil, F. Clement & R. Preu

Fraunhofer ISE, Freiburg, Germany

2CV.1.62 Effect of X-Y Translation Table Speeds to the Optical Absorption of Silicon Solar cells Textured by Pulsed Nd:YAG Laser

N.H. Abdul Razak, K. Sopian, N. Amin & M. Akhtaruzzaman
National University of Malaysia, Bangi, Malaysia

VISUAL PRESENTATIONS 6CV.2

13:30 – 15:00 Integration of Photovoltaic in Buildings, Vehicle, Infrastructure and Landscape

Chairpersons:

Alessandra Scognamiglio
ENEA, Italy

Francesco Frontini
SUPSI, Switzerland



- 6CV.2.1 OPV-Façades – Student Design Concepts of Multi-Functional Solar Façades**
R. Krippner, G. Becker & F. Flade
SeV Bavaria, Munich, Germany
- 6CV.2.2 PV Energy Yield Measurements of Electric Vehicles and Electric Vehicle Charging Station**
U. Muntwyler, D. Zurflüh & E. Schüpbach
BUAS, Burgdorf, Switzerland
- 6CV.2.3 Wind and Wave Effect on Floating Solar Panel**
S.-T. Hsu
ITRI, Hsinchu, Taiwan
K.-C. Su
National Cheng Kung University, Tainan, Taiwan
- 6CV.2.4 Architectural Design Optimization Study of Color BIPV Module Applying the BIM Design Environment**
H. Jeon & K. Choi
BIMS, Seoul, Republic of Korea
S. Lee & K.-J. Kim
KCL, Incheon, Republic of Korea
- 6CV.2.5 System Design and Economic Configuration of Building Integrated Photovoltaic**
Z. Ni, J. Jiang, X. Cai, L. Hu, G. Shi, H. Cao, W. Lu & Z. Wu
Talesun Solar, Suzhou, China
- 6CV.2.6 Yield Calculations of a PV System Integrated in Cruise Ships: A Case Study in the Waters of the Caribbean**
P. Schwager, K. Gehrke & M. Vehse
DLR, Oldenburg, Germany
- 6CV.2.7 Summary of PV Systems Implemented within SMARTER TOGETHER, an EU-Funded Smart City Project**
B. Gaidon
HESPUL, Lyon, France
F. Gonçalves
Energy Cities, Brussels, Belgium
V. Cerna
GOPA Com, Brussels, Belgium
M. Valentin & E. Vignali
SPL Lyon-Confluence, France
V. Stoppel & B. Klassen
City of Munich, Germany
N. Morishita-Steffen
MGS Munich, Germany
S. Hartmann & L. Schneider
City of Vienna, Austria
- 6CV.2.8 Architectural Criteria for PV Integration in Heritage Landscape**
L. Sandoval Huth
ISCTE, Lisbon, Portugal
- 6CV.2.9 Long-Term Reliability of PV-Modules in Alpine Environment**
G.C. Eder & Y. Voronko
OFI, Vienna, Austria
W. Mühleisen
SAL Silicon Austria Labs, Villach, Austria
K. Knöbl
UAS Technikum Wien, Vienna, Austria

- P. Kefer
FH OOE, Wels, Austria
C. Panhuber
Energie AG OÖ Power Solutions, Linz, Austria
- 6CV.2.10 Cleanvelope – Students Concepts of Refurbishment with Solar Energy and Building Greening**
R. Krippner
Nuremberg Tech, Germany
F. Flade
Bavarian Association for the Promotion of Solar Energy, Munich, Germany
- 6CV.2.11 Weather Data Influence on a Photovoltaic Driven Heat Pump System for Net-Zero Energy Multi-Family Buildings**
J. Schmidli, D. Carbonell, M. Haller & C. Biba
University of Applied Sciences Rapperswil, Switzerland
- 6CV.2.12 Integration of Solar Energy Systems for Increased Societal Support**
S. Lavrijssen
Tilburg University, Netherlands
W. Folkerts
TNO, Eindhoven, Netherlands
B. Van Mierlo & S. Stremke
University of Wageningen, Netherlands
L. Franco-Garcia & A.H.M.E. Reinders
University of Twente, Enschede, Netherlands
R. Loonen
Eindhoven University of Technology, Netherlands
H. Cornelissen
VU University Amsterdam, Netherlands
W.G.J.H.M. van Sark
Utrecht University, Netherlands
E. Alarcon-Llado & A. Polman
AMOLF, Amsterdam, Netherlands
A.W. Weeber
Delft University of Technology, Petten, Netherlands
- 6CV.2.13 Novel BIPV Products with Innovative Glass Coatings - New Degrees of Freedom in BIPV Design**
R. Trattnig
Joanneum Research, Weiz, Austria
Y. Voronko & G.C. Eder
OFI, Vienna, Austria
G. Cattaneo
CSEM, Neuchâtel, Switzerland
A. Kornherr
ERTEX Solar, Amstetten, Austria
T. Buchsteiner
FDT, Schladming, Austria
F. Jamschek
ehoch2 energy engineering, Mötz, Austria
- 6CV.2.14 Integration of Solar Modules in Double Glazing Elements**
N. Neugebohrn, N. Osterthun, K. Gehrke & M. Vehse
DLR, Oldenburg, Germany
- 6CV.2.15 Cooling of PV Modules in Floating PV Power Plants**
E.S. Marstein, D. Mortensen, D. Lindholm, H. Fjær & J.H. Selj
Institute for Energy Technology, Kjeller, Norway



- 6CV.2.16 Outdoor Testing Facility for an Experimental Validation of Yield Predictions for Building-Integrated Photovoltaic Modules**
T. Gewohn, M. Koopmeiners, M.R. Vogt, B. Lim & R. Brendel
ISFH, Emmerthal, Germany
C. Schinke
Leibniz University Hannover, Germany
- 6CV.2.17 Evaluations on Energy Performance of BIPV Systems**
C.D. Zomer, I.P. Custódio & R. Rütther
UFSC, Florianópolis, Brazil
- 6CV.2.19 Organic Photovoltaic Modules Installation: Italy and Algeria Case Studies**
C. Busto, G. Corso, G. Gorni, R. Po, A. Terenzi, I. Trattenero & F. Ferrazza
eni, Novara, Italy
M. Asses, C. Derennes, D. Hau, G. Pic & V. Vannieuwenhuys
ARMOR, Nantes, France
S. Leva & A. Dolara
Polytechnic University of Milan, Italy
- 6CV.2.20 How High Albedo Improves Vertical Bifacial PV Performance: Simulations and Measurements on a Solar Noise Barrier**
S. Villa, M.M. de Jong, J.C.P. Kester, A.R. Burgers & W. Folkerts
TNO Energy Transition, Eindhoven, Netherlands
- 6CV.2.21 Evaluation of the Solar Resource and Energy Generation in Vehicle Integrated Photovoltaics**
J. Macías Rodríguez, R. Herrero, R. Núñez & I. Antón Hernández
UPM, Madrid, Spain
- 6CV.2.22 Fire Performance Assessment of BIPV Facades Equipped with Active Rapid Shutdown**
F. Parolini, P. Bonomo, F. Frontini, M. Caccivio & G. Bellenda
SUPSI, Canobbio, Switzerland
G. Manzini
RSE, Milan, Italy
G. Traina
Giordano Institute, Gatteo, Italy
P. Cancelliere
Italian National Fire Services, Rome, Italy
- 6CV.2.23 Impact of Configurations on the Performance Prediction of Building Integrated Photovoltaic Modules**
Y.B. Assoa
CEA, Le Bourget-du-Lac, France
- 6CV.2.24 Monitoring Solar Highways: Performance and Lessons Learned from Operating a Bifacial Solar Noise Barrier**
M.M. de Jong & S. Villa
TNO Energy Transition, Eindhoven, Netherlands
J.C.P. Kester
TNO Energy Transition, Petten, Netherlands
J. van der Heijden
Ministry of Infrastructure and Water Management, 's Hertogenbosch, Netherlands
S. Verkuilen
Heijmans Wegen, Rosmalen, Netherlands
W. Folkerts
's Hertogenbosch, Eindhoven, Netherlands

- 6CV.2.25 Potential of Wind and Solar Energy Available in an Aerial Basin: Taking Advantage of the Integration of Dams Hydrosystems**
F.M. Valadao, V.O. da Silva, S.G. Relva, R. De Paula, A.L. Linhares, M. Galvao, A. Abubakar, A.L.V. Gimenes, M.E.M. Udaeta & L.C.R. Galvao
University of São Paulo, Brazil
- 6CV.2.26 Bio-Inspired Design of a Dynamic Solar Photovoltaic Envelope with Evolving Functionalities**
J. Ratovonkery, Y.B. Assoa & C. Ménézo
CEA-LITEN, Le Bourget-du-Lac, France
- 6CV.2.28 Energy and Exergetic Analysis of a Photovoltaic-Thermal System Using a Dynamic Bidimensional Model for High Radiation and High Geographical Altitude Conditions**
A.A. Taquichiri Ayaviri, M. Mendoza, M. Lague, E. Peñaranda & J. Velazco
Technical University of Oruro, Bolivia
M. Cortes, C. Portillo, M. Henriquez & A. Mallco
University of Antofagasta, Chile
- 6CV.2.31 Towards Net-Zero Public Buildings through BIPV: a Case Study in Castilla-León (Spain)**
D. Granados-López, M.I. Dieste-Velasco, A. García-Rodríguez, D. Gonzalez-Peña & C. Alonso-Tristán
UBU, Burgos, Spain
- 6CV.2.33 The Impact of Building Shape and Density on Active Solar Energy Potential**
S. Bensehla & Y. Lazri
University Guelma, Algeria
- 6CV.2.34 Koepfen-Geiger Climate Classification Not a Determinant for the Siting of Offshore Floating Photovoltaics**
A. Ayyad, S.Z. Mirbagheri Golroodbari & W.G.J.H.M. van Sark
Utrecht University, Netherlands
- 6CV.2.35 Outdoor Performance and Future Potential of Infra Integrated PV**
E.M.B. Heller
Amsterdam University of Applied Science, Netherlands
K.E. Sewalt
TNO, Delft, Netherlands
- 6CV.2.36 Re-Uniting Photosynthesis and Photovoltaics: Design for Architectural Greenhouses**
A. Scognamiglio, L.V. Mercaldo, M. Della Noce, M. Ferrara & P. Delli Veneri
ENEA, Portici, Italy
C.A. Toledo Arias
UPCT, Cartagena, Spain
F. Carteni, F. Giannino, M. Zotti & S. Mazzoleni
University of Naples, Portici, Italy
N. Salvatori
University of Udine, Italy
- 6CV.2.37 Community Energy Production at Airports - Taking Relationship to the Next Level?**
F. Kis
Budapest Airport, Hungary
I. Mudra
, Budapest, Hungary
- 6CV.2.39 PV in Mobility: Various Solutions for On-Board PV and PV Charging Stations for EVs**



D. Dijken & A. van der Ham
 Lightyear, Helmond, Netherlands
 R.H.H.S. Derks
 IM Efficiency, Heerlen, Netherlands
 P. Cats
 TRENS, Arnhem, Netherlands
 A.J. Carr & B.K. Newman
 TNO Energy Transition, Petten, Netherlands
 C. Gerçek, A. Sierra Rodriguez & A.H.M.E. Reinders
 University of Twente, Enschede, Netherlands

6CV.2.41 Land Use Efficiency and Land Occupation of Utility-Scale Photovoltaic Power Plants in Continental Portugal
 J. Tavora, M.J. Cortinhal & M. Meireles
 ISCTE, Lisbon, Portugal

6CV.2.42 Shiwa Off-Shore Floating PV Pilot Test South Korea 2014 ~2019
 W. Lawrence (Ph.D.), C.-S. Won & M. Gang
 SCOTRA, Seoul, Republic of Korea
 H.-J. Kim, Y. Cho & H. Jo
 K-Water Research Institute, Yuseong-gu, Republic of Korea
 H.-K. Ahn & B.G. Bhang
 Konkuk University, Seoul, Republic of Korea
 S. Shin
 Rural Research Institute, Gyeonggi-do, Republic of Korea

6CV.2.45 Power Generation Performance Analysis of High-Efficiency CIGS BIPV Modules - Based on Actual and Measurement Data Analysis
 R. Lee
 Hanbat National University, Daejeon, Republic of Korea
 J. Yoon, H. Kim & H. Lee
 Hanbat National University, Daejeon, Republic of Korea

6CV.2.46 A Comparison of the Different Solar Cell Technologies for Integrated Photovoltaics
 M. Heinrich, T.E. Kuhn, F. Dimroth, U. Würfel, H. Neuhaus & S.W. Glunz
 Fraunhofer ISE, Freiburg, Germany
 M. Powalla
 ZSW, Stuttgart, Germany

6CV.2.47 A Standardized Classification of Agrivoltaic Systems
 B. Willockx, B. Uytterhaegen, B. Ronsijn & J. Cappelle
 KU Leuven, Gent, Belgium

VISUAL PRESENTATIONS 5CV.3

15:15 – 16:45 Operation, Performance and Maintenance of PV Systems

Chairpersons:

João M. Almeida Serra
 University of Lisbon, Portugal

Gerhard Mütter
 ALTESO, Austria

5CV.3.1 Outdoor Performance Modeling of a Vertically Arranged Bifacial PV Module in Ben Guerir, Morocco
 A. Benazzouz, Z. Naimi, B. Ikken, A. Ghennioui, A. Bouaichi & H. Zitouni
 IRESEN, Rabat, Morocco
 A.A. Lamrini & R. Ouladsine
 International University of Rabat, Morocco

5CV.3.2 25-kW Grid-Tie Solar Photovoltaic (PV) System for the Engineering S-Building at Vaal University of Technology in Vanderbijlpark, South Africa
 J. Bekker & M. Viljoen
 Vaal University of Technology, Vanderbijlpark, South Africa

5CV.3.3 Concept of Graphene Enhanced Solar Cell and Performance Prediction
 C.-W. Wu, R.-T. Chang & C.-G. Huang
 CAS, Beijing, China

5CV.3.4 Experimental Study of the Behaviour of the Global MPP of Partially Shaded PV Strings
 K. Lappalainen & S. Valkealahti
 Tampere University, Finland

5CV.3.5 Fitting Procedure for PV Panel Measured Current-Voltage Curves
 H. Kalliojärvi-Viljakainen, K. Lappalainen & S. Valkealahti
 Tampere University, Finland

5CV.3.6 Soiling, New Portable Measurement Tool and Characterization Method, to Get Easy and Quick Field Diagnostic
 E. Pilat
 CEA / INES, Le Bourget-du-Lac, France
 M. Amhal
 CEA, Le Bourget-du-Lac, France

5CV.3.7 Novel Model to Estimate Transmittance Soiling Losses Using DUSST, an Innovative Soiling Sensor
 A. Fernández Solas, L. Micheli, F. Almonacid-Cruz & E.F. Fernández
 University of Jaén, Spain
 J. Morse & M. Muller
 NREL, Golden, USA

5CV.3.9 PV-Module's Backsheet Compositions Affecting PV-System's Yield and Degradation
 C. Buerhop-Lutz, T. Pickel, T. Winkler, O. Stroyuk & J. Hauch
 HI ERN, Erlangen, Germany
 C. Camus
 LayTec, Berlin, Germany
 M. Neswal
 ZAE Bayern, Erlangen, Germany
 M. Heindl
 SKZ-Testing, Würzburg, Germany

5CV.3.11 Real Time Availability Calculation for a PV Plant Portfolio
 N. Lebert
 HESPUL, Lyon, France
 S. Fraisse
 Epices Energie, Lyon, France



- 5CV.3.12 PV Infrastructure 1993+ and New Test Facilities for Education and Research**
U. Muntwyler, D. Zurflüh & E. Schüpbach
BUAS, Burgdorf, Switzerland
- 5CV.3.13 PV-AIDED: Photovoltaic Artificial Intelligence Defect Identification (PEARL TF-PV Project)**
E. Sovetkin & B.E. Pieters
Forschungszentrum Jülich, Germany
T. Weber
PI Berlin, Germany
E.J. Achterberg
Solar Tester, Schinnen, Netherlands
A. Weeber
Delft University of Technology, Netherlands
B. Rau
HZB, Berlin, Germany
M. Rennhofer
AIT, Vienna, Austria
M. Theelen
TNO, Eindhoven, Netherlands
- 5CV.3.14 The Adoption of IT Technologies, with a Focus on AI and Digital Twins, for PV Performance Optimization**
G. Mütter, M. Volgo & C. Schön
ALTESO, Vienna, Austria
- 5CV.3.15 PV String Fault Detection by Using the Clustering of Module Operating Points for Large-Scale PV Power Plant**
K. Tanina & Y. Ueda
Tokyo University of Science, Japan
- 5CV.3.16 Can Robotics in PV Plant Maintenance Develop Quickly Enough for the Set Roadmap?**
F. Popescu
Fraunhofer FOKUS, Berlin, Germany
S. Wendlandt
PI Berlin, Germany
- 5CV.3.18 Statistical Evaluation Approaches of PV Plants for O&M**
V. Dimitrievska, W. Mühleisen, F. Pittino & C. Hirschl
SAL Silicon Austria Labs, Villach, Austria
N. Diewald
Fronius, Wels, Austria
M. Makula
ENcome Energy Performance, Klagenfurt, Austria
- 5CV.3.19 Quantitative Assessment of the Power Loss of Silicon PV Modules by IR Thermography and Its Practical Application in the Field**
J. Denz, C. Buerhop-Lutz, T. Pickel, J. Hauch & C.J. Brabec
HI ERN, Erlangen, Germany
C. Camus
LayTec, Berlin, Germany
- 5CV.3.21 Integrated Concept for PV Plant Monitoring and Model Based Analytics**
C. Gradwohl, B. Böckl & T. Kienberger
University of Leoben, Austria
M. Graefe & F. Langmayr
Uptime Engineering, Graz, Austria
W. Mühleisen
SAL Silicon Austria Labs, Villach, Austria

- 5CV.3.22 Accuracy Analysis of Photovoltaic Simulation Softwares with Real Data**
M.Y. Kinali
Mevlana Development Agency, Konya, Turkey
- 5CV.3.23 Outdoor Fault Diagnosis of Field-Aged Solar Modules**
O.K. Segbefia, A.G. Imenes & T.O. Saetre
University of Agder, Grimstad, Norway
- 5CV.3.24 CIGS Photovoltaic Power Plants: Performance Analysis**
S. Sarikh, M. Raoufi & A. Bennouna
Cadi Ayyad University, Marrakech, Morocco
O. El Alani, H. Zitouni & A. Bouaichi
IRESEN, Rabat, Morocco
- 5CV.3.25 Outdoor IV Diagnosis of Photovoltaic Power Plants: Field Feedback**
M. Amhal, A. Plissonnier, A. Revel, S. Lespinats & H. Colin
CEA, Le Bourget-du-Lac, France
- 5CV.3.26 The Need for an Accuracy Check of Irradiation Sensors for Photovoltaic Power Plants**
W. Mühleisen, L. Neumaier & C. Hirschl
SAL Silicon Austria Labs, Villach, Austria
M. Makula & B. Streit
ENcome Energy Performance, Klagenfurt, Austria
M. Graefe & C. Gradwohl
Uptime Engineering, Graz, Austria
- 5CV.3.27 Performance Boost of Bifacial Silicon Heterojunction Modules: Verification Based on Field Data and Radiative Simulation**
A. Tuomiranta, J. Levrat, A. Faes, M. Despeisse & P.-J. Alet
CSEM, Neuchâtel, Switzerland
J. Cattin, M. Boccard & C. Ballif
EPFL, Neuchâtel, Switzerland
H. Colin, V. Barth & D. Muñoz
CEA, Le Bourget-du-Lac, France
F. Rametta
3SUN, Catania, Italy
O. Dupré
EPFL, Neuchâtel, France
A. Richter
Meyer Burger Technology, Gwatt (Thun), Switzerland
C. Colletti
ENEL Green Power, Catania, Italy
M. Izzì
ENEA, Rome, Italy
H. Ghedira
Khalifa University, Abu Dhabi, United Arab Emirates
- 5CV.3.28 Assessment of Photovoltaic Power Plants Using Fixed, Single Axis and Two Axis Tracking Systems**
P.H. Veríssimo & R. Rüther
UFSC, Florianópolis, Brazil
- 5CV.3.29 I-V Curve Measurement and Failure Analysis for Silicone Photovoltaic Power Plants**
S. Sarikh, M. Raoufi & A. Bennouna
Cadi Ayyad University, Marrakech, Morocco
H. Zitouni, O. El Alani, A. Bouaichi, A. Benlarabi & B. Ikken
IRESEN, Rabat, Morocco



- 5CV.3.30 Incidence Angle and Diffuse Radiation Adaptation of Soiling Measurements**
F. Wolfertstetter & S. Wilbert
German Aerospace Center, Tabernas, Spain
A. Esquelli
Berlin University of Technology, Germany
N. Hanrieder
German Aerospace Center, Almeria, Spain
L.F. Zarzalejo
CIEMAT, Madrid, Spain
M. Korevaar, T. Bergmans & J. Mes
Kipp & Zonen, Delft, Netherlands
- 5CV.3.31 The Dependence of LCOE on Solar Modules and Environmental Parameters**
L. Xu, T.G. Allen & S. De Wolf
KAUST, Thuwal, Saudi Arabia
- 5CV.3.32 Data Driven Risk Analysis and Decision Making in PV Investments – Quantification of Technical Risks**
U. Jahn & M. Herz
TUV Rheinland Energy, Cologne, Germany
D. Moser & S. Lindig
Eurac Research, Bolzano, Italy
M. Richter
3E, Brussels, Belgium
K.A. Berger
AIT, Vienna, Austria
J. Vedde
SiCon, Birkerød, Denmark
M. Köntges
ISFH, Emmerthal, Germany
- 5CV.3.33 Identifying Snow Events in PV System Data**
M.B. Øgaard, A. Skomedal, H.N. Riise & J.H. Selj
Institute for Energy Technology, Kjeller, Norway
B.L. Aarseth
University of Oslo, Kjeller, Norway
- 5CV.3.34 Machine Learning Based PV Online Fault Detection for Soiling and Shading**
H.-F. Huang & C. Huang
Thingnario, Taipei, Taiwan
W.H. Hsu
NTU, Taipei, Taiwan
- 5CV.3.35 A Machine Learning-Based Anomaly Detection System for Solar Inverters**
P. Mercade Ruiz & G. Guerra
Greenpowermonitor, Barcelona, Spain
L. Landberg
DNV GL, Hellerup, Denmark
- 5CV.3.36 PV-System Degradation Rates in the Nordics**
E.B. Sveen, M.B. Øgaard, J.H. Selj & G. Otnes
Institute for Energy Technology, Kjeller, Norway
A.G. Imenes
University of Agder, Kristiansand, Norway
- 5CV.3.37 Climate Related Dependence of Performance Losses of over 3,500 PV Systems**

- S. Lindig & D. Moser
Eurac Research, Bolzano, Italy
J. Leloux
UPM, Madrid, Spain
J. Ascencio-Vásquez & M. Topic
University of Ljubljana, Slovenia
- 5CV.3.38 Cleaning the PV Panels, the First Laboratory Test Equipment for Assessing the Best Solutions**
E. Pilat, A. Roisin, J. Deville, V. Viallet & J. Aime
CEA, Le Bourget-du-Lac, France
J. Magalhaes
LYSI, La Ravoire, France
- 5CV.3.40 Soiling Rate Prediction from Meteorological Parameters Using an ANN Developed Model**
H. El Gallassi & A. Ghennioui
Green Energy Park, Benguerir, Morocco
A. Alami Merrouni & M. Chourak
University Mohammed I, Oujda, Morocco
- 5CV.3.41 Correlation of the Soiling Ratio and the Deposited Dust Density on Different Photovoltaic Technologies in Benguerir Morocco**
H. Zitouni, A. Bouaichi, C. Hajjaj, A. Benazzouz, S. Sarikh, A. Ghennioui, Z. Naimi & B. Ikken
IRESEN, Rabat, Morocco
M. Regragui
University Mohammed V-Agdal, Rabat, Morocco
- 5CV.3.44 Computer Vision Method for Extracting an Induced Electroluminescence Signal from Photovoltaic Modules in Daylight Conditions Using Drone-Captured Images**
T.K. Hass, S.V. Spataru, G.A. dos Reis Benatto, A.A. Santamaria Lancia & P.B. Poulsen
Technical University of Denmark, Roskilde, Denmark
H.R. Parikh
Aalborg University, Denmark
- 5CV.3.46 Analysis of Brazilian Power Plants Common Faults**
A.K. Vidal de Oliveira, M. Braga, A. Medeiros Pires & R. Rütger
UFSC, Florianópolis, Brazil
M. Aghaei
University of Freiburg, Germany
- 5CV.3.47 Development of Predictive Maintenance Algorithms for Photovoltaic Systems Using Synthetic Database**
E.A. Sarquis Filho, F.C. Santos & P.J. Costa Branco
Technical University of Lisbon, Portugal
- 5CV.3.48 Impact of Amazonian Climate and Forest Fires on Photovoltaic Generation**
L. Lima, A. Gallina, C. Magalhães, L. Silva & T. Lima
CEEAC, Rio Branco, Brazil
V.O. da Silva & S.G. Relva
University of São Paulo, Brazil
- 5CV.3.49 Failure Rates in Photovoltaic Systems: A Careful Selection of Quantitative Data Available in the Literature**
E.A. Sarquis Filho, A. Zuniga & P.J. Costa Branco, J.F. Pereira Fernandes
Technical University of Lisbon, Portugal



- 5CV.3.50 Thermal Infrared Imaging of mc-Si PV Modules under Changing Soiling Conditions**
M. Vumbugwa, J.L. Crozier, E.E. van Dyk & F.J. Vorster
NMU, Port Elizabeth, South Africa
- 5CV.3.52 Fault Detection in PV Systems by Lazy Nowcasting of Expected Energy Production through Half-Sibling Regression and Fast Time Series Analysis**
G. Almondo
MedMod, Stockholm, Sweden
K. Nyman & D.-E. Archer
Checkwatt, Danderyd, Sweden
- 5CV.3.53 Determination of a PV Module Malfunction from Their Maximum Power Point or from Their Operation Voltage, Two Different Strategies**
J.C. Jimeno, E. Ortega, G. Aranguren, R. Gutierrez, E. Cereceda, A. Otaegi & V. Fano
UPV/EHU, Bilbao, Spain
O. Kunz
UNSW Australia, Sydney, Australia
- 5CV.3.54 Analysis of the Performance of the I-V Curve Correction Methods in the Presence of Defects**
B. Li, A. Migan-Dubois & D. Diallo
CNRS/GeePs, Gif-sur-Yvette, France
C. Delpha
CNRS/CentraleSupélec, Gif-sur-Yvette, France

VISUAL PRESENTATIONS 5CV.4

17:00 – 18:30 PV System Design and Modeling / Energy Storage / Concentrators and PV for Space Applications

Chairpersons:

Kari Lappalainen
Tampere, Finland

Ignacio Antón Hernández
UPM, Madrid

Francesco Dolci
European Commission JRC, The Netherlands

- 5CV.4.1 Student Awards Finalist Presentation: Techno-Economic Assessment of an Integrated PV System Using Innovative Sizing Tool for Educational Building (Case Study)**
M. Hammad, A. Obayda, N. Khaled, I.M. Mahmoud & T.S. Abdel-Salam
British University in Egypt, Elshrouk, Egypt
- 5CV.4.2 New Flexible Software for Study, Sizing and Energy Assess of Monofacial and Bifacial Technologies Which Takes into Account the Innovations of the PV Market of Large Scale Photovoltaic Plants Design**
M. Carbone, D. Guida, E. Giuliano & S. Latella
ENEL Green Power, Rome, Italy

- 5CV.4.3 Assessment of Rear Side Irradiation Mismatch for Tracked Versus Fixed-Tilt Bifacial Systems**
T. Müller & B. Song
ENGIE Laborelec, Santiago, Chile
S. Scheerlinck
ENGIE Laborelec, Linkebeek, Belgium
- 5CV.4.4 Economic Optimization of PV Systems with Storage**
H. Apaydin, A. Viloz, B. Wittmer & A. Mermoud
PVsyst, Satigny, Switzerland
- 5CV.4.6 Optimization of DC/AC Ratio in Different Climatic Zones: a Technical Analysis on a Sub-Hourly Level**
I. Meyer & J. Tellez Mejia
Mott MacDonald, Brighton, United Kingdom
A. Salles
Mott MacDonald, Paris, France
V. Vorasitchai & N. Cherdangan
Mott MacDonald, Bangkok, Thailand
- 5CV.4.8 Repercussions of Interannual Variability in Irradiance on Sizing PV for Autonomous Renewable Energy Systems**
H.G. Beyer
University of the Faroe Islands, Torshavn, Faroe Islands
- 5CV.4.9 The Construction of Test Fields for Photovoltaic Module Assessment**
H. Choi, J. Kim, C. Lim, S. Lee & C. Kim
Green Energy Institute, Mokpo, Republic of Korea
S. Oh & J. Jung
Yeungnam University, Daegu, Republic of Korea
- 5CV.4.10 Validation of the Solarfarmer Software with Operational Data**
A. Neubert
GL Maritime Software, Oldenburg, Germany
M. Mikofski
Garrad Hassan America, Oakland, USA
M. Hamer & P. Rainey
Garrad Hassan, Bristol, United Kingdom
- 5CV.4.11 Energy Yield Analysis of Bifacial Solar Arrays Considering Angular Reflection Losses**
P. Tillmann, C. Becker & K. Jäger
HZB, Berlin, Germany
- 5CV.4.14 Improved Solar Farm Performance via Design and Manipulation: Considering Momentum and Heat Transfer**
S.E. Smith, A. Glick, N. Ali, J. Bossuyt, J. McNeal, G. Recktenwald & R.B. Cal
Portland State University, USA
M. Calaf
University of Utah, Salt Lake City, USA
- 5CV.4.15 Design Considerations for Photovoltaic Systems Deployed in Snowy Climates**
L. Burnham & D.S. Riley
Sandia National Laboratories, Albuquerque, USA
J.M. Pearce
Michigan Technological University, Houghton, USA
E. Whitney & C. Pike
UAF, Fairbanks, USA



B. Walker
Evolve|RE, Winooski, USA

- 5CV.4.16 GPU-Based Simulation of the Bifacial Energy Gain for PV Plants: First Results**
J. Robledo & J. Leloux
LuciSun, Sart-Dames-Avelines, Belgium
C.A. Gueymard
Solar Consulting, Colebrook, USA
A. Driesse
PV Performance Labs, Freiburg, Germany
- 5CV.4.17 Studies on Optimizing the Orientation of Fixed-Tilt Bifacial Modules and Its Impact on Energy Generation**
P. Maheshwari, S. Patel, A. Mahajan & V. Chaudhari
PV Diagnostics, Mumbai, India
- 5CV.4.18 Comparison of Different Data Sources for Machine Learning Algorithms in Photovoltaic Output Power Estimation**
P. Graniero
Free University of Berlin, Germany
A. Louwen
Eurac Research, Bolzano, Italy
R. Schlatmann
HZB, Berlin, Germany
C. Ulbrich
PVcomB, Berlin, Germany
- 5CV.4.27 Techno-Economic Analysis of Battery Energy Storage System in Grid-Connected Photovoltaic (PV) System**
J.Z. Tee, Z.W. Tham, I. Lim & K. Zhou
University of Glasgow, Singapore, Singapore
O. Anaya-Lara
University of Strathclyde, Glasgow, United Kingdom
- 5CV.4.28 Analysis and Optimization of the Battery Operation in Photovoltaic Systems**
M. Andam, J. El Alami & Y. Louartassi
Mohammed V University, Salé, Morocco
- 5CV.4.29 Performance Evaluation of Hydrogen Storage and Fuel Cell in EMS for PV Powered Factory**
Y. Ogawa & Y. Ueda
Tokyo University of Science, Japan
M. Sugiyama
University of Tokyo, Japan
F. Aono
Enoah, Aichi, Japan
- 5CV.4.30 Combined Heat and Power Systems for Decentralised Long Term Electricity Storage**
P. Grunow
PI Berlin, Germany
- 5CV.4.31 Addressing the Urgent Need for Battery and Energy Storage System Performance and Reliability Testing Standards**
R. Mokidm
RETC, Fremont, USA
- 5CV.4.32 Optimized Integration of VRFB Storage with Grid-Tied Solar PV Power System to Mitigate Voltage Instability Due to High PV Penetration**

N. Ra & A. Bhattacharjee
BITS Pilani, Hyderabad, India

- 5CV.4.42 A Mobile PV Fluxmeter for the Optical Characterization of Parabolic Trough Concentrating Solar Power Plants**
A. Parretta & A. Moretti
University of Ferrara, Italy
M. Izzi & M. Tucci
ENEA, Rome, Italy
- 5CV.4.43 Simulation of Three-Dimensional Thermoelectric-Concentrator Photovoltaic Receivers at Ultra-High Concentrations**
A. Valera, E.F. Fernández, P.M. Rodrigo, P.J. Pérez-Higueras & F. Almonacid-Cruz
University of Jaén, Spain
- 5CV.4.44 Characterisation of Secondary Optics to Improve the Uniformity and Performance of Multi-Junction Solar Cells**
J.M. Saura, M. Angeles Ceballos, J.P. Ferrer-Rodriguez, F. Almonacid-Cruz & E.F. Fernández
University of Jaén, Spain
D. Chemisana
UDL, Lleida, Spain
- 5CV.4.45 Optimal Design of a Two Stage Micro Photovoltaic Concentrator**
S. El Ayane, S. El Himer & A. Ahaitouf
USMBA, Fez, Morocco
- 5CV.4.46 A New Hybrid System Integrating a Solar Parabolic Trough Collector with a Cylindrical Thermoelectric Generator**
A. Habchi, B. Hartiti & N. Belouaggadia
Hassan II University of Casablanca, Morocco
H. Labrim
CNESTEN, Rabat, Morocco
E. Ntsoenzok
CNRS, Orleans, France
- 5CV.4.47 Development of Large-Scale Solar Array with RF Antenna for Space Applications**
K. Tanaka
Japan Aerospace Agency, Sagamihara, Japan
R. Mudassir & T. Yamagami
Sokendai, Kanagawa, Japan
T. Nakamura
Tokyo University of Science, Kanagawa, Japan
N. Sekiya
Hosei University, Kanagawa, Japan
K. Ijichi
Jspacsystems, Kanagawa, Japan



Thursday, 10 September 2020

VISUAL PRESENTATIONS 7DV.1

08:30 – 10:00 **Costs, Economics, Finance and Markets / Assessment, Policies and Scenarios for Renewables; Societal and Global Challenges**

Chairpersons:

Nigel Taylor
European Commission JRC, Italy

Silvia Caneva
WIP Renewable Energies, Germany

7DV.1.5 Super PV Progress Report – Developing Innovative High-Quality PV Systems to Regain European Leadership in the Global PV Market

J. Urbikas & V. Urbikaite
PROTECH, Vilnius, Lithuania
J. Denafas
Soli "Tek R&D", Vilnius, Lithuania
R. Witteck & M. Köntges
ISFH, Emmertal, Germany
M. Topic
University of Ljubljana, Slovenia
F. Frontini, P. Bonomo & E. Saretta
SUPSI, Canobbio, Switzerland
P. Macé
Becquerel Institute, Brussels, Belgium
P.J. Bolt
TNO, Eindhoven, Netherlands
A.G. Ulyashin
SINTEF, Oslo, Norway
T. Haarberg
BNW-Energy, Trondheim, Norway
W. Palitzsch
LuxChemtech, Freiberg, Germany
B. Terheiden
University of Konstanz, Germany
I. Weiss & N. LaPointe
WIP Renewable Energies, Munich, Germany
J.L. Domínguez-García
IREC, Barcelona, Spain

7DV.1.7 Results from the Worldwide Performed Questionnaire: BIPV Market, Technology and Preferences

C. Erban & H. Ley
Sunovation, Elsenfeld, Germany

7DV.1.8 Analysis of PV Price Development and PV Price Predictions in Switzerland

U. Muntwyler & E. Schüpbach
BUAS, Burgdorf, Switzerland

7DV.1.10 Towards a Successful Dutch BIPV Sector

A. De Vries
Celstar, Brussels, Belgium
A. Kahn
4WWWIE, Ouderkerk aan de Amstel, Netherlands
R. Comuth
Adviesbureau Comuth, Maastricht, Netherlands
W. van Hooff
Holland Solar, Utrecht, Netherlands
G. Verpaalen
Kameleon Solar Specials, Roosendaal, Netherlands
C. Maas
Chatim, Heerlen, Netherlands
S. de Ridder
WellSun, Delft, Netherlands
P. de Jong
Solinso, Kessel, Netherlands
W. van de Wall
Wallvision, Heeze, Netherlands
Z. Vroon
ZUYD, Geleen, Netherlands
A. Kuypers, J. Kester & R.M.E. Valckenborg
TNO, Eindhoven, Netherlands
W.G.J.H.M. van Sark
Utrecht University, Netherlands
R. Loonen
Eindhoven University of Technology, Netherlands
R. Derks
Q-Roof, Heerlen, Netherlands
E. Teunissen
Berenschot, Utrecht, Netherlands

7DV.1.11 South African Independent Power Producer Program Investments in Solar PV

S. Zuma
University of Fort Hare, Alice, South Africa

7DV.1.12 Student Awards Finalist Presentation: Are Purchased Third Country Renewable Credits Worthwhile Than PV's in Malta?

B. Bartolo
MCAST, Paola, Malta
B. Azzopardi, R. Mikalauskiene, V. Jately & S. Bhattacharya
MCAST, Paola, Malta
A. Guérin de Montgareuil
CEA, St-Paul-lez-Durance, France

7DV.1.14 LCOE Analysis of Talesun New-Generation Product

P. Ni, Q. Wei, K. Huang, H. Tang, X. Cai, W. Lian & H. Qian
Talesun Solar, Changshu, China
J. Zhu
Institute for Energy Technology, Kjeller, Norway

7DV.1.15 Cost Benefit Analysis for Business Model in a Grid Connected PV System with Energy Storage

J. Solis & C. Kato
Karlstad University, Sweden
J. Ericson & M. Nilsson
Glava Energy Center, Sweden

7DV.1.17 Super PV Project – Support Cost-Reduction of the PV System through Innovative Technologies on PV Module Level

J. Denafas, P. Lukinskas, T. Radavičius & L. Petreniene



- Soli "Tek R&D", Vilnius, Lithuania
J. Ulbikas
PROTECH, Vilnius, Lithuania
R. Witteck & M. Köntges
ISFH, Emmerthal, Germany
J. Crespo Gutierrez
Lurederra, Los Arcos, Spain
J. Cordon
Tecnan, Los Arcos, Spain
T. Carrère & R. Einhaus
Apollon Solar, Saint Priest, France
U. Rühle
Flisom, Dübendorf, Switzerland
P.J. Bolt, D. Roosen-Melsen & F.J. van den Bruele
TNO, Eindhoven, Netherlands
A.G. Ulyashin
SINTEF, Oslo, Norway
T. Haarberg
BNW-Energy, Trondheim, Norway
W. Palitzsch
LuxChemtech, Freiberg, Germany
N. LaPointe & I. Weiss
WIP Renewable Energies, Munich, Germany
- 7DV.1.18 100% Renewable Electricity in Indonesia**
D.F. Silalahi, A. Blakers, M. Stocks, B. Lu, C. Cheng, A. Nadolny & L. Hayes
ANU, Canberra, Australia
- 7DV.1.27 Economic Analysis of Electricity Costs with More Solar Power Capacity in 2035 in France**
H.J.J. Yu
CEA, Gif sur Yvette, France
- 7DV.1.30 C-Si and Thin Film Photovoltaic Penetration Scenarios in Kano State - Nigeria**
S.G. Relva, A. Abubakar, M.E.M. Udaeta, V.O. da Silva, A.L.V. Gimenes & C.F.M. Almeida
University of São Paulo, Brazil
- 7DV.1.32 Statement of Certified PV Module Registration and Policy in Taiwan**
M.-A. Tsai, M.-C. Chiu, Y.-Y. Lin, H.-M. Chang, W.-Y. Liang & T.-C. Wu
ITRI, Hsinchu, Taiwan
- 7DV.1.33 The Renewable Energy Status of Offshore Islands in Taiwan**
C.-H. Du & C.-W. Wu
ITRI, Taipei, Taiwan
L.-C. Huang & S.-T. Hung
Taiwan Power Company, Taipei, Taiwan
- 7DV.1.34 An Updated SWOT Analysis of the Solar Energy and Best Practices to Enhance the Solar Energy Uptake in Solarise 2Seas Countries**
T.E. Motoasca
KU Leuven, Ghent, Belgium
- 7DV.1.35 Effects of Basic Access to Electricity on Future Power Demands by Rural Households in Developing Communities**
N.N. Opiyo
Ulster University, Londonderry, United Kingdom
- 7DV.1.36 Effects of Mobile-Platform-Based Microcredit Facilities on Uptake of PV Systems in Rural Developing Communities**

- N.N. Opiyo
Ulster University, Londonderry, United Kingdom
- 7DV.1.37 A Resource-Efficient Europe – A Programme for Climate, Competitiveness and Employment**
A.K. Lutzenberger
Alrene, Siek, Germany
- 7DV.1.38 RESCUE - Resource-Efficient Pathways towards Greenhouse-Gas-Neutrality of the German Federal Environment Agency (UBA)**
H. Lehmann
Federal Environment Agency of Germany, Dessau-Roßlau, Germany
- 7DV.1.39 The Impact of Large-Scale PV Power Stations on Climate**
C. Yang & Z. Chen
CMA, Wuhan, China
- 7DV.1.41 Solar PV Powered and Consumer Motivation Secured Collective Energy Access Tier Scaling Prospect**
M. Ray
IIT Kharagpur, India
I.D. Miller & L.H. Shu
University of Toronto, Canada
P. De
Merck Sharp & Dohme, Mumbai, India
- 7DV.1.43 Text Annotation Made Easy (TAME) Handling Large Data Rooms Using Natural Language Processing Methods**
M. Ngo & G. Tourasse
kiloWattsol, Lyon, France
- 7DV.1.44 Australia, a Global Renewable Energy Pathfinder**
A. Blakers, M. Stocks, B. Lu & C. Cheng
ANU, Canberra, Australia
- 7DV.1.45 MOST Project – Advanced Master’s Education based on Smart Grid Technology**
S. Arancón, S. Caneva & M. Kovarova
WIP Renewable Energies, Munich, Germany
F. Pilo & S. Mocchi
University of Cagliari, Italy
V. Efthymiou, A. Stavrou, G.E. Georghiou, C. Panayi, M. Kynigos & C. Papadimitriou
University of Cyprus, Nicosia, Cyprus
G.C. Christoforidis, I. Panapakidis & A. Bouhouras
Western Macedonia University of Applied Sciences, Kozani, Greece
G. Heilscher, S. Hofbauer, F. Ebe, B. Idlbi & S. Chen
Ulm University of Applied Sciences, Germany
A. Michiorri
MINES ParisTech, France
E. Loucaidou & K. Ioannou
Deloitte, Limassol, Cyprus



VISUAL PRESENTATIONS 2DV.2**10:30 – 12:00 Silicon Wafer Technology / Thin Film and Foil-Based Si Cells****Chairpersons:**

Marko Topic
University of Ljubljana, Slovenia

Stephan Riepe
Fraunhofer ISE, Germany

2DV.2.1 Crystalline Silicon Synthesis by Magnesiothermic Reduction of Natural Silica Sand
A. Darghouth, S. Aouida & B. Bessais
CRTE n, Hammam-Lif, Tunisia

2DV.2.4 “GFVis”: A Non-Destructive Method for Phase Front Analysis Based on Photos on Brick Sides
T. Trötschler, nee Strauch, S. Haddouk, A.S. Kovvali, A. Hess, P. Krenckel, S. Riepe, M. Demant & S. Rein
Fraunhofer ISE, Freiburg, Germany
H. Franz & C. Morche
ALD Vacuum Technologies, Hanau, Germany

2DV.2.6 Study of Diamond Wire Slicing Parameters by Three-Dimensional Visualization of a Multicrystalline Silicon Ingot
S.M. Karabanov, A.E. Serebryakov, D.V. Suvorov & A.S. Karabanov
RSREU, Ryazan, Russian Federation
O.A. Belyakov
Helios-Resource, Saransk, Russian Federation

2DV.2.7 Novel Study of Chemical Etching for Diamond-Cut Multi-Crystalline Silicon Wafers
V. Matkivskiy & G. Tranell
NTNU, Trondheim, Norway
A. Røyset, J.H. Kvello, M. Juel, I. Kaus, P. Tettie & B. Rynningen
SINTEF, Trondheim, Norway

2DV.2.9 Kerfless Wafering Approach with Si and Ge Templates for Si, Ge and III-V Epitaxy
C. Weiss, M. Drießen, W. Schreiber & S. Janz
Fraunhofer ISE, Freiburg, Germany

2DV.2.10 Methodology to Determine Bulk Crystal Quality in Terms of Carrier Lifetime without Wafering
M. Müller, A. Weber, A.I. Kropp, M. Ehrl, T. Urban, P. Häussermann, B. Neubert, A. Albrecht, S. Seidel, R. Otto & J. Heitmann
Freiburg University of Technology, Germany
K. Dadzis & R. Menzel
IKZ Institute for Crystal Growth, Berlin, Germany
M. Trempa & C. Reimann
Fraunhofer IISB, Erlangen, Germany
C. Kranert
Fraunhofer THM, Freiberg, Germany

2DV.2.11 Early Stage Quality Assessment in Silicon Ingots from MDP Brick Characterization
A.S. Kovvali, M. Demant, B. Rebba & S. Rein
Fraunhofer ISE, Freiburg, Germany
N. Schüler
Freiberg Instruments, Germany

2DV.2.13 Light and Elevated Temperature Induce Degradation of Ga-Doped Monocrystalline Silicon Wafer
H. Li, X. Wang, C. Zhou & W.J. Wenjing
CAS, Beijing, China

2DV.2.14 Effective Lifetime Variations Significant for Process Evaluation or Just an Artifact of Wafer Size and Quality? – An Attempt to Quantify Material Induced Variations
C. Fischer, A. Schmid, A. Zuschlag & G. Hahn
University of Konstanz, Germany

2DV.2.15 Firing-Triggered LID (FT-LID) of the Carrier Lifetime in Cz-Si Wafers
M. Winter, L. Helmich, D.C. Walter & J. Schmidt
ISFH, Emmerthal, Germany

2DV.2.18 Limitations of the Growth Rate of Silicon Mono Ingots Grown by the Czochralski Technique
F. Mosel, A.V. Denisov, B. Klipp & N. Sennova
PVA TePla, Wetztenberg, Germany
C. Kranert
Fraunhofer THM, Freiberg, Germany
M. Trempa, C. Reimann, J. Friedrich & T. Jung
Fraunhofer IISB, Erlangen, Germany

2DV.2.19 Experimental Research of the Influence of Electromagnetic Stirring of Silicon Melt on Multicrystalline Silicon Parameters
S.M. Karabanov, O.A. Belyakov, D.V. Suvorov, E.V. Slivkin & A.S. Karabanov
RSREU, Ryazan, Russian Federation

VISUAL PRESENTATIONS 2DV.3**13:30 – 15:00 Crystalline Silicon Solar Cell Technologies****Chairpersons:**

Arthur Weeber
TNO Energy Transition, Netherlands

Thorsten Dullweber
ISFH, Germany

2DV.3.2 Evaluation of Heterojunction Solar Cell Losses due to Half-Cell Processes
M. Turek, O. Breitenstein, S. Eiternick & S. Großer
Fraunhofer CSP, Halle (Saale), Germany
K. Sporleder



Fraunhofer CSP, Halle, Germany

- 2DV.3.3 Impact of Hydrogen Plasma Treatment on a-Si:H/a-SiO_x:H Passivation Film**
K. Saito
Fukushima University, Japan
T. Takamura, Y. Ichikawa & M. Konagai
Tokyo City University, Japan
- 2DV.3.4 Graphene-Based Transparent Electrode Incorporated into Silicon Heterojunction Solar Cell Technology**
I. Torres, S. Fernández, J.J. Gandía, N. González Peñalba, R. Barrio Martin, M. de Cruz & J. Cárabe
CIEMAT, Madrid, Spain
- 2DV.3.5 Laser-Induced Oxidation of Doped Poly-Si at Room Temperature for Si Solar Cells with Structured Passivated Contacts**
S. Schäfer, A. Mercker, V. Mertens, T. Neubert, A. Köhler, L. Mettner, R. Brendel & R. Peibst
ISFH, Emmerthal, Germany
- 2DV.3.7 Alternative Cz Ingot Squaring and Half-Cell Cutting Methodology for Low-Temperature PV Cell and Module Technologies**
J.F. Lelièvre, S. Harrison, M. Albaric, L. Carton, B. Portaluppi & V. Barth
CEA, Le Bourget-du-Lac, France
- 2DV.3.8 Silver- and Indium-Free Silicon Heterojunction Solar Cell**
A. Lachowicz, G. Christmann, S. Nicolay & C. Ballif
CSEM, Neuchâtel, Switzerland
- 2DV.3.10 Lateral Transport in Passivating Contact Solar Cells: The Challenge of Current Crowding for High Resistive TCOs**
M. Bivour, C. Messmer, L. Tutsch, C. Luderer, J. Schön & M. Hermle
Fraunhofer ISE, Freiburg, Germany
- 2DV.3.11 Advanced PERC Solar Cells with TOPCon Passivated Layers**
S.-Y. Chen, S.-C. Liu, S.-P. Hsu, C.-P. Huang, Y.-S. Chen, C.H. Tsai & C.-J. Huang
ITRI, Tainan, Taiwan
- 2DV.3.12 Lean Integration of p- and n-Type High-Temperature Passivating Contacts Deposited by PECVD and Activated during Short or Long Annealing**
J.J. Diaz Leon, C. Allebé, A. Ingenito, G. Nogay, A. Descoedres, M. Despeisse & S. Nicolay
CSEM, Neuchâtel, Switzerland
P. Wyss, F.-J. Haug & C. Ballif
EPFL, Neuchâtel, Switzerland
- 2DV.3.13 Influence of the TCO Oxygen Content on the TCO/a-Si Heterojunction and Its Thermal Stability**
C. Luderer, L. Tutsch, D. Kurt, M. Bivour & M. Hermle
Fraunhofer ISE, Freiburg, Germany
- 2DV.3.14 Technological Viability and Proof-of-Concept of Applying Low-Temperature PECVD Si_xN_y for Inkjet-Masked Selective Emitters**
B. Kafle, K. Demel, R. Efinger, R. Keding & M. Hofmann
Fraunhofer ISE, Freiburg, Germany
W. Shepherd & M. Pickrell
Sun Chemical, Bath, United Kingdom

- 2DV.3.15 Lithium Doped Nickel Oxide as Hole Transport Layer for Heterostructure Solar Cells**
F. Menchini, L. Serenelli, L. Martini, E. Salza, M. Izzi & M. Tucci
ENEA, Rome, Italy
S. Rakhshani, A. Latini, G. de Cesare & D. Caputo
Sapienza University of Rome, Italy
- 2DV.3.16 Insights on Cell Edge Defects Impact and Post-Process Repassivation for Heterojunction**
B. Portaluppi, S. Harrison & V. Giglia
CEA, Le Bourget-du-Lac, France
A. Sekkat & D. Munoz-Rojas
University of Grenoble Alpes, France
- 2DV.3.17 Low Temperature Ag-Paste Screening for Silicon Hetero Junction Solar Cells and Modules**
S. Pingel, D. Erath, T. Wenzel, D. Eberlein, A. De Rose, S. Tepner, J. Schube, S. Nold, A. Moldovan, A. Lorenz & F. Clement
Fraunhofer ISE, Freiburg, Germany
- 2DV.3.18 Investigating the Effect of Interstitial Fe Impurity Contamination on n-Type cz-Silicon Material for High Efficiency Solar Cell Processing**
A.T. Hajjiah
Kuwait University, Safat, Kuwait
I. Gordon, J. Szlufcik, J. Poortmans & J. John
imec, Leuven, Belgium
- 2DV.3.19 Front Side Optimization on Boron- and Gallium-Doped Cz-Si PERC Solar Cells Exceeding 22% Conversion Efficiency**
E. Lohmüller, J. Greulich, P. Saint-Cast, S. Lohmüller, S. Schmidt, U. Belledin, T. Fellmeth, S. Mack, G. Emanuel, K. Krieg, M. Zimmer, M. Linse, J. Horzel, M. Meßmer, A. Wolf & R. Preu
Fraunhofer ISE, Freiburg, Germany
R. Kunert & F. Zobel
Fraunhofer CSP, Halle (Saale), Germany
- 2DV.3.21 PECVD Shadow Mask Deposition of a-Si Fingers – a Short Cut to Structured Poly-Si for Local Passivating Contacts**
M. Stöhr, B. Beier, R. Brendel & T. Dullweber
ISFH, Emmerthal, Germany
- 2DV.3.22 Evidence of Charge Polarity Reversal in Silicon Oxide Film Deposited by Atomic Layer Deposition**
T. Mochizuki, K. Usuki, K. Tanahashi & H. Takato
AIST, Koriyama, Japan
A. Ito & H. Nakanishi
SCREEN, Kyoto, Japan
I. Kawayama
Kyoto and Osaka University, Japan
M. Tonouchi
Osaka University, Suita, Japan
- 2DV.3.23 A Study on the Influence of Aluminum Oxide Layer Properties on Contact Formation**
B. Gapp, F. Geml, J. Engelhardt & G. Hahn
University of Konstanz, Germany
- 2DV.3.24 Silicon Wafers with a Thickness below 130-Micrometers in Mass Production of Heterojunction Solar Cells**
I. Nyapshaev, K. Emtsev & D. Andronikov
R&D Center TFTE, St. Petersburg, Russian Federation



A. Ivanov, V. Tarasov, A. Dubrovskiy & P. Ishmuratov
Hevel Solar, Novocheboksarsk, Russian Federation
I. Shakhray
Avelar Solar Technology, Moscow, Russian Federation

- 2DV.3.26 Laser Annealing of Selective and Passivating Contact Layers for Crystalline Silicon Solar Cells**
S. Kurth, W. Beyer, M. Pomaska, J. Kirchhoff, S. Kasper, A. Gerber & S. Haas
Forschungszentrum Jülich, Germany
J. Hoß & J. Lossen
ISC Konstanz, Germany
- 2DV.3.27 P-Type $\mu\text{-Si:H}$ Based Hole Selective Fired Passivating Contacts (FPC) without Hydrogenation After Firing**
A. Desthieux & J. Posada
EDF R&D, Palaiseau, France
B. Bazer-Bachi & G. Goaer
Photowatt, Bourgoin-Jallieu, France
E. Drahi
TOTAL, Paris la Defense, France
P. Roca i Cabarrocas
CNRS, Palaiseau, France
- 2DV.3.28 An Investigation of an Atmospheric Screen-Printable Cu Paste and Rapid Thermal Sintering Contact for Cost-Effective Silicon Solar Cell**
A. Ebong, K. Ren & S. Huneycutt
UNC Charlotte, USA
R. Dharmadasa, K. Ankireddy & T. Druffel
Bert Thin Films, Louisville, USA
- 2DV.3.29 VOx Heterojunctions Applied to Thin c-Si Solar Cells**
G. López, E. Ros, G. Masmitjà, P.R. Ortega, C. Voz Sánchez,
J. Puigdollers González & I. Martín
UPC, Barcelona, Spain
- 2DV.3.30 Improved Performance of TiOx Based Dopant-Free Selective Contact with Metal Doped TiOx**
W. Liang, J. Tong, P. Narangari, S. Armand, K.J. Weber, A. Blakers & K.C. Fong
ANU, Canberra, Australia
K. McIntosh
PV Lighthouse, Coledale, Australia
- 2DV.3.31 Module Reliability of Solar Cells with Ultra-Thin Plated Metallization for Silver and Nickel Reduction**
S. Hoffmann, A. De Rose & A. Kraft
Fraunhofer ISE, Freiburg, Germany
M. Passig, N. Bay & D. Brunner
RENA, Freiburg, Germany
- 2DV.3.32 Rear-Emitter Si Heterojunction Solar Cells with Front n-Type SiOx Electron Collector and Back MoOx Hole Collector**
E. Bobeico, M. Della Noce, L. Lancellotti, I. Usatii, L.V. Mercedo & P. Delli Veneri
ENEA, Portici, Italy
- 2DV.3.33 An Industrial Feasible n+ Poly-Si-IBC Screen Printed Solar Cell with 702 mV Voc on Large Area p-Type Substrates**
L.J. Koduvelikulathu, J. Lossen, A. Adrian, D. Rudolph, Z.-W. Peng,
A. Chaudhary & R. Harney

ISC Konstanz, Germany
M. Troeller, A. Piechulla, V.X. Nguyen, D. Seiffert, T. Pernau & H. Haverkamp
centrotherm international, Blaubeuren, Germany
F. Haase & R. Peibst
ISFH, Emmerthal, Germany

- 2DV.3.35 P- and n-Doped Layers Optimization for Silicon Heterojunction Solar Cells in the Rear Emitter Configuration**
A.V. Semenov, A. Abramov, D. Andronikov, K. Emtsev & E.I. Terukov
R&D Center TFTE, St. Petersburg, Russian Federation
I. Shakhray
Hevel Solar, Moscow, Russian Federation
- 2DV.3.36 Screen-Printed Aluminium Contacts on n+-Doped Silicon**
S. Suzuki, M. Nakahara, N. Morishita, T. Kuroki & M. Dhamrin
Toyo Aluminium, Shiga, Japan
Z.-W. Peng, K. Tsuji & T. Buck
ISC Konstanz, Germany
- 2DV.3.38 Reduced Surface Reflection of Solar Silicon and Solar Glass by Maskless Plasma Texturing with CHF₃/H₂**
A. Okhorzina & N. Bernhard
Anhalt University of Applied Sciences, Köthen, Germany
- 2DV.3.39 Role of Wafer Thickness in Performance of Silicon Heterojunction Solar Cells**
O. Astakhov, T. Merdzhanova, D. Weigand, L. Wolf, A. Gad, K. Ding & U. Rau
Forschungszentrum Jülich, Germany
- 2DV.3.40 Fabrication of a Silicon Nanoparticle Layer on a Textured Silicon Substrate for Decreasing Reflectance**
S. Kato & T. Soga
Nagoya Institute of Technology, Japan
- 2DV.3.42 Colorization of Si Based Solar Cells and Panels Using Double Layer Coatings**
M. Rudzikas & A. Setkus
Center for Physical Sciences and Technology, Vilnius, Lithuania
M. Stange & A.G. Ulyashin
SINTEF, Oslo, Norway
J. Ulbikas
Applied Research Institute for Prospective Technologies, Vilnius, Lithuania
- 2DV.3.43 Study on Carrier Selective Passivation for p-Type Crystalline Solar Cell**
Z. Yang, Q. Wei & P. Ni
Talesun Solar, Suzhou, China
Y. Xu
NUAA, Nanjing, China
- 2DV.3.44 Inverted Pyramids Texturization of Monocrystalline Silicon for Highly Efficient Light Trapping: Monitoring H₂O₂ Evaporation by Voltammetric Detection**
S. Kubendhiran, G. Sison, H.P. Hsu & C.-W. Lan
NTU, Taipei, Taiwan
- 2DV.3.45 Band-Offset Reduction for Effective Hole Carrier Collection in Bifacial Silicon Heterojunction Solar Cells**
D.P. Pham, S. Lee, E.-C. Cho, Y. Kim, Y.-H. Cho & J. Yi
University of Sungkyunkwan, Suwon, Republic of Korea



- 2DV.3.46 Local Laser Crystallization of a-Si on Tunneling SiO₂ for Passivated Contacts of Solar Cells**
G. Jia, A. Gawlik, G. Andrá & J. Plentz
IPHT, Jena, Germany
- 2DV.3.47 Interdigitated Back Contact Silicon Heterojunction Solar Cells: Towards Industrially Feasible Manufacturing Methods**
S. Abolmasov, V.N. Verbitskiy, A. Titov, G. Shelopin, P. Valkov & E.I. Terukov
R&D Center TFTE, St. Petersburg, Russian Federation
- 2DV.3.48 Single-Shot and Periodic Photoelectrochemical Texturing of Silicon for Improved Light Absorption**
N. Avishan, A. Akbiyik, E. Yüce & A. Bek
METU, Ankara, Turkey
- 2DV.3.49 New Procedure for Specific and High Absorbents Silicon Surface Nanotextures: Inverted Pyramids, Cubic Nano-Microholes, Spiroconical Nano-Microholes and Rhombohedral - Stared Nanosheets Bouquets**
N.C.Y. Fall, M. Touré, R. Ndioukane, A.K. Diallo & D. Kobar
Ziguinchor University, Senegal
M. Pasquinelli
Aix Marseille University, France
- 2DV.3.50 Analysis of Electrical Properties by Various Electrode Design of Shingled Solar Cells with p-Type PERC Structure**
D. Oh, Y. Kim & J. Yi
Sungkyunkwan University, Suwon, Republic of Korea
- 2DV.3.51 Heterojunction Silicon Solar Cells Incorporating Unpatterned MoO_x and LiF/Al Layers on Wet-Chemically Processed Silicon Surfaces**
K. Tsoi & M. Ghasemi
GÜNAM, Ankara, Turkey
D. Türkay, E. Donercark, R. Turan & S. Yerci
METU, Ankara, Turkey
- 2DV.3.52 Engineering SiO₂/TiO₂ Stacks for Improved Electron Selective Contacts**
I. Costa, D. Vilhena, G. Gaspar, D. Pera, J. Canhoto Cardoso, K. Lobato, J. Almeida Silva & J.M. Almeida Serra
University of Lisbon, Portugal
- 2DV.3.53 Back Contact Coating to Increase the Efficiency of Polycrystalline Silicon Solar Cells**
R. AbdelRassoul & S. El-Hashash
AASTMT, Alexandria, Egypt
A.-E.-H.-B Kashyout
SRTA-City, Alexandria, Egypt

VISUAL PRESENTATIONS**15:15 – 16:45 POSTER AWARDS WINNERS SESSION****Chairperson:**Julio Cárabe
CIEMAT, Spain

Aiming to increase the visibility of poster awards winners and as a recognition to the quality of their presentation, the winners will be presented on this dedicated Poster Awards Winners session. This session will be composed of 2 parts: The above mentioned presentation of the winners, and a chat discussion in a dedicated virtual room together with the winners and interested audience.

