CONFERENCE PROGRAMME

Please note, that this Programme may be subject to alteration and the organisers reserve the right to do so without giving prior notice. The current version of the Programme is available at ***www.photovoltaic-conference.com.***

(i) = invited

Monday, 25 September 2017

OPENING

PLENARY SESSION 1AP.1

08:30 - 09:30 Stairway to High Efficiency

Chairpersons:
Nicholas J. Ekins-Daukes
Imperial College London, United Kingdom
John Van Roosmalen
ECN, Netherlands

1AP.1.1 **Indirect to Direct Bandgap Transition in Methylammonium Lead Halide Perovskite**
T. Wang, B. Daiber, S.A. Mann, E.C. Garnett & B. Ehrler
AMOLF, Amsterdam, Netherlands
J.M. Frost & A. Walsh
Imperial College London, United Kingdom

1AP.1.2 **EU PVSEC Student Award Winner Presentation: Maximum Power Extraction Enabled by Monolithic Tandems Using Interdigitated Back Contact Bottom Cells with Three Terminals**
M. Rienäcker, S. Kajari-Schröder, R. Niepelt, R. Brendel & R. Peibst
ISFH, Emmerthal, Germany
E. Warren, M. Schnabel, P. Stradins & A. Tamboli
NREL, Golden, United States

1AP.1.3 **Monolithic III-V//Si Multi-Junction Solar Cell Exceeding an Efficiency of 31%**
J. Benick, R. Cariou, P. Beutel, D. Lackner, N. Tucher, M. Hermle, S.W. Glunz, A.W. Bett & F. Dimroth
Fraunhofer ISE, Freiburg, Germany

Opening Addresses

Moderated Opening Panel

Becquerel Prize Ceremony

Monday, 25 September 2017

ORAL PRESENTATIONS 1AO.1

13:30 - 15:00 Devices & Characterisation

Chairpersons:
Martin C. Schubert
Fraunhofer ISE, Germany
Albert Polman
AMOLF, Netherlands

1AO.1.1 **Analysis for Efficiency Potential of High Efficiency Solar Cells**
M. Yamaguchi
TTI, Nagoya, Japan
H. Yamada
NEDO, Kawasaki, Japan
Y. Katsumata
JST, Chiyoda, Japan

1AO.1.2 **Special Introductory Presentation: Efficiency Limit of a 17.8% Efficiency Nanowire Solar Cell**
J.E.M. Haverkort, D. van Dam, Y. Cui, A. Cavalli, N.J.J. van Hoof, P.J. van Veldhoven & E.P.A.M. Bakkers
Eindhoven University of Technology, Netherlands
S.A. Mann & E.C. Garnett
AMOLF, Amsterdam, Netherlands
J. Gómez Riva
DIFFER, Eindhoven, Netherlands

1AO.1.3 **EU PVSEC Student Award Winner Presentation: Multi-Segment Photovoltaic Laser Power Converters and Their Electrical Losses**
R. Kimovec & M. Topic
University of Ljubljana, Slovenia
H. Helmers & A.W. Bett
Fraunhofer ISE, Freiburg, Germany

1AO.1.4 **Feasibility of Thin-Film InGaP/GaAs/InGaAs Multi-Junction Solar Cells Using Light Trapping for Low-Cost and High-Efficiency Applications**
A.G. Reddy, K. Watanabe, M. Sugiyama & Y. Nakano
University of Tokyo, Japan
L. Zhu & H. Akiyama
University of Tokyo, Kashiwa, Japan

1AO.1.5 **Uncertainty Propagation on the Spectral Matching Ratios Using a Calibrated Spectroradiometer. Preliminary Results**
D. Pavanello & R. Galleano
European Commission JRC, Ispra, Italy

ORAL PRESENTATIONS 2AO.4

13:30 - 15:00 Characterisation of Contacts and Doped Layers

Chairpersons:
Rolf Brendel
ISFH, Germany
Maarten Debucquoy
imec, Belgium

2AO.4.1 **Reconstructing Photoluminescence Spectra from Heavily Doped Regions of Silicon Solar Cells**
H. Wu, H.T. Nguyen & D. Macdonald
ANU, Canberra, Australia

2AO.4.2 **EU PVSEC Student Award Winner Presentation: Efficient Carrier Injection from Amorphous Silicon into Crystalline Silicon Determined from Photoluminescence**
A.R. Paduthol, M.K. Juhl, Z. Hameiri & T. Trupke
UNSW Australia, Sydney, Australia
G. Nogay & P. Löper
EPFL, Lausanne, Switzerland

2AO.4.3 **On the Determination of the Contact Resistivity for Passivating Contacts Using 3D Simulations**
G. Kökbudak, R. Müller, F. Feldmann, A. Fell & S.W. Glunz
Fraunhofer ISE, Freiburg, Germany
R. Turan
METU, Ankara, Turkey

2AO.4.4 **Front Side Metallization of p and n-Type Si Solar Cells: A Percolation Model for Explaining the Current Path**
M. Pfeffer, P. Kumar, M. Zehender, B. Wiillsch & O. Eibl
University of Tuebingen, Germany

2AO.4.5 **Investigation on the Ag-Al Metal Spiking into Boron-Diffused p+ Layer of Industrial Bifacial n-Type Silicon Wafer Solar Cells by Numerical Simulation**
M. Li, R. Stangl & A.G. Aberle
SERIS, Singapore, Singapore
F.-J. Ma & B. Hoex
UNSW Australia, Sydney, Australia
G.S. Samudra
NUS, Singapore, Singapore

2AO.4.6 **The Role of the Oxide in the Carrier Selectivity of Metal/Poly-Si/Oxide Contacts to Silicon Wafers**
G.J.M. Janssen, M.K. Stodolny, I.G. Romijn & B.G. Geerligs
ECN, Petten, Netherlands

Monday, 25 September 2017

ORAL PRESENTATIONS 3AO.7

13:30 - 15:00 Optical Losses and TCO`s

Chairpersons:
Wiltraud Wischmann
ZSW, Germany
Alessandro Romeo
University of Verona, Italy

3AO.7.1 **Mechanism of Efficiency Enhancement of Cu(In,Ga)Se2 Solar Cells by Insertion of Cu-Deficient Layer**
T. Nishimura, S. Toki, H. Sugiura, K. Nakada & A. Yamada
Tokyo Institute of Technology, Japan

3AO.7.2 **Determination of Optical and Recombination Losses in Cu2ZnSn(S,Se)4-Based Solar Cells**
A. Nakane & H. Fujiwara
Gifu University, Japan
H. Tampo, K. Kim, S. Kim, H. Shibata & S. Niki
AIST, Tsukuba, Japan

3AO.7.3 **Light Management Approaches Based on Periodic Textures for Cu(In,Ga)Se2 Thin-Film Solar Cells**
R. Vismara, O. Isabella & M. Zeman
Delft University of Technology, Netherlands
L. Grenet & F. Emieux
CEA, Grenoble, France

3AO.7.4 **Effects of Ultra-Thin Copper Layer on the Performance and Stability of CdTe/CdS Solar Cells**
E. Artegiani, D. Menossi & A. Romeo
University of Verona, Italy

3AO.7.5 **Amorphous Indium Zinc Oxide Windows of Different Composition for Cu(In,Ga)Se2 Solar Cells**
R. Menner, T. Magorian-Friedlmeier, S. Paetel, P. Jackson & W. Wischmann
ZSW, Stuttgart, Germany

3AO.7.6 **Application of In2O3-Based Transparent Conducting Oxide Layers in Cu(In,Ga)Se2 Solar Cells**
T. Koida, Y. Ueno, J. Nishinaga, H. Higuchi, H. Takahashi, M. Iioka & H. Shibata
AIST, Tsukuba, Japan

VISUAL PRESENTATIONS 2AV.1

13:30 - 15:00 Feedstock, Crystallisation, Wafering, Defect Engineering

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

ORAL PRESENTATIONS 1AO.2

15:15 - 16:45 Optics and Materials

Chairpersons:
Martina Schmid
HZB, Germany
Diego Alonso-Álvarez
Imperial College London, United Kingdom

1AO.2.1 **High-Efficiency CuInS2-Based Nanocrystal Luminescent Solar Concentrators**
D.L. Patrick
Western Washington University, Bellingham, United States

1AO.2.2 **Recent Applications of the Luminescent Solar Concentrator: A Standalone Chemical Microfactory**
M.G. Debije, D. Cambie, F. Zhao & T. Noël
Eindhoven University of Technology, Netherlands

1AO.2.3 **Analysis of Backsheet and Rear Cover Reflection Gains for Bifacial Solar Cells**
M. Mittag, A. Schmid, A. Grünzweig, M. Wiese & M. Ebert
Fraunhofer ISE, Freiburg, Germany

1AO.2.4 **Silver Paste Design from Rheological Viewpoints**
Y.-H. Wen & W.-C. Tang
Heraeus, Taoyuan, Taiwan
H.-C. Lee, J.-S. Jiang & C.-C. Hua
National Chung Cheng University, Chiayi, Taiwan

1AO.2.5 **A New Design of Intermediate Band Solar Cell with Multi-Layer MoS2 Nanoribbons**
S.-F. Chen & Y.-R. Wu
NTU, Taipei, Taiwan

1AO.2.6 **Benefit of Textured CIGS Cells for Low Reflecting Nanogrid Application**
J. van Deelen & M. Barink
TNO, Eindhoven, Netherlands

ORAL PRESENTATIONS 2AO.5

15:15 - 16:45 Characterisation of Cells and Modules

Chairpersons:
Francesca Ferrazza
eni spa, Italy
Axel Herguth
University of Konstanz, Germany

2AO.5.1 **Multi-Wire Interconnection for Multi-Busbar Interdigitated Back-Contact Cells: Opportunities and Pitfalls in Cell-Module Co-Design**
J. Govaerts, T. Borgers, P. Manganiello, M. Debucquoy, A. van der Heide, H. Goverde, E. Voroshazi, J. Szlufcik & J. Poortmans
imec, Leuven, Belgium

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2AO.5.2 **PCBtouch: A Flexible Solution for the Measurement of Complex Solar Cells in Production and Laboratory Environments**
J. Levrat, P. Häfliger, J. Champliaud, C. Ballif & M. Despeisse
CSEM, Neuchâtel, Switzerland
J. Geissbühler
EPFL, Neuchâtel, Switzerland
N. Bassi, V. Fakhfouri & R. Ambigapathy
Pasan, Neuchâtel, Switzerland

2AO.5.3 **Contactless Determination of Dielectric Absorption from the Spectral Response of Photoluminescence**
M.K. Juhl, M.E. Pollard, A.R. Paduthol, T. Trupke & Z. Hameiri
UNSW Australia, Sydney, Australia

2AO.5.4 **Angle-Dependent Reflectance of Isotextured Silicon**
A. Alapont Sabater, J. Greulich, N. Tucher & B. Bläsi
Fraunhofer ISE, Freiburg, Germany

2AO.5.5 **Benchmarking Mechanical Strength Data for New Solar Cell Concepts**
F. Kaule, S. Meyer & S. Schoenfelder
Fraunhofer CSP, Halle, Germany

2AO.5.6 **Characterization of Large Area IBC Cells without Gaps between Emitters and BSFs**
H. Chu, G. Galbiati, J. Theobald, L.J. Koduvelikulathu, R. Roescu, D. Rudolph, A. Halm & V.D. Mihailetchi
ISC Konstanz, Germany

ORAL PRESENTATIONS 3AO.8

15:15 - 16:45 Module Stability and Characterisation

Chairpersons:
Michael Powalla
ZSW, Germany
Daniel Lincot
CNRS, France

3AO.8.1 **Performance Characterisation and Extended Reliability Testing of CIGS PV Modules**
P. Lechner, J. Schnepf & D. Stellbogen
ZSW, Stuttgart, Germany

3AO.8.2 **Separating the Influence of Material Composition and Local Defects on the Voc of CIGS Solar Modules**
J. Hepp, B. Hofbeck, C. Camus & J. Hauch
ZAE Bayern, Erlangen, Germany
A. Vetter & C.J. Brabec
University of Erlangen-Nuremberg, Germany

3AO.8.3 **Towards an Improved Understanding of CIGS Thin Film Solar Cells**
T. Lavrenko, R. Vidal Lorbada, D. Mücke & T. Walter
Ulm University of Applied Sciences, Germany
B. Plesz
BME, Budapest, Hungary

3AO.8.4 **The Nature of Non-Ohmic Shunts in CIS-Based Solar Cells**
A. Zelenina, F. Werner, H. ElAnzeery & S. Siebentritt
University of Luxembourg, Belvaux, Luxembourg

3AO.8.5 **Reverse-Breakdown Stability of Cu(In,Ga)Se2 Thin-Film Solar Cells**
M. Richter, M. Vrenegor & J. Parisi
University of Oldenburg, Germany

3AO.8.6 **Imaging of TCO Lateral Resistance Effects in Thin-Film PV Modules by Lock-In Thermography and Electroluminescence Techniques**
A. Sinha, S. Roy & R. Gupta
IIT Bombay, Mumbai, India
M. Bliss, X. Wu & R. Gottschalg
Loughborough University, United Kingdom

VISUAL PRESENTATIONS 2AV.2

15:15 - 16:45 **Homojunction Solar Cells**

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

ORAL PRESENTATIONS 1AO.3

17:00 - 18:30 **Advanced and Novel Concepts for Very High-Efficiency Solar Cells**

Chairpersons:
Antonio Martí Vega
UPM, Spain
Jonathan Govaerts
imec, Belgium

1AO.3.1 **Highly Reliable Low Concentration InGaP/GaAs/Si 3-Junction Solar Cells with Smart Stack Technology**
K. Makita, R. Oshima, T. Tayagaki & T. Sugaya
AIST, Tsukuba, Japan
H. Mizuno & H. Takato
AIST, Koriyama, Japan
M. Baba & N. Yamada
Nagaoka University of Technology, Japan

1AO.3.2 **Increasing Photovoltage Boosted by Photon Up-Conversion in a Single Junction Solar Cell with a Hetero-Interface**
S. Asahi, K. Kusaki, T. Kaizu & T. Kita
Kobe University, Japan

1AO.3.3 **Surface Passivation of InP Nanowires by ALD POx/Al2O3 for Solar Cells**
L.E. Black, A. Cavalli, M.A. Verheijen, J.E.M. Haverkort, E.P.A.M. Bakkers & W.M.M. Kessels
Eindhoven University of Technology, Netherlands

1AO.3.4 **Achromatic Lens Casting Nearly Uniform Irradiance over MJ Solar Cells**
M. Victoria Pérez, G. Vallerotto, S. Askins, I. Antón & G. Sala
UPM, Madrid, Spain

1AO.3.5 **Dielectric Nanoparticle Array for Low Loss Colorful Light Scattering Coatings in PV Application**
V. Neder & A. Polman
AMOLF, Amsterdam, Netherlands
S.L. Luxembourg
ECN, Petten, Netherlands

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1AO.3.6 **Optical Potential of BaSi2 Absorber Material for Thin-Film PV Applications**
R. Vismara, O. Isabella & M. Zeman
Delft University of Technology, Netherlands

ORAL PRESENTATIONS 2AO.6

17:00 - 18:30 **Industrial Production of Highly Efficient c-Si Solar Cells**

Chairpersons:
Peter Wohlfart
SINGULUS TECHNOLOGIES, Germany
Peter Fath
RCT-Solutions, Germany

2AO.6.1 **Accuracy and Significance of the Projections in the International Technology Roadmap for Photovoltaic (ITRPV)**
P. Baliozian, S. Al-Hajjawi, S. Nold & R. Preu
Fraunhofer ISE, Freiburg, Germany
J. Trube
VDMA, Frankfurt am Main, Germany
M. Fischer
Hanwha Q CELLS, Bitterfeld-Wolfen, Germany
R.G. Yadav
University of Freiburg, Germany

2AO.6.2 **Toward 21.4% Efficiency by Implementing Industrially Feasible Technolgies in Printed-AlOx PERC Technology**
Y.-S. Lin, C.-H. Ku, T.-C. Chen, C.-S. Hu & C.-C. Wen
E-TON Solar Tech, Tainan, Taiwan
J.-Y. Hung
New E Materials, Kaohsiung, Taiwan
J.-C. Wang
Eternal Chemical, Kaohsiung, Taiwan

2AO.6.3 **20% Efficient 15.6 × 15.6 cm2 BackPEDOT Solar Cells with Screen-Printed Front Side**
D. Zielke, R. Gogolin & J. Schmidt
ISFH, Emmerthal, Germany
R. Sauer & W. Lövenich
Heraeus, Leverkusen, Germany

2AO.6.4 **Industrially Feasible PERC Cells on Diamond Wire Sawing Multi-Crystalline Silicon Wafers Textured by RIE towards 20.13% Efficiency**
W. Wang, J. Dong, Q. Ye, Y. Yang, W. Cai, J. Sheng, J. Yang, C. Zhang, X. Zhou & J. Zheng
GCL System Integration Technology, Suzhou, China

2AO.6.5 **Ultrasonically Tinned PVD Al Rear Contacts on High-Efficiency Crystalline Silicon Solar Cells for Module Integration**
H. Nagel, D. Eberlein, S. Hoffmann, A. Kraft, U. Eitner, M. Glatthaar & S.W. Glunz
Fraunhofer ISE, Freiburg, Germany
H. Haverkamp
Gebr. SCHMID, Freudenstadt, Germany
T. Fischer
Teamtechnik, Freiberg, Germany
A. Hain & P. Wohlfart
Singulus Technologies, Kahl am Main, Germany
V. Mertens & J.W. Müller
Hanwha Q CELLS, Bitterfeld-Wolfen, Germany
T. Buck
ISC Konstanz, Germany

2AO.6.6 **Effectiveness of the IEC 60904-9 Spectral Match Classification for Industrially-Relevant Si Solar Cells**
H. Wilterdink, R. Sinton & A. Blum
Sinton Instruments, Boulder, United States
E. Schneller & K.O. Davis
University of Central Florida, Orlando, United States

ORAL PRESENTATIONS 3AO.9

17:00 - 18:30 Device Characterisation

Chairpersons:
James R. Sites
Colorado State University, United States
Martha Ch. Lux-Steiner
HZB, Germany

3AO.9.1 **In Situ Analysis of the In-Ga Inter-Diffusion in Cu(In,Ga)Se2 Absorbers during Rapid Selenisation at High Se Pressure**
J. Marquez-Prieto, H. Stange, S. Levcenko, J.-P. Bäcker, T. Kodalle, A. Redinger, S.S. Schmidt, M. Klaus, C. Genzel, R. Schlatmann, T. Unold & R. Mainz
HZB, Berlin, Germany

3AO.9.2 **Cu-Depleted Grains Induced by the Presence of Heavy-Alkali during the Growth of the CIGS Absorber**
O. Donzel-Gargand, F. Larsson & M. Edoff
Uppsala University, Sweden
T. Thersleff
Stockholm University, Sweden
E. Wallin & L. Stolt
Solibro Research, Uppsala, Sweden

3AO.9.3 **Stacking Fault Annihilation through Grain Growth in Chalcopyrite Thin Films: A Model Supported by Simulation and In-Situ XRD**
H. Stange
Technical University of Berlin, Germany
S. Brunken, D. Greiner, M.D. Heinemann, S.S. Schmidt, J.-P. Bäcker, C.A. Kaufmann, M. Klaus, C. Genzel & R. Mainz
HZB, Berlin, Germany
D.A. Barragan Yani
Technical University of Darmstadt, Germany
L.A. Wägele & R. Scheer
Martin Luther University, Halle, Germany

3AO.9.4 **Micro-Electroluminescence Imaging and Simulation of Thin-Film CIGS Solar Cells**
U. Malm, T. Jarmar & O. Lundberg
Solibro Research, Uppsala, Sweden

3AO.9.5 **Sub-Micrometer Resolved Electroluminescence Measurements on CZTSe and CIGSe Thin Film Solar Cells**
A. Redinger, S. Levcenko, J.M. Marquez-Prieto, D. Greiner, C.A. Kaufmann & T. Unold
HZB, Berlin, Germany
E. Saucedo & S. Giraldo
IREC, Barcelona, Spain

3AO.9.6 **XPS and GD-OES Coupling for Advanced Profiling Characterization of CIGS Absorbers: The Challenge of the GD-OES Crater Engineering**
A. Loubat, M. Bouttemy, M. Frégnaux, D. Aureau & A. Etcheberry
UVSQ, Versailles, France
S. Gaiaschi & P. Chapon
HORIBA, Longjumeau, France
V. Achard, F. Donsanti, M. Jubault, N. Naghavi & D. Lincot
CNRS, Chatou, France

VISUAL PRESENTATIONS 2AV.3

17:00 - 18:30 Heterojunction Solar Cells

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

Tuesday, 26 September 2017

ORAL PRESENTATIONS 2BO.1

08:30 - 10:00 Silicon Crystallisation

Chairpersons:
Anis Jouini
CEATECH-INES, France
Atsushi Ogura
Meiji University, Japan

2BO.1.1 Properties of Multi-Crystalline Silicon Ingot Grown by Self-Nucleating Crucible
J. Laurent & E. Drode
Vesuvius, Feignies, France
C. Reimann, M. Trempa & J. Friedrich
Fraunhofer IISB, Erlangen, Germany
C. Kranert
Fraunhofer THM, Freiberg, Germany
L. Teale, R. Dyer & I. Dorrity
PV Crystalox Solar, Oxfordshire, United Kingdom

2BO.1.2 Eco-Solar Factory: Multicrystalline Silicon Ingot Crystallisation from Reusable Silicon Nitride Crucibles
M.P. Bellmann & G. Stokkan
SINTEF, Trondheim, Norway
K.E. Ekstrøm
NTNU, Trondheim, Norway
A. Ciftja & R. Roligheten
Steuler Solar Technology, Porsgrunn, Norway
J. Denafas
Soli "Tek R&D", Vilnius, Lithuania
F. Buchholz
ISC Konstanz, Germany
K. Wambach
bifa Environmental Institute, Augsburg, Germany
S. Würzner & T. Kaden
Fraunhofer THM, Freiberg, Germany

2BO.1.3 Identification of Defect-Repressing Grain Boundaries in Multicrystalline Silicon Based on Measurements of as-Cut Wafers Using Advanced Image Processing
T. Strauch, M. Demant, P. Krenckel, S. Riepe & S. Rein
Fraunhofer ISE, Freiburg, Germany

2BO.1.4 Control of Ingot Quality and Cell Appearance for Mono-Like Silicon Casting by Using Seed Partitions
C.Y Lan, Y.C. Wu, W.C. Lan, C.-F. Yang, C.-W. Lan & I.-T. Liu
NTU, Taipei, Taiwan
W.C. Hsu
SAS, Hsinchu, Taiwan
C.M. Lu & A. Yang
Solartech Energy, Hsinchu, Taiwan

2BO.1.5 Silicon Crystal Growth from Granulate Crucible for Photovoltaic Application
R. Menzel, K. Dadzis, N.V. Abrosimov & H. Riemann
IKZ Institute for Crystal Growth, Berlin, Germany

Tuesday, 26 September 2017

2BO.1.6 Ga Doped Monocrystalline Silicon by Continuous Czochralski (CCz) Process for Making Light Induced Degradation (LID) Free p-Type Solar Cells
H. Xu, S. Keohane & S. Turchetti
GT Advanced Technologies, Merrimack, United States
Y. Zhang, Q. Li & R. Zhou
LONGi Green Energy Technology Co., Ltd., Xian, China

ORAL PRESENTATIONS 5BO.5

08:30 - 10:00 Backsheet and Encapsulant Materials

Chairpersons:
Gernot Oreski
PCCL, Austria
William J. Gambogi
DuPont, United States

5BO.5.1 Hybrid Encapsulation Film for PV Modules Operating at High Voltage
S.C. Pop, R.N. Schulze & X. Wang
Yingli Green Energy, San Francisco, United States
J. Kapur
DuPont, Wilmington, United States
P. Hacke & M. Kempe
NREL, Golden, United States

5BO.5.2 Extended Qualification Testing of 1-Cell Crystalline Si PV Laminates: Impacts of Advanced Cell Metallization and Encapsulation Schemes
J. Govaerts, A. van der Heide, T. Borgers, E. Voroshazi, J. Szlufcik & J. Poortmans
imec, Leuven, Belgium
B. Geyer
ZOEK, Cologne, Germany
S. Hellström
Borealis, Stenungsund, Sweden
B. Broeders
Borealis, Beringen, Belgium

5BO.5.3 Adhesion Degradation of the Metallization-Encapsulant Interface
N. Bosco, P. Hacke & S.R. Kurtz
NREL, Golden, United States
J. Tracy & R.H. Dauskardt
Stanford University, United States

5BO.5.4 Depth Profiling of Optical, Chemical and Nanomechanical Properties of Glass/Encapsulant/Backsheet PV Laminates Aged under Different Intensities of UV Light
Y. Lyu, J.H. Kim, A. Fairbrother & X. Gu
NIST, Gaithersburg, United States

5BO.5.5 Comparison of Accelerated UV Test Methods with Florida Exposure for Photovoltaic Backsheet Materials
E. Parnham, A. Whitehead, S. Pain & B. Brennan
DuPont Teijin Films, Redcar, United Kingdom

5BO.5.6 **Analysis of UV Degradation of PV Backsheets Using Arrhenius Formalism to Extract Intrinsic Material Characteristics and Model Lifetime Performance under Various Climate Conditions**
A. Borne & S. Padlewski
DuPont, Geneva, Switzerland
T.-J. Trout
DuPont, Wilmington, United States
M. Köhl
Fraunhofer ISE, Freiburg, Germany

ORAL PRESENTATIONS 3BO.9

08:30 - 10:00 Manufacturing and Performance Improvements

Chairpersons:
Bernhard Dimmler
Manz CIGS Technology, Germany
Veronica Bermudez
Solar Frontier, Japan

3BO.9.1 **Special Introductory Presentation: Wide Bandgap Sequential Absorber with Tunable Buffer Bandgap for CIGSSe Solar Modules at 18% Efficiency**
R. Lechner, P. Eraerds, M. Stölzel, T.P. Niesen, M. Sode, A. Weber, M. Algasinger, C. Schubbert, R. Verma, T. Dalibor & J. Palm
Avancis, Munich, Germany

3BO.9.2 **Cd-Free Cu(In,Ga)Se2 Thin-Film Solar Cells with High Ga Contents**
D. Hariskos, W. Witte, S. Paetel, W. Hempel & M. Powalla
ZSW, Stuttgart, Germany

3BO.9.3 **Challenges for High-Efficiency Buffer-Free Cu(In,Ga)Se2 Solar Cells**
S. Ishizuka, T. Koida, N. Taguchi, S. Tanaka, P. Fons & H. Shibata
AIST, Tsukuba, Japan

3BO.9.4 **Back Contact Modification in Cu2ZnSnSe4 Solar Cells: The Use of Transition Metal Oxides as Possible Back Electron Reflectors**
S. Giraldo, M. Espindola-Rodriguez, F. Oliva, V. Izquierdo-Roca & E. Saucedo
IREC, Barcelona, Spain
A. Perez-Rodriguez
University of Barcelona, Spain

3BO.9.5 **High Efficiency CdTe Solar Cells by Low Temperature Deposition with MgZnO HRT Layer**
D. Menossi, E. Artegiani & A. Romeo
University of Verona, Italy
F. Bittau, J.W. Bowers & J.M. Walls
Loughborough University, United Kingdom
M. Barbato, M. Meneghini & G. Meneghesso
University of Padua, Italy

VISUAL PRESENTATIONS 6BV.1

08:30 - 10:00 Design and Operation of PV Systems (I)

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

Tuesday, 26 September 2017

PLENARY SESSION 2BP.1

10:30 - 12:10 Silicon Photovoltaics

Chairpersons:
Giso Hahn
University of Konstanz, Germany
Derk L. Bätzner
Meyer Burger Research, Switzerland

2BP.1.1 **Record-Breaking Efficiency Back-Contact Heterojunction Crystalline Si Solar Cell and Module**
K. Yamamoto, K. Yoshikawa, D. Adachi, W. Yoshida, T. Irie, K. Konishi, T. Fujimoto, H. Kawasaki, M. Kanematsu, H. Ishibashi, T. Uto, Y. Takahashi, T. Terashita, G. Koizumi, N. Nakanishi & M. Yoshimi
Kaneka, Osaka, Japan
J.L. Hernández
Kaneka, Westerlo-Oevel, Belgium

2BP.1.2 **Pilot Line Results of n-Type IBC Cell Process in Mass Production Environment**
I. Cesar, N. Guillevin & A.R. Burgers
ECN, Petten, Netherlands
P. Venema
Tempress, Vaassen, Netherlands
Z. Wang, J.Y. Zhai & D. Liu
Yingli Green Energy, Baoding, China

2BP.1.3 **Simultaneous Fabrication of n & p Contacts for Bi-Facial Cells by a Novel Co-Plating Process**
R. Russell, L. Tous, E. Cornagliotti, F. Duerinckx & J. Szlufcik
imec, Leuven, Belgium

2BP.1.4 **Understanding Light-Induced Degradation in Multicrystalline Silicon: Possible Complex Formation Mechanisms**
F. Schindler, W. Kwapil, J. Schön, R. Eberle, T. Niewelt & M.C. Schubert
Fraunhofer ISE, Freiburg, Germany

2BP.1.5 **Influence of the Precursor Layer Composition and Deposition Processes on the Electronic Quality of Liquid Phase Crystallized Silicon Absorbers**
D. Amkreutz, N. Preissler, P. Sonntag, C. Thi-Trinh, R. Schlatmann & B. Rech
HZB, Berlin, Germany

ORAL PRESENTATIONS 2BO.2

13:30 - 15:00 LID and Defect Engineering

Chairpersons:
Markus Rinio
University of Karlstad, Sweden
Erik Sauar
Brighterlite, Norway

2BO.2.1 **Identification of Possible Impurities in mc-Si Wafers Responsible for Light-Induced Lifetime Degradation**
D. Bredemeier, D.C. Walter & J. Schmidt
ISFH, Emmerthal, Germany

2BO.2.2 **Influence of Different Transition Metal Contaminations on Degradation and Regeneration in mc Si**
A. Schmid, A. Zuschlag, D. Skorka, J. Fritz & G. Hahn
University of Konstanz, Germany

2BO.2.3 **New Insight into LID in Multi-PERC Solar Cells and Modules**
A. Ciesla, D. Chen, C. Chan, D. Payne, I. Zafirovska, C. Sen, J. Colwell, B. Hallam, R. Chen, M. Abbott & S.R. Wenham
UNSW Australia, Sydney, Australia
C.M. Chong
Nanyang Technological University, Singapore, Singapore
G. Bourret-Sicotte
University of Oxford, United Kingdom

2BO.2.4 **How to Assess the Electrical Quality of Silicon Material**
B. Michl, F. Schindler & M.C. Schubert
Fraunhofer ISE, Freiburg, Germany

2BO.2.5 **Oxygen Precipitates in Czochralski Silicon: Influence of Growth Conditions on the Minority Carrier Lifetime**
F. Rougieux, H.T. Nguyen & D. Macdonald
ANU, Canberra, Australia
B. Mitchell
UNSW Australia, Sydney, Australia
R. Falster
SunEdison, Merano, Italy

2BO.2.6 **Investigating the Influence of Interstitial Iron on the Study of Boron-Oxygen Defects**
M. Kim, D. Chen, M. Abbott, S. Wenham & B. Hallam
UNSW Australia, Sydney, Australia

ORAL PRESENTATIONS 5BO.6

13:30 - 15:00 Electrical Characterisation of PV Devices

Chairpersons:
Werner Herrmann
TÜV Rheinland Energy, Germany
Ronald Sinton
Sinton Instruments, United States

5BO.6.1 **Comparison of Primary Calibrations for Filtered Reference Cells**
H. Müllejans, W. Zaaiman & D. Pavanello
European Commission JRC, Ispra, Italy
I. Kröger
PTB, Braunschweig, Germany

5BO.6.2 **Spectral Angular Responsivity Calibration Facility at PTB**
I. Kröger, T. Fey, F. Witt, F. Plag & S. Winter
PTB, Braunschweig, Germany

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5BO.6.3 **Extending Solar Simulators' Spectrum Characterisation from 300 nm to 1200 nm: Challenges on Spectral Measurements in UV and NIR**
G. Belluardo
EURAC, Bolzano, Italy
R. Galleano & W. Zaaiman
European Commission JRC, Ispra, Italy
M. Pravettoni
Private Consultant, Milan, Italy
M. Halwachs
AIT, Vienna, Austria
R. Fucci
ENEA, Napoli, Italy
A. Drobisch
PI Berlin, Germany
M. Friederichs
PV Lab, Potsdam, Germany
E. Haverkamp
Radboud University, Nijmegen, Netherlands
A. Phinikarides
University of Cyprus, Nicosia, Cyprus
G. Friesen
SUPSI, Canobbio, Switzerland

5BO.6.4 **Spectral and Angular Correction - a Multidimensional Approach to Model Measurements under Outdoor Conditions**
F. Plag, S. Riechelmann, I. Kröger & S. Winter
PTB, Braunschweig, Germany

5BO.6.5 **Reproducible Outdoor I-V Curve Measurement by the Use of PV Module Irradiance Sensors and Comparison with Indoor Results**
Y. Hishikawa, T. Doi, M. Higa, T. Takenouchi, H. Ohshima & K. Yamagoe
AIST, Tsukuba, Japan

5BO.6.6 **Smart PV Module Batch Testing: Reduction of Performance Measurment Uncertainty by Up to 50%**
B. Jaeckel
UL International, Neu-Isenburg, Germany
B. Mihaylov & R. Gottschalg
Loughborough University, United Kingdom
J. Arp
PV Lab Germany, Potsdam, Germany

ORAL PRESENTATIONS 3BO.10

13:30 - 15:00 Alkaline Treatments

Chairpersons:
Akira Yamada
Tokyo Institute of Technology, Japan
Thomas Dalibor
AVANCIS, Germany

3BO.10.1 Special Introductory Presentation: Influence of Post-Deposition Treatment with Alkali Elements on Bulk and Interface Properties of High Efficiency Cu(In,Ga)Se2 Solar Cells: Results of the EU Project Sharc25
W. Witte, P. Jackson, D. Hariskos, F. Kessler & M. Powalla
ZSW, Stuttgart, Germany
S. Buecheler, R. Carron, E. Avancini, B. Bissig, T. Weiss & A.N. Tiwari
EMPA, Dübendorf, Switzerland
S. Siebentritt, F. Werner & M.H. Wolter
University of Luxembourg, Belvaux, Luxembourg
P. Pareige, P. Muguerou, S. Duguay, E. Cadel, C. Castro & A. Vilalta-Clemente
INSA Rouen, Saint Etienne du Rouvray, France
R. Menozzi, G. Sozzi & S. Di Napoli
University of Parma, Italy
E. Bourgeois & G. Degutis
imec, Leuven, Belgium
M. Bär, R.G. Wilks & T. Kunze
HZB, Berlin, Germany
S. Sadewasser & N. Nicoara
INL, Braga, Portugal
M. Puska, M. Fedina, H.-P. Komsa & V. Havu
Aalto University, Finland
P. Reinhard
Flisom, Dübendorf, Switzerland
B. Dimmler & R. Wächter
Manz CIGS Technology, Schwäbisch Hall, Germany

3BO.10.2 Effect of KF Post Absorber Deposition Treatment on the Functionality of Different TCOs in CIGSe Solar Cells
J. Keller, A. Aijaz, T. Kubart, M. Edoff & T. Törndahl
Uppsala University, Sweden
F. Chalvet, J. Joel & L. Stolt
Solibro Research, Uppsala, Sweden

3BO.10.3 Efficiency Improvement of Low Temperature (450°C) Deposited Cu(In,Ga)Se2 Solar Cells by Alkali Treatment and Deposition of Cu-Poor Layer
A. Sadono, T. Ogihara, K. Nakada & A. Yamada
Tokyo Institute of Technology, Japan
M. Hino & K. Yamamoto
Kaneka, Osaka, Japan

3BO.10.4 Sulfurization of Co-Evaporated Cu(In,Ga)Se2 as a Post Deposition Treatment
J.K. Larsen, J. Keller, J.J.S. Scragg, L. Riekehr & C. Platzer-Björkman
Uppsala University, Sweden
O. Lundberg, T. Jarmar & L. Stolt
Solibro Research, Uppsala, Sweden

3BO.10.5 Thermal Annealing Effect of KF-PDT on the Property of CIGS Solar Cell on Glass Substrate
Y. Kamikawa-Shimizu, J. Nishinaga, S. Ishizuka, T. Tayagaki, H. Shibata & S. Niki
AIST, Tsukuba, Japan

Tuesday, 26 September 2017

VISUAL PRESENTATIONS 6BV.2

13:30 - 15:00 Design and Operation of PV Systems (II)

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

ORAL PRESENTATIONS 2BO.3

15:15 - 16:45 New Wafering Technologies

Chairpersons:
Dirk Habermann
Meyer Burger Technology, Switzerland
Yoshio Ohshita
Toyota Technological Institute, Japan

2BO.3.1 Machining Behaviour of Silicon in Wire EDM for PV Applications
M.M. Kane, A. Jadhav, M. Kumar, S.V. Kulkarni, S.S. Joshi & H. Bahirat
IIT Bombay, Mumbai, India

2BO.3.2 Kerf-Less Wafering Using Polymer Split Method for Photovoltaic Solar Cells and Modules
S. Schoenfelder, F. Kaule & J. Schneider
Fraunhofer CSP, Halle, Germany
R. Lantzsch & K. Petter
Hanwha Q CELLS, Bitterfeld-Wolfen, Germany
C. Beyer & J. Richter
SILTECTRA, Dresden, Germany

2BO.3.3 Fabrication of Free-Standing Ultra-Thin Silicon Wafer by Controlled Exfoliation Process
Y. Lee, S.M. Han & J. Oh
KAIST, Daejeon, Korea South
Y.-J. Kim
KRISS, Daejeon, Korea South
H.-E. Song
KIER, Daejeon, Korea South

2BO.3.4 Overview of Novel Dicing Methods for the Delineation and Exfoliation of Thin Kerfless Si Epitaxial Foils with High Mechanical Strength
H. Sivaramakrishnan Radhakrishnan, K. Vanstreels, M. Xu, V. Depauw, K. Van Nieuwenhuysen, T. Bearda, S. Jambaldinni, M. Gonzalez, I. Gordon, M. Debucquoy, J. Szlufcik & J. Poortmans
imec, Leuven, Belgium
K. Yokoyama
DISCO Hi-Tec, Munich, Germany
F. Bamberg, H.-U. Zuehlke & M. Grimm
3D-Micromac, Chemnitz, Germany

2BO.3.5 Towards Multi-ms Spatially Homogeneous Carrier Lifetimes from Epitaxial Silicon Wafers Grown on Porous Si
S. Kajari-Schröder, C. Gemmel, J. Hensen & R. Brendel
ISFH, Emmerthal, Germany

2BO.3.6 Origin and Impact of Crystallographic Defects in Epitaxially Grown Si Wafers
S. Janz, D. Amiri, E. Gust, S. Kühnhold-Pospischil, S. Riepe, F. Heinz & M. Drießen
Fraunhofer ISE, Freiburg, Germany

ORAL PRESENTATIONS 6BO.7

15:15 - 16:45 Advanced Field Performance Estimation

Chairpersons:
Fabrizio Bonemazzi
ENEL, Italy
Giorgio Graditi
ENEA, Italy

6BO.7.1 Survey on Yield of PV Systems in Germany 2014 to 2016
H. te Heesen & M. Rumpler
Trier University of Applied Science, Neubrücke, Germany
V. Herbort
Ulm University of Applied Sciences, Germany

6BO.7.2 Statistical Analysis of the Performance Loss Rate of PV Plants Distributed in a Region: A Real-Case Study in South Tyrol
G. Belluardo, P. Ingenhoven & D. Moser
EURAC, Bolzano, Italy
M. Pierro & C. Cornaro
University of Rome, Italy

6BO.7.3 A 368-kWp Grid-Connected PV System: Known and Hidden Losses
G.H. Yordanov, G. Verbeek, K. Baert & J. Driesen
KU Leuven, Belgium
F. Smolders
KU Leuven, Geel, Belgium
A. Olaerts
Affluent Energy, Leuven, Belgium

6BO.7.4 Comparison of Soiling Sensitivity of the Performance of Polycrystalline and Amorphous Photovoltaic Systems in Benguerir, Morocco
H. Zitouni, A. Alami Merrouni, Z. Naimi & B. Ikken
IRESEN, Rabat, Morocco
A. Bennouna
Cadi Ayyad University, Marrakech, Morocco
M. Regragui & M. Regragui
University Mohammed V-Agdal, Rabat, Morocco

6BO.7.5 Effects of Urban Environment on Solar PV Performance
P. Moraitis, B.B. Kausika & W.G.J.H.M. van Sark
Utrecht University, Netherlands

6BO.7.6 Machine Learning PV System Performance Analyser
S. Rodrigues
M-ITI, Funchal, Portugal
H. Geirinhas Ramos
University of Lisbon, Portugal
F. Morgado-Dias
University of Madeira, Funchal, Portugal

Tuesday, 26 September 2017

ORAL PRESENTATIONS 3BO.11

15:15 - 16:45 Kesterites

Chairpersons:
Marc Meuris
imec, Belgium
Susanne Siebentritt
University of Luxembourg, Luxembourg

3BO.11.1 Insights into the Formation Pathways of Cu2ZnSnSe4 Using Rapid Thermal Processes
A. Hernández-Martínez, M. Placidi, L. Arqués, S. Giraldo, Y. Sánchez, V. Izquierdo-Roca, P. Pistor & E. Saucedo
IREC, Barcelona, Spain

3BO.11.2 New Strategy to Deal with the Interface Problem - Improving Pure Sulfide Cu2ZnSnS4 Solar Cell towards 10% Efficiency
K. Sun, J. Huang, C. Yan, F. Liu, X. Hao & M.A. Green
UNSW Australia, Sydney, Australia
S.W. Johnson
NREL, Golden, United States

3BO.11.3 Characterization and Simulation of Cu2ZnSnS4 Absorber Layers Fabricated by Sequential DC Magnetron Sputtering and Rapid Thermal Processing
M. Zhukova, R. Kotipalli & D. Flandre
Catholic University of Leuven, Louvain-la-Neuve, Belgium
L. Samain & L. Fourdrinier
CRM Group, Liège, Belgium

3BO.11.4 Optimization of CZGeSe/CdS Interface
L. Choubrac, L. Arzel, S. Harel, L. Assmann & N. Barreau
University of Nantes, France
G. Brammertz & M. Meuris
imec, Diepenbeek, Belgium
B. Vermang
Hasselt University, Belgium

3BO.11.5 Compositional and Electronic In-Depth Analysis of the CdS/Cu2ZnGeSe4 Solar Cell Interface
X. Kozina, C. Hartmann, R. Félix, R.G. Wilks & M. Bär
HZB, Berlin, Germany
L. Choubrac
University of Nantes, France
G. Brammertz & M. Meuris
imec, Diepenbeek, Belgium
B. Vermang
imec, Heverlee, Belgium

3BO.11.6 Sodium Doping Strategies for Vacuum Processed Cu2ZnSnSe4 Solar Cells
C. Andres, S.G. Haass, R. Carron, Y.E. Romanyuk & A.N. Tiwari
EMPA, Dübendorf, Switzerland
R. Caballero
UAM, Madrid, Spain

VISUAL PRESENTATIONS 6BV.3

15:15 - 16:45 **Solar Resource and Forecasting / Building, Infrastructure and Landscape Applications / Grid and Energy System Integration**

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

ORAL PRESENTATIONS 2BO.4

17:00 - 18:30 **Novel Approaches for c-Si Solar Cells**

Chairpersons:
Stefan W. Glunz
Fraunhofer ISE, Germany
Thorsten Dullweber
ISFH, Germany

2BO.4.1 **Wide-Band Gap Silicon Carbide for Front Side Carrier Selective Contacts**
A. Ingenito, G. Nogay, J.A. Stuckelberger, P. Wyss, F.-J. Haug, P. Löper & C. Ballif
EPFL, Neuchâtel, Switzerland
J. Horzel, C. Allebé & M. Despeisse
CSEM, Neuchâtel, Switzerland

2BO.4.2 **Principles of Carrier-Selective Contacts Based on Induced Junctions**
M. Bivour, C. Messmer, L. Neusel, F. Zähringer, J. Schön, M. Hermle & S.W. Glunz
Fraunhofer ISE, Freiburg, Germany
T. Matsui
AIST, Tsukuba, Japan

2BO.4.3 **EU PVSEC Student Award Winner Presentation: Locally Conductive Transport Channel Formation in High Temperature Stable Hole-Selective Silicon-Rich Silicon Carbide Passivating Contact**
G. Nogay, J. Stuckelberger, P. Wyss, Q. Jeangros, F.-J. Haug, P. Löper & C. Ballif
EPFL, Neuchâtel, Switzerland
M. Hyvl, M. Ledinsky & A. Fejfar
ASCR, Prague, Czech Republic
C. Allebé & M. Despeisse
CSEM, Neuchâtel, Switzerland

2BO.4.4 **Thermal Stability of Novel Hole-Selective Contacts for Silicon Wafer Solar Cells**
C.-Y. Lee, T. Zhang, K. Khoo & B. Hoex
UNSW Australia, Sydney, Australia
A.A. Abdallah, S. Rashkeev & N. Tabet
QEERI, Doha, Qatar

2BO.4.5 **High Efficiency Locally Laser Doped IBC Solar Cells**
M. Ernst, E. Franklin, T.K. Chong, E.C. Wang, K.C. Fong, T. Kho & A. Blakers
ANU, Canberra, Australia

2BO.4.6 **Optical Performance Enhancement of Flat Silicon Solar Cells and Their Tandems with PDMS Scattering Layers**
S. Manzoor, Z.J. Yu, A. Ali, W. Ali & Z.C. Holman
Arizona State University, Tempe, United States
K.A. Bush, A.F. Palmstrom, S.F. Bent & M.D. McGehee
Stanford University, United States

Tuesday, 26 September 2017

ORAL PRESENTATIONS 6BO.8

17:00 - 18:30 **Failure Modes and Degradation**

Chairpersons:
Christian Camus
ZAE Bayern, Germany
Marko Topic
University of Ljubljana (UL FE), Slovenia

6BO.8.1 **Effect of PID on Energy Conversion Efficiency of Crystalline Silicon Photovoltaic Power Plant**
H. Yang, J. Chang, H. Wang, F. Wang & P. Zhao
Xi'an Jiaotong University, China

6BO.8.2 **Quantitative Study of Potential Induced Degradation of a Roof-Top PV-Installation with IR-Imaging**
C. Buerhop-Lutz, T. Pickel, F.W. Fecher, C. Camus & J. Hauch
ZAE Bayern, Erlangen, Germany
C. Zetzmann
Rauschert, Pressig, Germany
C.J. Brabec
University of Erlangen-Nuremberg, Germany

6BO.8.3 **Scientific Investigation of a PV Generator After Hail**
W. Mühleisen, L. Neumaier & C. Hirschl
CTR, Villach, Austria
M. Spielberger
PVSV, Guttaring, Austria
H. Sonnleitner
ENcome, Klagenfurt, Austria
Y. Voronko
OFI, Vienna, Austria

6BO.8.4 **The Development of Cell Thickness Reduction of Crystalline Solar Cells in PV Modules and Its Impacts on Large PV Power Plants**
E. Cunow
LSPV Consulting, Gröbenzell, Germany

6BO.8.5 **Experimental Assessment of Performance Degradation for a PV Power Plant Operating in a Desert Maritime Climate**
D. Hassan Daher, L. Gaillard & M. Amara
INSA Lyon, Villeurbanne, France
C. Ménézo
LOCIE, Le Bourget du Lac, France

6BO.8.6 **Implementation of an Accurate Measurement Procedure to Determinate Maximum Power of Modules at Standard Test Conditions in the Field through Correlation with Measurements Carried Out in Laboratory**
L. Perez, J.A. Florez, M. Martinez, F. Domínguez, G. Castillo, R. Gomez, M. Fernández, V. Parra & A. Velasco
Enertis Solar, Alcobendas, Spain

ORAL PRESENTATIONS 3BO.12

17:00 - 18:30 Organic Based PV

Chairpersons:
Bruno Ehrler
AMOLF, Netherlands
Ching-Fuh Lin
NTU, Taiwan

3BO.12.1 **Phosphor Particles for Luminescent Down-Shifting in Photovoltaics: Determination of Complex Refractive Indices**
B. Lipovsek, J. Krc & M. Topic
University of Ljubljana, Slovenia
A. Solodovnyk, J. Gast & E. Stern
ZAE Bayern, Erlangen, Germany
D. Riedel, A. Osvet, K. Forberich, M. Batentschuk & C.J. Brabec
University of Erlangen-Nuremberg, Germany

3BO.12.2 **TiO2 Coated ZnO Core/Shell Electrodes Applying in Dye-Sensitized Solar Cell**
C. Li & S. Hou
Kochi University of Technology, Kami, Japan

3BO.12.3 **Power Matrix Measurements and Energy Rating Analysis of Organic PV Mini-Modules**
G. Bardizza, E. Salis, A.M. Gracia Amillo, T. Huld & E. Dunlop
European Commission JRC, Ispra, Italy

3BO.12.4 **Development of a Reproducible Laser Structuring Process of Stacked Thin Films on Ultra-Barrier Films for Organic Solar Devices**
N. Friedrich-Schilling & B. Gburek
Heliatek, Dresden, Germany
H. Fledderus
Holst Centre, Eindhoven, Netherlands
T. Kuntze
Fraunhofer IWS, Dresden, Germany
F. Peuckert
3D-Micromac, Chemnitz, Germany

3BO.12.5 **Roll to Roll Printed Polymeric Photovoltaic Modules based on P3HT (Poly(3-Hexiltiophene)) and Fullerene: A Comparison between PCBM (Phenyl-C61-Butyric Acid Methyl Ester) and ICBA (Indene-C60 Bisadduct)**
P. Apilo, M. Välimäki, K.-L. Väisänen, M. Ylikunnari & J. Hast
VTT, Oulu, Finland
R. Po, A. Bernardi & G. Corso
eni spa, Novara, Italy
M. Vilkman
VTT, Espoo, Finland

3BO.12.6 **Evaluation Emerging PV Performance Rating under Indoor Lighting Simulator**
Y.-S. Long, E.-Y. Wang, S.-T. Hsu & T.-C. Wu
ITRI, Hsinchu, Taiwan
M.-A. Tsai
ITRI, Chutung, Taiwan

VISUAL PRESENTATIONS 5BV.4

17:00 - 18:30 PV Module Performance and Reliability (I)

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

Wednesday, 27 September 2017

ORAL PRESENTATIONS 1CO.1

08:30 - 10:00 Advanced Materials and Technologies for PV Modules

Chairpersons:
Jozef (Jef) Poortmans
imec, Belgium
Marta Victoria Pérez
UPM, Spain

1CO.1.1 **Shingling Technology for Cell Interconnection: Technological Aspects and Process Integration**
D. Tonini, M. Bertazzo, A. Fecchio & M. Galiazzo
Applied Materials, Olmi di San Biagio, Italy

1CO.1.2 **FEM-Based Development of Novel Back-Contact PV Modules with Ultra-Thin Solar Cells**
A.J. Beinert & U. Eitner
Fraunhofer ISE, Freiburg, Germany
R. Leidl
AIT, Vienna, Austria
P.M. Sommeling
ECN, Petten, Netherlands
J. Aktaa
Karlsruhe Institute of Technology, Germany

1CO.1.3 **Effects of Tuning the Innovative Additive-Free Silver Paste Formulation for Fine Line Printing and High Efficiency**
C. Yüce & N. Willenbacher
Karlsruhe Institute of Technology, Germany
A. Grumbach & M. König
Heraeus, Hanau, Germany
F. Clement, M. Linse & M. Pospischil
Fraunhofer ISE, Freiburg, Germany

1CO.1.4 **TPedge: Progress on Cost-Efficient and Durable Edge-Sealed PV Modules**
M. Mittag & U. Eitner
Fraunhofer ISE, Freiburg, Germany
T. Neff
Bystronic, Neuhausen, Germany

1CO.1.5 **How Cell Texturing Impacts Annual Yield of Solar Modules and the Role of Module Embedding**
I. Haedrich, A. Thomson, M. Ernst & D. Macdonald
ANU, Canberra, Australia
P. Zheng, X. Zhang & H. Jin
Jinko Solar, Haining, China

1CO.1.6 **New Chemical Functionalization Concept for Anti-Reflective and Anti-Soiling Front Glass of PV Modules Based on Surface Structuring and Modification**
C. Pfau, K. Ilse, J. Schneider, M. Turek, P. Miclea & C. Hagendorf
Fraunhofer CSP, Halle, Germany
P. Zabek & W. Szczepanik
DA Glass, Rzeszów, Poland

ORAL PRESENTATIONS 5CO.5

08:30 - 10:00 Performance Enhancing Coatings and Outdoor Performance

Chairpersons:
Mike Van Iseghem
EDF R&D, France
Sener Oktik
Sisecam, Turkey

5CO.5.1 High-Performance AR Coating on Glass Applied Using High-Pressure Molding
J. Jong & E. Brouwer
TOWA Europe, Duiven, Netherlands
V. Rosca, A.R. Burgers, A.J. Carr & L.A.G. Okel
ECN, Petten, Netherlands

5CO.5.2 PV Module Sand Abrasion Testing
G. Mathiak, N. Pfeiffer, L. Rimmelspacher, W. Herrmann, F. Reil & J. Althaus
TÜV Rheinland Energy, Cologne, Germany
C. Holze
toughtrough, Bremen, Germany
A. Morlier
ISFH, Emmerthal, Germany

5CO.5.3 Evaluation of Antireflection and Antisoiling Coatings for PV Modules in the Atacama Desert
D. Diaz Almeida, F. Araya & P. Ferrada
University of Antofagasta, Chile
A. Sanz Martinez
Tecnalia Research & Innovation, Derio, Spain
N. Yurrita & O. Zubillaga
Tecnalia, San Sebastian, Spain

5CO.5.4 Estimation of Soiling Rates from PV Modules in the Desert Climate of Dubai
J.J. John, A. Elnosh, A. Safieh, A. Almheiri, M. Stefancich & P. Banda
Dubai Electricity and Water Authority, United Arab Emirates

5CO.5.5 Performance and Reliability of Photovoltaic Modules in Desert Environment
A.A. Abdallah, A. Abotaleb, M. Houchati & M. Buffière
QEERI, Doha, Qatar

5CO.5.6 Long Term Statistics over 6 Years on Micro Cracks and Their Impact on Performance
J. Arp
PV Lab, Potsdam, Germany
B. Jaeckel
UL International, Neu-Isenburg, Germany

Wednesday, 27 September 2017

ORAL PRESENTATIONS 2CO.9

08:30 - 10:00 Production Technologies for Silicon Solar Cells

Chairpersons:
Axel Metz
Germany
Adrien Danel
CEA, France

2CO.9.1 Pilot Production of High Efficient MCT Textured DWS mc-Si Solar Cell and Nickel-Copper Plated Front Contacts
D. Pysch, J. Burschik, N. Bay, W. Dümpelfeld, H. Kühnlein, M. Passig, M. Sieber, K. Vosteen & K. Vosteen
RENA, Freiburg, Germany
B. Lee & A. Letize
MacDermid, Waterbury, United States

2CO.9.2 Development and Optimization of a Novel Inline Black Silicon Texturing Process for Increased Solar Cell Performance
W. Jooss, I. Melnyk, A. Teppe, T. Werling, O. Voigt, F. Binaie Masouleh & P. Fath
RCT-Solutions, Konstanz, Germany
B. Hu, Q. Zhang & P. Tian
RCT Automation Equipment, Suzhou, China
X. Gou, W. Fan, S. Zhou, Q. Huang, J. Huang & X. Zhang
CECEP Solar Energy Technology, Zhenjiang, China

2CO.9.3 High Throughput Printing for Highly Efficient Cost-Effective Si Solar Cells
F. Clement, A. Lorenz, M. Pospischil, D. Biro & R. Preu
Fraunhofer ISE, Freiburg, Germany
H. Brocker, D. Bangel, R. Greutmann & M. Lehner
Gallus Ferd. Rüesch, St. Gallen, Switzerland
T. Ott, F. Hage, K. Oppelt, T. Honold & L. Wende
ASYS, Dornstadt, Germany
A. Senne
ContiTech, Northeim, Germany
J. Rohde
Zecher, Paderborn, Germany

2CO.9.4 Production-Compatible Regeneration of Boron-Doped Czochralski-Silicon in a Combined Fast-Firing and Regeneration Belt-Line Furnace
D.C. Walter, V. Steckenreiter & J. Schmidt
ISFH, Emmerthal, Germany
T. Pernau
centrotherm photovoltaics, Blaubeuren, Germany

2CO.9.5 In-Line Capable Ultrafast Regeneration Process for Preventing Light Induced Degradation of Boron Doped p-Type Cz-Si PERC Solar Cells
A.A. Brand, K. Krauß, S. Gutscher, S. Roder, S. Rein & J. Nekarda
Fraunhofer ISE, Freiburg, Germany

2CO.9.6 Mass Production of Q.ANTUM Solar Cells and Modules on p-Type Cz Silicon Substrates
F. Fertig, R. Lantzsch, A. Mohr, M. Schaper, F. Kersten, S. Bordihn, M. Bartzsch, D. Wissen, A. Mette, S. Peters, A. Eidner, M. Schütze, J. Cieslak, K. Duncker, M. Junghänel, E. Jarzembowski, M. Kauert, S. Geißler, S. Hörnlein, C. Klenke, L. Niebergall, A. Schönmann, A. Weihrauch, A. Hofmann, T. Rudolph, A. Schwabedissen, J.W. Müller & D.J.W. Jeong
Hanwha Q CELLS, Bitterfeld-Wolfen, Germany

ORAL PRESENTATIONS 6CO.13

08:30 - 10:00 Bifacial and Shaded System Performance

Chairpersons:
Khalid Radouane
EDF EN, France
Robert P. Kenny
European Commission JRC, Italy

6CO.13.1 Data Analysis for Effective Monitoring of Partially Shaded Photovoltaic Systems
O. Tsafarakis & W.G.J.H.M. van Sark
Utrecht University, Netherlands
K. Sinapis
ECN, Eindhoven, Netherlands

6CO.13.2 Effects of Combining Shading Analysis and the Unique I-V Characteristics of the PV Module
R. Herrero Alonso, R. Silva Simplicio, C. Biasi de Moura, A. Alves Myazaki & M. Knörich Zuffo
University of São Paulo, Brazil

6CO.13.3 Outdoor Field Performance from Bifacial Photovoltaic Modules and Systems
J.S. Stein, D.S. Riley, M. Lave & C.W. Hansen
Sandia National Laboratories, Albuquerque, United States
C. Deline
NREL, Golden, United States
F. Toor
University of Iowa, United States

6CO.13.4 Performances Estimation of Bifacial PV Modules: a Simulation Approach through Both Physical and Semi-Empirical Math Models and Its Validation Using a Real Bifacial Plant Data
M. Catena, I. Cascone, C. Lo Piano & M. Carbone
ENEL, Rome, Italy

6CO.13.5 Bifacial Performance Assessment with One Simulation Tool in Development, and One Monitored 50 KWc Outdoor Power Plant Demonstrator
E. Pilat, J. Sayritupac, H. Colin, F. Haffner & Y. Veschetti
CEA, Le Bourget du Lac, France

6CO.13.6 Simulation Resolution of PV System Partial Shading Studies
K. Lappalainen & S. Valkealahti
Tampere University of Technology, Finland

VISUAL PRESENTATIONS 3CV.1

08:30 - 10:00 CI(G)S, CdTe and Related Thin Film Solar Cells and Modules (I)

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

Wednesday, 27 September 2017

PLENARY SESSION 3CP.1

10:30 - 12:00 Thin Film PV: Pushing the Limits with Breakthroughs in Industry and Research

Chairpersons:
Ayodhya Nath Tiwari
EMPA, Switzerland
Sjoerd Veenstra
ECN, Netherlands

3CP.1.1 Keynote: Present Status of Solar Frontier Cu(In,Ga)(Se,S)2 Record Efficiencies and Overall Progress
V. Bermudez, K.F. Tai, J.-L. Wu, A. Handa, T. Yagioka, H. Sugimoto & T. Kato
Solar Frontier, Atsugi, Japan

3CP.1.2 17% Total Area Efficiency at Commercial Size CIGS Module
P. Kratzert, S. ten Haaf, S. Hartnauer, S. Jander, R. Hunger, M. Vogl & S. Weeke
Solibro Hi-tech, Bitterfeld-Wolfen, Germany
O. Lundberg, E. Wallin, V. Gusak, S. Lotfi, U. Malm, T. Jarmar, L. Stolt & J. Mathiasson
Solibro Research, Uppsala, Sweden

3CP.1.3 Enhancements to CdTe Cell Efficiency
J.R. Sites, A. Munshi, J. Kepart, D. Swanson, A. Moore & W. Sampath
Colorado State University, Fort Collins, United States

3CP.1.4 Progress with Perovskite/Silicon and All-Perovskite Tandem Solar Cells
M.A. Green & A.W.Y. Ho-Baillie
UNSW Australia, Sydney, Australia

ORAL PRESENTATIONS 1CO.2

13:30 - 15:00 New Materials and Advanced Applications for Photovoltaics

Chairpersons:
Ignacio Antón
UPM, Spain
Jens Schneider
Fraunhofer CSP, Germany

1CO.2.1 Low-Cost Large-Area Graphene Layer Deposition for Transparent Conducting Electrodes in Photovoltaics
G. Jia, J. Plentz, J. Dellith, A. Dellith & G. Andrä
IPHT, Jena, Germany

1CO.2.2 Solar-Driven Water Spliting: 14.2% Stable Solar-to-Fuel Conversion Efficiency Using Silicon Heterojunction Solar Cells
J.-W. Schüttauf, A. Faes, M. Despeisse, C. Ballif & J. Bailat
CSEM, Neuchâtel, Switzerland
M.A. Modestino, E. Chinello, D. Psaltis & C. Moser
EPFL, Lausanne, Switzerland

1CO.2.3 Fabrication and Characterization of White-Light Solar Windows Based on a Glass Waveguide Plate
G. Lee & M. Shin
Korea Aerospace University, Goyang, Korea South
G.Y. Lee & H. Ko
KIST, Seoul, Korea South

1CO.2.4 **Combined Interconnection and Lamination of Bifacial Busbarless Cells through Woven Wiring**
T. Borgers, J. Govaerts, E. Voroshazi, J. Szlufcik & J. Poortmans
imec, Leuven, Belgium
J. D´Haen & P. Nivelle
imomec, Leuven, Belgium

1CO.2.5 **Co-Extrusion of a Novel Multilayer Photovoltaic Backsheet Based on Polyamide-Ionomer Alloy Skin Layers**
C. Thellen, A. Rothacker, R. Davis & D. Santoleri
Tomark-Worthen, Nashua, United States

1CO.2.6 **Using Photovoltaic Concepts to Improve the Back Surface Field of an Amorphous Silicon Carbide (a-SiC:H) Photocathode**
P. Perez Rodriguez, I. Digdaya, A. Mangel Raventos, R. Vasudevan, M. Zeman, W. Smith & A.H.M. Smets
Delft University of Technology, Netherlands

ORAL PRESENTATIONS 5CO.6

13:30 - 15:00 **Potential Induced Degradation, Light & Elevated Temperature Induced Degradation and Partial Shading Effects on PV Modules**

Chairpersons:
Roland Einhaus
Apollon Solar, France
Christos Monokroussos
TÜV Rheinland, China

5CO.6.1 **Voltage Dependence of Potential-Induced Degradation and Recovery on Photovoltaic One-Cell Laminates**
J. Carolus & M. Daenen
Hasselt University, Belgium
J. Govaerts, E. Voroshazi & W. De Ceuninck
imec, Leuven, Belgium

5CO.6.2 **Investigation of Correlation between Field Performance and Indoor Acceleration Measurements of Potential Induced Degradation (PID) for c-Si PV Modules**
Y. Chen, Z. Wang, P.P. Altermatt, Z. Feng & P.J. Verlinden
Trina Solar Energy, Changzhou, China
K. VanSant
Colorado School of Mines, Golden, United States
C. Deline, P. Hacke & S.R. Kurtz
NREL, Golden, United States
Y.S. Khoo, W. Luo, J. Chai, Y. Wang & A.G. Aberle
SERIS, Singapore, Singapore

5CO.6.3 **Potential-Induced Degradation of Photovoltaic Modules Composed of Interdigitated Back Contact Solar Cells Observed in an Actual Photovoltaic System**
T. Ishii
CREIPI, Yokosuka, Japan
R. Sato, S. Choi, Y. Chiba & A. Masuda
AIST, Tosu, Japan

Wednesday, 27 September 2017

5CO.6.4 **Performance Loss Induced by LeTID in the Field: Experiment and Simulation**
F. Kersten, F. Fertig, K. Petter, B. Klöter, M.B. Strobel & J.W. Müller
Hanwha Q CELLS, Bitterfeld-Wolfen, Germany
E. Herzog
Hanwha Q CELLS, Berlin, Germany
J. Heitmann
Freiberg University of Technology, Germany

5CO.6.5 **A Detailed Analysis of Visible Defects Formed in Silicon Thin-Film Modules by Partial Shading**
A. Gerber, C. Zahren, B.E. Pieters & U. Rau
Forschungszentrum Jülich, Germany
S.W. Johnson
NREL, Golden, United States

5CO.6.6 **Shadows from People and Tools Can Cause Permanent Damage in Monolithic Thin-Film Photovoltaic Modules**
T.J. Silverman & I. Repins
NREL, Golden, United States

ORAL PRESENTATIONS 2CO.10

13:30 - 15:00 **c-Si Solar Cell Process Technology**

Chairpersons:
Jörg Horzel
CSEM, Switzerland
Joachim John
imec, Belgium

2CO.10.1 **Constructing Submicron-Texture on Diamond-Wire-Sawn Multi-Crystalline Silicon Solar Cells via Copper Catalyzed Chemical Etching**
X. Su, J. Zha, T. Wang, C. Pan, K. Chen & F. Hu
Soochow University, Suzhou, China

2CO.10.2 **Early Efficiency Prediction of Silicon Heterojunction Cells Processed on Thermal Donors-Rich Czochralski Wafers**
J. Veirman, R. Varache, A. Danel, M. Albaric, E. Letty, B. Martel & C. Roux
CEA, Le Bourget du Lac, France

2CO.10.3 **Towards "Defect-Free" n-Type Emitters Using Oxygen during POCl3 Diffusion**
H. Li, F.-J. Ma, Z. Hameiri, S.R. Wenham & M. Abbott
UNSW Australia, Sydney, Australia

2CO.10.4 **Solar Cell Efficiency of 23.3% Reached by Rapid Vapour Direct Diffused Emitter**
S. Kühnhold-Pospischil, A. Richter, B. Steinhauser, M. Drießen, B. Michl, J. Greulich, J. Benick & S. Janz
Fraunhofer ISE, Freiburg, Germany
S. Lindekugel
SICK, Waldkirch, Germany

2CO.10.5 **Charge-Controllable Mg-Doped AlOx Passivation Layers for p- and n-Type Silicon**
H. Lee, T. Kamioka, N. Iwata & Y. Ohshita
TTI, Nagoya, Japan
F. Nishimura & H. Yoshida
University of Hyogo, Himeji City, Japan

2CO.10.6 **Laser-Transferred Ni-Seed for the Metallization of Silicon Heterojunction Solar Cells by Cu-Plating**
A. Rodofili, R. Rohit, J. Becerra, F. Al-Falahi, G. Cimiotti, W. Wolke, L. Kroely, M. Bivour, J. Bartsch, M. Glatthaar & J.-F. Nekarda
Fraunhofer ISE, Freiburg, Germany

ORAL PRESENTATIONS 6CO.14

13:30 - 15:00 Design of PV Plants & Hybrid Systems and Their Applications

Chairpersons:
Nigel Taylor
European Commission JRC, Italy
Stephen Koopman
CSIR, South Africa

6CO.14.1 **La Silla PV Plant as a Utility-Scale Side-by-Side Test for Innovative Modules Technologies**
A. Di Stefano, G. Leotta & F. Bizzarri
ENEL Green Power, Catania, Italy

6CO.14.2 **Validation Study of Solar PV Energy Simulation Tools and Methodologies**
M. Aspinall
Prevailing Analysis, Bristol, United Kingdom

6CO.14.3 **Managing Technical Risks in PV Investments – How to Quantify the Impact of Risk Mitigation Measures for Different PV Project Phases?**
U. Jahn & M. Herz
TÜV Rheinland Energy, Cologne, Germany
D. Moser & G. Belluardo
Eurac Research, Bolzano, Italy
M. Richter
3E, Brussels, Belgium

6CO.14.4 **Review of Different Software Solutions for the Holistic Simulation of Distributed Hybrid Energy Systems for the Commercial Energy Supply**
L. Schmeling
University of Oldenburg, Germany
P. Klement, B. Hanke, K. von Maydell & C. Agert
NEXT ENERGY, Oldenburg, Germany
T. Erfurth & J. Kästner
KEHAG Energiehandel, Oldenburg, Germany

6CO.14.5 **Advanced Modelling of EIPV Systems from Location to Load**
O. Isabella, R. Caroprese Castro, R. Santbergen & M. Zeman
Delft University of Technology, Netherlands

6CO.14.6 **Laboratory of Hybrid Systems and Mini-Grids**
C. Barbosa & J. Correa
UFPA, Ananindeua, Brazil
J.T. Tavares Pinho, M.A. Barros Galhardo, J. Verissimo, I. Lemos & E.M.D. Pereira
UFPA, Belém, Brazil
A.R. Arrifano Manito
University of São Paulo, Brazil

Wednesday, 27 September 2017

VISUAL PRESENTATIONS 2CV.2

13:30 - 15:00 Thin Film and Foil-Based Solar Cells / Characterisation & Simulation Methods / Manufacturing & Production

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

ORAL PRESENTATIONS 3CO.3

15:15 - 16:45 Materials, Interfaces & Charge Dynamics in Perovskite Solar Cells

Chairpersons:
Brett Kamino
CSEM, Switzerland
Klaus Jäger
HZB, Germany

3CO.3.1 **Atomic Layer Deposition Processing for Perovskite Solar Cells: Opportunities and Challenges**
Y. Kuang, D. Koushik, R.J. van Gils, W.M.M. Kessels & M. Creatore
Eindhoven University of Technology, Netherlands
V. Zardetto
Solliance, Eindhoven, Netherlands
R.E.I. Schropp
University Utrecht, Netherlands

3CO.3.2 **Contact Passivation for Efficient and Stable Low-Temperature-Processed Planar Perovskite Solar Cells**
H. Tan, A. Jain, O. Voznyy, S. Hoogland & E.H. Sargent
University of Toronto, Canada

3CO.3.3 **Long-Lived Carriers Found in Double Metal Perovskite Cs2AgBiBr6 Single Crystals by TRMC**
D. Bartesaghi & T. Savenije
Delft University of Technology, Netherlands
A. Slavney & H. Karunadasa
Stanford University, United States

3CO.3.4 **Anharmonicity and Dielectric Properties in Hybrid and Inorganic Perovskite Materials Used for Photovoltaics Applications**
A. Marronnier, H. Lee, D. Tondelier, B. Geffroy, J.-E. Bouree & Y. Bonnassieux
CNRS, Palaiseau, France
C. Eypert & J.P. Gaston
HORIBA, Palaiseau, France
G. Roma
University of Paris Saclay, France

3CO.3.5 **Determination of Charge Transport Properties and Their Limiting Factors in Hybrid Perovskite Photovoltaic Devices via Time-Resolved Photocurrent Studies**
I. Grill, M. Aygüler, N. Giesbrecht, T. Bein, P. Docampo, N.F. Hartmann, M. Handloser & A. Hartschuh
LMU Munich, Germany

3CO.3.6 **Enhanced Environmental Stability of ZnO Film Based Planar Perovskite Solar Cells by Suppressing Photocatalytic Decomposition**
S. Li, P. Zhang, Y. Wang, D. Liu, Z. Wang & Z.D. Chen
UESTC, Chengdu, China
J. Wu
University College London, United Kingdom

ORAL PRESENTATIONS 5CO.7

15:15 - 16:45 Bifacial Characterisation, Energy Rating and Yield Prediction

Chairpersons:
Hartmut Nussbaumer
ZHAW, Switzerland
Ralph Gottschalg
Loughborough University, United Kingdom

5CO.7.1 **Single-Side Versus Double-Side Illumination Method I-V Characterization for Bifacial PV Modules under Different Irradiances and Temperatures**
S. Roest, W. Nawara & E. Garcia Goma
Eternal Sun, The Hague, Netherlands
B.B. Van Aken
ECN, Petten, Netherlands

5CO.7.2 **Electrical Performance of Bifacial PV Modules – Comparative Measurements of Market-Ready Products**
M. Schweiger & W. Herrmann
TÜV Rheinland Energy, Cologne, Germany

5CO.7.3 **Comparison of Electrical Performance of Bifacial Silicon PV Modules**
J. Lopez-Garcia & T. Sample
European Commission JRC, Ispra, Italy

5CO.7.4 **Progress in Energy Rating Standards: Accuracy and Optimisation**
J.C. Blakesley
National Physics Laboratory, Teddington, United Kingdom
T. Huld & H. Müllejans
European Commission JRC, Ispra, Italy

5CO.7.5 **Energy Rating of Commercial c-Si PV-Modules in Accordance with IEC 61853-1,-2 and Impact on the Annual Energy Yield**
C. Monokroussos, X.Y. Zhang, D. Etienne, S. ChanKam, A. Zhou, V. Feng, Y. Zhang & C. Zou
TÜV Rheinland, Shanghai, China
M. Schweiger
TÜV Rheinland, Cologne, Germany

5CO.7.6 **A Systematic Comparison of >7 Empirical Models Used for Energy Yield Predictions vs PV Technology**
S. Ransome
Steve Ransome Consulting, Kingston upon Thames, United Kingdom

Wednesday, 27 September 2017

ORAL PRESENTATIONS 2CO.11

15:15 - 16:45 c-Si Homojunction Cells

Chairpersons:
Arthur W. Weeber
ECN, Netherlands
Jörg Müller
Hanwha Q CELLS, Germany

2CO.11.1 **Key Aspects for Fabrication of p-Type Cz-Si PERC Solar Cells Exceeding 22% Conversion Efficiency**
S. Werner, E. Lohmüller, P. Saint-Cast, J.M. Greulich, J. Weber, S. Maier, A. Moldovan, A.A. Brand, T. Dannenberg, S. Mack, S. Wasmer, M. Demant, M. Linse, R. Ackermann, A. Wolf & R. Preu
Fraunhofer ISE, Freiburg, Germany

2CO.11.2 **Formation of Cu-Containing Precipitates at mc-LID Sensitive mc-PERC Cells**
T. Luka, M. Turek, S. Großer & C. Hagendorf
Fraunhofer CSP, Halle, Germany

2CO.11.3 **Bifacial p-Type PERL Solar Cells with Screen-Printed Pure Ag Metallization and 89% Bifaciality**
E. Lohmüller, S. Werner, M.H. Norouzi, S. Mack, M. Demant, S. Gutscher, P. Saint-Cast, M. Hermle & A. Wolf
Fraunhofer ISE, Freiburg, Germany
B. Bitnar, P. Palinginis & H. Neuhaus
SolarWorld Innovations, Freiberg, Germany
M. König
Heraeus, Hanau, Germany

2CO.11.4 **Research of Industrial High Efficiency n-Type Solar Cell with Selective Back Surface Field Process**
D. Liu, Z. Wang, J. Zhai, F. Li, J. Shi & D. Song
Yingli Green Energy, Baoding, China

2CO.11.5 **Large-Area (6 Inch) Screen-Printed IBC Solar Cells with Efficiency Approaching 24% without Passivated Contacts**
G. Xu, Y. Yang, X. Zhang, S. Chen, W. Liu, Y. Chen, Y. Chen, P.P. Altermatt, P.J. Verlinden & Z. Feng
Trina Solar Energy, Changzhou, China

2CO.11.6 **Quantification of pn-Junction Recombination in Industrial Interdigitated Back-Contact Solar Cells**
B.W.H. van de Loo & W.M.M. Kessels
Eindhoven University of Technology, Netherlands
P. Spinelli & I. Cesar
ECN, Petten, Netherlands
A.H.G. Vlooswijk
Tempress, Vaassen, Netherlands

ORAL PRESENTATIONS 6CO.15

15:15 - 16:45 Innovative O&M and Inspection Methods and Safety Aspects

Chairpersons:
Felice Montanari
ENEL Green Power, Italy
Gerhard Mütter
Alternative Energy Solutions, Austria

6CO.15.1 **Field Testing of Portable LED Flasher for Nominal Power Measurements of PV-Modules On-Site**
R. Knecht, F.P. Baumgartner & F. Carigiet
ZHAW, Winterthur, Switzerland
C. Frei & F. Beglinger
Electrosuisse, Fehraltdorf, Switzerland
W. Zaaiman, D. Pavanello, M. Field, R. Galleano & T. Sample
European Commission JRC, Ispra, Italy

6CO.15.2 **Dynamic IV Analysis System for Diagnosis of PV-Module Strings in a Large Scale PV-Power Plant**
M. Vervaart, S. Lespinats & F. Al Shakarchi
CEA, Le Bourget du Lac, France

6CO.15.3 *Invited*

6CO.15.4 **Implementation of a Friendly Daylight Electroluminescence System for the Inspection of Solar PV Panels**
M. Guada, A. Moretón, S. Rodríguez-Conde, O. Martínez, M.A. González, J. Jiménez & J. Pérez
UVa, Valladolid, Spain
M. Martinez, J.A. Florez, F. Domínguez, A. Velasco, L. Perez & V. Parra
Enertis Solar, Madrid, Spain

6CO.15.5 **Digital Plant Lifecycle Record – a New Standard for Efficient PV O&M**
C. Bertsch-Engel
CEE Operations, Hamburg, Germany

6CO.15.6 **NEC2017 Rapid Shutdown: Useful Safety Feature or Unnecessary Nuisance?**
D. Gfeller, J. Wälten, U. Muntwyler, C. Renken & M. Rutschi
BUAS, Burgdorf, Switzerland

VISUAL PRESENTATIONS 1CV.3

15:15 - 16:45 Fundamental Studies / New Materials and Concepts for Cells and Modules

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

Wednesday, 27 September 2017

ORAL PRESENTATIONS 3CO.4

17:00 - 18:30 Processing and Upscaling of Perovskite Solar Cells and Modules

Chairpersons:
Giorgio Bardizza
European Commission JRC, Italy
Tom Aernouts
imec, Belgium

3CO.4.1 **Scaling Limits to Large Area Perovskite Solar Cell Efficiency**
B.M.W. Wilkinson, M.A. Green & A.W.Y. Ho-Baillie
UNSW Australia, Sydney, Australia

3CO.4.2 **Laser-Patterning Engineering for Perovskite Solar Modules with 95% Aperture Ratio**
A.L. Palma, F. Matteocci, A. Agresti, S. Pescetelli, E. Calabrò, L. Vesce & A. Di Carlo
University of Rome II, Italy
G. Mincuzzi
ALPHANOV, Talence, France
S. Christiansen
MPI, Erlangen, Germany
M. Schmidt
University of Erlangen-Nuremberg, Germany

3CO.4.3 **NIR-Transparent Flexible Perovskite Solar Cells: All-Laser Scribed Mini-Modules Fabricated by Large-Area Scalable Deposition Methods**
S. Pisoni, F. Fu, T. Feurer, A.N. Tiwari & S. Buecheler
EMPA, Dübendorf, Switzerland
R. Ziltener
Flisom, Dübendorf, Switzerland

3CO.4.4 **High Efficiency Perovskite Solar Modules Using a Low-Cost Nanosecond Pulse-Laser Ablation in All P1-P3 Processes**
K.-Y. Tian & W.-F. Su
NTU, Taipei, Taiwan
C.-P. Hsu & H.-C. Liao
Frontmaterials, Taipei, Taiwan

3CO.4.5 **From Sheet-to-Sheet to Roll-to-Roll Production of High Efficiency Flexible Perovskite Solar Cells**
F. Di Giacomo, Y. Galagan, S. Shanmugam, G. Kirchner, H. Gorter, I. de Vries, H. Lifka, P. Groen & R.A.J.M. Andriessen
TNO, Eindhoven, Netherlands
M. Dörenkämper
ECN, Petten, Netherlands
W. Qiu, T. Aernouts & S.C. Veenstra
imec, Leuven, Belgium

3CO.4.6 **Integration of Established Back-End Processing Steps to Perovskite Solar Cells for Scale Up**
B. Kamino, S.-J. Moon, A. Walter, L. Löfgren, D. Sacchetto, G. Cattaneo, J. Levrat, N. Badel, A. Faes, M. Despeisse, J. Bailat, S. Nicolay & C. Ballif
CSEM, Neuchâtel, Switzerland
J. Werner, F. Sahil, M. Bräuniger & B. Niesen
EPFL, Neuchâtel, Switzerland
S. Narbey, F. Oswald & D. Martineau
Solaronix, Aubonne, Switzerland

ORAL PRESENTATIONS 5CO.8

17:00 - 18:30 Accelerated Testing and Imaging Techniques

Chairpersons:
Ulrike Jahn
TÜV Rheinland Energy, Germany
Eszter (Esther) Voroshazi
imec, Belgium

5CO.8.1 **Characterization of Adhesion in Flexible PV Modules Using the Climbing Drum Peel Test Method**
V. Bheemreddy & K. Hardikar
MiaSolé, Santa Clara, United States

5CO.8.2 **Performance Analysis of Pre-Cracked PV-Modules at Realistic Loading Conditions**
C. Buerhop-Lutz, T. Winkler, F.W. Fecher, C. Camus, J. Hauch & C.J. Brabec
ZAE Bayern, Erlangen, Germany
A. Bemm
Allianz Risk Consulting, Munich, Germany

5CO.8.3 **Experimental Investigation of Sensitivities Regarding the In-Laminate Fatigue of Solar Cell Interconnectors**
M. Pander, S. Dietrich & R. Meier
Fraunhofer CSP, Halle, Germany

5CO.8.4 **Degradation Behavior with Acetic Acid in Crystalline Silicon Photovoltaic Cells**
T. Tanahashi, Y. Hara & A. Masuda
AIST, Tsukuba, Japan

5CO.8.5 **Quantification of Solar Cell Failure Signatures Based on Statistical Analysis of Electroluminescence Images**
S.V. Spataru & D. Sera
Aalborg University, Denmark
P. Hacke
NREL, Golden, United States

5CO.8.6 **Non-Destructive Evaluation of Delamination in Photovoltaic Module by Thermography**
A. Sinha, H. Mohammed Niyaz & R. Gupta
IIT Bombay, Mumbai, India

ORAL PRESENTATIONS 2CO.12

17:00 - 18:30 Thin Film and Foil-Based Silicon Solar Cells

Chairpersons:
Paola Delli Veneri
ENEA, Italy
Julio Cárabe
CIEMAT, Spain

2CO.12.1 **EU PVSEC Student Award Winner Presentation: Quadruple-Junction Thin-Film Silicon Solar Cells Using Four Different Absorber Materials**
F.T. Si, H. Tan, D.Y. Kim, G. Yang, R. Santbergen, R.A.C.M.M. van Swaaij, A.H.M. Smets, O. Isabella & M. Zeman
Delft University of Technology, Netherlands

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2CO.12.2 **Solar Cells on < 50µm Thick Epitaxial Foils Conductively Bonded to Low-Cost Si Carrier**
H. Sivaramakrishnan Radhakrishnan, T. Bearda, K. Van Nieuwenhuysen & I. Gordon
imec, Leuven, Belgium
N. Bednar & N. Adamovic
Vienna University of Technology, Austria
R. Roozeman & J. Heikkinen
INKRON, Espoo, Finland
A. Ulyashin & M. Syvertsen
SINTEF, Oslo, Norway

2CO.12.3 **Smart Applications of Textiles with Amorphous Silicon Thin Film Solar Cells: Energy Harvesting and Safety Sensors**
J. Plentz, U. Brückner, D. Müller, A. Gawlik & G. Andrä
IPHT, Jena, Germany

2CO.12.4 **Texturing of 50-um Thin Epitaxial Foils with Minimal Silicon Removal and High Reflectance**
A. Umer, K. Van Nieuwenhuysen, T. Bearda, S. Jambaldinni, J. John, M. Haslinger, H. Sivaramakrishnan Radhakrishnan, V. Depauw, M. Filipic, A. Razzaq, M. Xu, I. Gordon, M. Debucquoy & J. Poortmans
imec, Leuven, Belgium

2CO.12.5 **Development of Liquid Phase Crystallized Silicon Thin Film Modules**
S. Kühnapfel, T. Frijnts, H. Rhein, Z. Müller-Karpe & S. Gall
HZB, Berlin, Germany

2CO.12.6 **Color Controllability and Improved Performance of a-Si:H Transparent Solar Cells by Regulating the Conditions of Al2O3 Passivation Films**
J.-W. Lim, G. Kim & S.J. Yun
ETRI, Daejeon, Korea South
M. Shin
Korea Aerospace University, Seoul, Korea South

ORAL PRESENTATIONS 6CO.16

17:00 - 18:30 PV Energy System Integration within the Building

Chairpersons:
Franz P. Baumgartner
ZHAW, Switzerland
Kristian Peter
ISC Konstanz, Germany

6CO.16.1 **Analysing the Effect of PV System Size and Battery Storage Capacity on the Self-Sufficiency Degree and Self-Consumption Ratio for Different Consumers**
M. Basappa Ayanna, T. Bischof-Niemz, P. Klein & S. Koopman
CSIR, Pretoria, South Africa

6CO.16.2 **Synthesizing Residential Load Profiles Using Behavior Simulation**
N. Pflugradt & U. Muntwyler
BUAS, Burgdorf, Switzerland

6CO.16.3 **Evaluation of the Performance of Household Li-Ion Battery Storage Systems and Their Impact on Profitability**
N. Munzke, B. Schwarz, F. Büchle & J. Barry
Karlsruhe Institute of Technology, Eggenstein-Leopoldshafen, Germany

6CO.16.4 **Grid-Relieving Effects of PV Battery Energy Storage Systems with Optimized Operation Strategies**
G. Angenendt, S. Zurmühlen, J. Badeda & D.U. Sauer
RWTH Aachen University, Germany

6CO.16.5 **Identifying Risks, Costs and Lessons from ARENA-Funded off-Grid Renewable Energy Projects in Regional Australia**
B. Herteleer & L. Frearson
CAT Projects, Alice Springs, Australia
A. Dobb, O. Boyd & S. Rodgers
ARENA, Canberra, Australia

6CO.16.6 **Impact of Self-Consumption on Integration of Photovoltaics in Martinique: Simulation Results from the Insolations Project**
F. Bourry, F. Al Shakarchi & N. Martin
CEA, Le Bourget du Lac, France
S. Darivon & L. Bellemare
AME, Ducos, Martinique

VISUAL PRESENTATIONS 4CV.4

17:00 - 18:30 **III-V-Based Devices for Terrestrial and Space Applications**

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

Thursday, 28 September 2017

PLENARY SESSION 5DP.1

08:30 - 10:10 **Performance, Reliability and Sustainability of Photovoltaic Modules and Balance of System Components**

Chairpersons:
Karsten Wambach
Wambach-Consulting, Germany
Tony Sample
European Commission JRC, Italy

5DP.1.1 **Keynote: PV Module Performance Characterization – Challenges from Recent Technology Advances and Demands from Energy Yield Perspective**
W. Herrmann
TÜV Rheinland Energy, Cologne, Germany

5DP.1.2 **Keynote: Qualitative versus Quantitative Reliability Testing of PV - Gaining Confidence in a Rapidly Changing Technology**
S.R. Kurtz
NREL, Golden, United States

5DP.1.3 **Google's Little Box Challenge and the Development of the True AC-Module**
H. Oldenkamp
OKE-Services, The Hague, Netherlands

5DP.1.4 **The Product Environmental Footprint (PEF) of Photovoltaic Modules – Lessons Learned from the Environmental Footprint Pilot Phase on the Way to a Single Market for Green Products in the European Union**
A. Wade
First Solar, Mainz, Germany
P. Stolz & R. Frischknecht
Treeze, Uster, Switzerland
G. Heath
NREL, Golden, United States
P. Sinha
First Solar, Tempe, United States

PLENARY SESSION 6DP.2

10:30 - 12:00 **PV System Performance and Integration**

Chairpersons:
Peter Lechner
ZSW, Germany
Heinz Ossenbrink
Band Gap, Germany

6DP.2.1 **Keynote: Optimal Sizing of Batteries for PV Self-Consumption: Usage for Peak Shaving**
W. Schram & W.G.J.H.M. van Sark
Utrecht University, Netherlands

6DP.2.2 **Aesthetics and Performance of PV**
T. Minderhoud
UNStudio, Amsterdam, Netherlands

6DP.2.3 **PV Production Forecasting Model Based on Artificial Neural Networks (ANN)**
S. Theocharides, V. Venizelou, G. Makrides & G.E. Georghiou
University of Cyprus, Nicosia, Cyprus

6DP.2.4 **Predictive Maintenance in Photovoltaic Plants with a Big Data Approach**
A. Betti, F. Ruffini & C. Lanzetta
I-EM, Livorno, Italy
M.L. Lo Trovato, F.S. Leonardi & G. Leotta
ENEL Green Power, Rome, Italy

ORAL PRESENTATIONS 2DO.1

13:30 - 15:00 **c-Si Heterojunction Solar Cells**

Chairpersons:
Delfina Muñoz
CEA, France
Rutger Schlatmann
HZB, Germany

2DO.1.1 **High Efficiency Silicon Heterojunction Solar Cells with Improved IR Response**
L.-L. Senaud, G. Christmann, N. Badel, C. Allebé, L. Barraud, A. Descoeudres, S. Martin de Nicolàs, J. Geissbühler, B. Paviet-Salomon, S. Nicolay, C. Ballif & M. Despeisse
CSEM, Neuchâtel, Switzerland

2DO.1.2 **From Advanced Thin-Films Modules to High Efficiency Silicon Heterojunction Technology at 3SUN**
W. Favre, A.-S. Ozanne, D. Muñoz, A. Moustafa, A. Valla, J. Stendera, F. Medlège, M. Fernandes & P.J. Ribeyron
CEA, Le Bourget du Lac, France
G. Condorelli, A. Canino, P. Rotoli, A. Battaglia, A. Ragonesi & M. Guercio
3Sun, Catania, Italy
C. Gerardi
ENEL Green Power, Catania, Italy

2DO.1.3 **A New Pilot Research Facility for HJT and Selective Contact Solar Cells – PV-TEC SELECT**
J. Rentsch, A. Moldovan, M. Bivour, F. Feldmann, D. Erath, S. Mack, M. Hermle, S.W. Glunz & R. Preu
Fraunhofer ISE, Freiburg, Germany

2DO.1.4 **High Efficiency Silicon Heterojunction Solar Cells with Electrodeposited Copper Contacts: Progress in Process Development for Bifacial Cells**
J. Geissbühler, A. Lachowicz, A. Faes, N. Badel, J. Horzel, J. Champliaud, L. Curvat, C. Ballif & M. Despeisse
CSEM, Neuchâtel, Switzerland
P. Papet & B. Strahm
Meyer Burger Research, Hauterive, Switzerland
J. Hermans
Meyer Burger, Eindhoven, Netherlands

2DO.1.5 **Versatile Pilot Line to Support the Heterojunction Solar Cell Industrial Development: Busbar and Busbar-Less Configurations**
R. Varache, A. Danel, S. Harrison, M. van den Bossche, N. Rey, P. Lefillastre, J. Gaume, J. Veirman, A. Bettinelli & C. Roux
CEA, Le Bourget du Lac, France

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2DO.1.6 **Contact Resistance of the p-Type Amorphous Silicon Hole Contact in Silicon Heterojunction Solar Cells**
M. Leilaeioun, W. Weigand, P. Muralidharan, D. Vasileska, S. Goodnick & Z.C. Holman
Arizona State University, Tempe, United States
M. Boccard
EPFL, Neuchâtel, Switzerland

ORAL PRESENTATIONS 4DO.4

13:30 - 15:00 **III-V-Based Devices for Terrestrial and Space Applications**

Chairpersons:
Carla Signorini
ESA-ESTEC, Netherlands
Giovanni Flamand
imec, Belgium

4DO.4.1 **Wafer Integrated Micro-Scale Concentrating Photovoltaics**
T. Gu, L. Li, D. Li & J. Hu
MIT, Cambridge, United States
B.H. Jared, G. Keeler, B. Miller, W.C. Sweatt, S.M. Paap, M.P. Saavedra, C. Alford, J. Mudrick & A. Tauke-Pedretti
Sandia National Laboratories, Albuquerque, United States
U.K. Das & S. Hegedus
University of Delaware, Newark, United States

4DO.4.2 **EU PVSEC Student Award Winner Presentation: MBE Growth of 1.7eV AlGaAs Solar Cells on Si Using Dislocation Filters: An Alternative Pathway Toward III-V/Si Multijunction Architectures**
A. Onno, J. Wu, M. Tang & H. Liu
University College London, United Kingdom
Y. Maidaniuk, M. Benamara, Y.I. Mazur & G.J. Salamo
University of Arkansas, Fayetteville, United States
L. Oberbeck
TOTAL, Paris, France

4DO.4.3 **Development of III-V on Si Multijunction Photovoltaics by Wafer Bonding**
L. Vauche, E. Veinberg Vidal, C. Jany, C. Morales, C. Dupre & P. Mur
CEA, Grenoble, France
J. Decobert
GIE IIIVLab, Palaiseau, France

4DO.4.4 **Measurement of Subcell Capacitance in Multijunction Solar Cells with Pulsed Lasers**
M. Rutzinger, M. Salzberger, H. Nesswetter, A. Gerhard & C.G. Zimmermann
Airbus, Taufkirchen, Germany
P. Lugli
Munich University of Technology, Germany

4DO.4.5 **Analysis of Current Generation in InGaP/GaAs/Ge Triple Junction Solar Cells with Optically Non- Uniform Luminescence Coupling Effect**
B.M.F. Yu Jeco, K. Yoshida, R. Tamaki & Y. Okada
University of Tokyo, Japan

4DO.4.6 **Solar Powered Vehicles with Static Concentrator Photovoltaics**
T. Masuda, K. Okumura, S. Urabe, Y. Kudo, K. Kimura, T. Nakadoa & A. Sato
Toyota, Susono, Japan
K. Araki & M. Yamaguchi
TTI, Nagoya, Japan

ORAL PRESENTATIONS 3DO.7

13:30 - 15:00 Perovskite-Based Hybrid Tandems

Chairpersons:
Mariadriana Creatore
Eindhoven University of Technology, Netherlands
Bart G. Geerligs
ECN, Netherlands

3DO.7.1 The Impact of Local Operating Conditions on the Field Performances of Silicon-Based Tandem Devices
O. Dupré, J. Cattin, J. Haschke, B. Niesen, M. Boccard & C. Ballif
EPFL, Neuchâtel, Switzerland
S. De Wolf
KAUST, Thuwal, Saudi Arabia

3DO.7.2 Numerical Optical Optimization of Perovskite-Silicon Tandem Solar Cells
K. Jäger, M. Werth, L. Mazzarella, S. Calnan, F. Ruske, L. Korte, B. Stannowski, B. Rech & S. Albrecht
HZB, Berlin, Germany

3DO.7.3 High Efficiency 4-Terminal Perovskite/c-Si Hybrid Tandem Solar Cells
D. Zhang, M. Najafi, W. Verhees & S.C. Veenstra
ECN, Eindhoven, Netherlands
V. Zardetto
TNO, Eindhoven, Netherlands
A. Jamodkar
Delft University of Technology, Netherlands
A. Gutjahr, I.G. Romijn, B. Geerligs & A.W. Weeber
ECN, Petten, Netherlands
T. Aernouts
imec, Leuven, Belgium
R.A.J.M. Andriessen
Holst Centre, Eindhoven, Netherlands

3DO.7.4 Efficient and Stable NIR-Transparent Perovskite Solar Cells Prepared by Partial Ion Ex-Change Method for All-Thin-Film Tandem Applications
F. Fu, S. Pisoni, T. Feurer, A. Wäckerlin, S. Nishiwaki, A.N. Tiwari & S. Buecheler
EMPA, Dübendorf, Switzerland

3DO.7.5 High-Efficiency 4-Terminal and Monolithic Perovskite / Silicon Tandem Solar Cells
J. Werner, F. Sahil, M. Bräuniger, R. Monnard, B. Niesen & C. Ballif
EPFL, Neuchâtel, Switzerland
B. Kamino, D. Sacchetto, A. Walter, S.-J. Moon, L. Barraud, B. Paviet-Salomon, J. Geissbühler, C. Allebé, M. Despeisse & S. Nicolay
CSEM, Neuchâtel, Switzerland

3DO.7.6 EU PVSEC Student Award Winner Presentation: 23.6%-Efficient Monolithic Perovskite/Silicon Tandem Cell
Z.J. Yu & Z.C. Holman
Arizona State University, Tempe, United States
K.A. Bush, A.F. Palmstrom, S.F. Bent & M.D. McGehee
Stanford University, United States

Thursday, 28 September 2017

ORAL PRESENTATIONS 6DO.10

13:30 - 15:00 Photovoltaics and the Building Envelope: Main Issues and Challenges

Chairpersons:
Gabriele C. Eder
OFI, Austria
Laurent Quittre
ISSOL, Belgium

6DO.10.1 BIPV Products Overview for Solar Building Skin
P. Bonomo, I. Zanetti & F. Frontini
SUPSI, Canobbio, Switzerland
M.N. van den Donker, F. Vossen & W. Folkerts
SEAC, Eindhoven, Netherlands

6DO.10.2 Building-Integrated Photovoltaics (BIPV) over the Time – Represented within Competitions
G. Becker, F. Flade, R. Krippner, B. Schiebelsberger & W. Weber
SeV Bavaria, Munich, Germany

6DO.10.3 PV Quality Issues Applying Building Integrated Photo Voltaic (BIPV) on Façade and Roof when Deep Renovating a 50 Years Old Apartment Building
A. Andersson
RISE Research Institute of Sweden, Boras, Sweden
D.-E. Archer
Emulsionen, Göteborg, Sweden
Z. Norwood
Chalmers University of Technology, Göteborg, Sweden

6DO.10.4 Design of an Autonomous Solar Charging Station for E-Bikes
R.M.E. Valckenborg, R. Ghotge & W. Folkerts
SEAC, Eindhoven, Netherlands

6DO.10.5 An Architectural Approach for Improving Aesthetics of PV
L.H. Slooff & J.A.M. Van Roosmalen
ECN, Petten, Netherlands
T. Minderhoud
UNStudio, Amsterdam, Netherlands
T. Sepers
TS Visuals, Oudkarspel, Netherlands

6DO.10.6 Flexible Pneumatic Actuator for PV Solar Tracking Applications
B. Svetozarevic, J. Hofer, I. Hischier & A. Schlueter
ETH Zurich, Switzerland

VISUAL PRESENTATIONS 7DV.1

13:30 - 15:00 PV Economics and Markets / PV-Related Policies, Strategies and Societal Issues

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

ORAL PRESENTATIONS 2DO.2

15:15 - 16:45 c-Si Solar Cells with Poly-Si Based pn-Junction

Chairpersons:
G. Paul Wyers
ECN, Netherlands
Barbara Terheiden
University of Konstanz, Germany

2DO.2.1 Tunnel Oxide Passivated Electron Contacts as Full-Area Rear Emitter of High-Efficiency p-Type Silicon Solar Cells
A. Richter, J. Benick, R. Müller, F. Feldmann, C. Reichel, M. Hermle & S.W. Glunz
Fraunhofer ISE, Freiburg, Germany

2DO.2.2 Building Blocks for Industrial, Screen-Printed Two Sides-Contacted POLO Cells with Highly Transparent ZnO:Al Layers
R. Peibst, S. Reiter, Y. Larionova, R. Reineke-Koch & R. Brendel
ISFH, Emmerthal, Germany
D. Tetzlaff, J. Krügener & T. Wietler
Leibniz University of Hannover, Germany
U. Höhne & J.-D. Kähler
centrotherm photovoltaics, Hannover, Germany
H. Mehlich
Meyer Burger, Hohenstein-Ernstthal, Germany

2DO.2.3 Opimized IBC c-Si Solar Cells Based on Poly-Si(Ox) Carrier-Selective Passivating Contacts
G. Yang, P. Procel Moya, Y. Zhang, A.W. Weeber, O. Isabella & M. Zeman
Delft University of Technology, Netherlands

2DO.2.4 Interdigitated Back-Contacted Silicon Heterojunction Solar Cells Featuring an Interband Tunnel Junction Enabling Simplified Processing
B. Paviet-Salomon, N. Badel, G. Christmann, L. Barraud, A. Descoeudres, J. Geissbühler, A. Faes, S. Nicolay, C. Ballif & M. Despeisse
CSEM, Neuchâtel, Switzerland
A. Tomasi, Q. Jeangros & J.P. Seif
EPFL, Neuchâtel, Switzerland
D. Lachenal & B. Strahm
Meyer Burger Research, Hauterive, Switzerland
M. Ledinsky & A. Fejfar
ASCR, Prague, Czech Republic
S. De Wolf
KAUST, Thuwal, Saudi Arabia

2DO.2.5 Interdigitated Back Contact Silicon Solar Cells Featuring Ion-Implanted Poly-Si/SiOx Passivating Contacts
C. Reichel, R. Müller, F. Feldmann, A. Richter, M. Hermle & S.W. Glunz
Fraunhofer ISE, Freiburg, Germany

2DO.2.6 Opto-Electrical Modelling of IBC Solar Cells Based on Poly-Si or Heterojunction Carrier-Selective Passivating Contacts
P. Procel Moya, G. Yang, O. Isabella & M. Zeman
Delft University of Technology, Netherlands

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ORAL PRESENTATIONS 5DO.5

15:15 - 16:45 Balance of System Components

Chairpersons:
Marion Perrin
CEA, France
Nicola Pearsall
Northumbria University, United Kingdom

5DO.5.1 Update on Rankings of Conversion Efficiencies and Energy Yield of Micro-Inverters, Includung Inverters for Two PV Modules
S. Krauter & J. Bendfeld
University of Paderborn, Germany

5DO.5.2 Analysis of the Single-Stage Transformerless Boost Grid-Connected Microinverter (STBM) under Partial Shading Conditions
F. Cardoso Melo, L. Sampaio Garcia, L. Carlos de Freitas, E.A.A. Coelho, V.J. Farias & L.C. Gomes de Freitas
Federal University of Uberlândia, Brazil

5DO.5.3 Verifying Defective PV-Module Recognition by IR-Imaging and Module Optimizers
C. Buerhop-Lutz, T. Pickel, C. Camus, J. Hauch & C.J. Brabec
ZAE Bayern, Erlangen, Germany
A. Häring & T. Adamski
SolarEdge Technologies, Munich, Germany

5DO.5.4 In-Situ Electromagnetic Compatibility Characterization of Three Selected Solar Photovoltaic (PV) Sites in Georgia Power Company Service Territory
P. Keebler
Electrotek Concepts, Knoxville, United States
M. Page
Georgia Power Company, Atlanta, United States

5DO.5.5 Electrical and Thermal Modeling of Junction Boxes
M. Mittag, C. Kutter, S. Hoffmann, A.J. Beinert, T. Zech & M. Ebert
Fraunhofer ISE, Freiburg, Germany

5DO.5.6 Increasing the Efficiency of Photovoltaic (PV) Batteries through Non-Intrusive Load Monitoring
P. Baumann & A. Heinzelmann
ZHAW, Winterthur, Switzerland
P. Held & D. Benyoucef
HFU, Furtwangen, Germany

ORAL PRESENTATIONS 7DO.8

15:15 - 16:45 Global PV Economics and Market Trends

Chairpersons:
Thomas Nordmann
TNC Consulting, Switzerland
Izumi Kaizuka
RTS, Japan

7DO.8.1 **Solar Photovoltaics Demand for the Global Energy Transition in the Power Sector**
C. Breyer, D. Bogdanov, A. Aghahosseini, A. Gulagi, M. Child, N. Ghorbani, A.S. Oyewo, U. Caldera, S. Afanasyeva, J. Farfan & K. Sadovskaia
Lappeenranta University of Technology, Finland
L.S.N.S. Barbosa
University of São Paulo, Brazil
P. Vainikka
VTT, Lappeenranta, Finland

7DO.8.2 **Levelized Cost of PV Electricity in 2017**
C. Kost, T. Schlegl, N. Saad Hussein & S. Philipps
Fraunhofer ISE, Freiburg, Germany

7DO.8.3 **Affordable and Clean Energy: Addressing Project Development Challenges of Utility-Scale Solar PV Plants**
S. Benmarraze, C. Ruiz & R. Roesch
IRENA, Bonn, Germany

7DO.8.4 **Improving the Competitiveness of Solar PV with Electricity Storage**
E. Vartiainen
Fortum Growth, Finland
G. Masson
Becquerel Institute, Brussels, Belgium
C. Breyer
Lappeenranta University of Technology, Finland

7DO.8.5 *Invited*

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7DO.8.6 **CrowdFundRES: A New Opportunity for Financing Renewable Energy Projects**
S. Caneva, I. Weiss, M. Papapetrou & P. Alonso
WIP - Renewable Energies, Munich, Germany
O. Gajda & K. Kohl
European Crowdfunding Network, Brussels, Belgium
A. Bergmann & B. Burton
University of Dundee, United Kingdom
T. Aschenbeck-Florange, A. Dlouhy & T. Drefke
Osborne Clarke, Cologne, Germany
A. de Ferrari & M. Martinoli
youris.com EEIG, Milan, Italy
J. Wahlmüller & S. Egger
GLOBAL 2000, Vienna, Austria
T. Harwood, R. van Maaren & K. Harder
Abundance, London, United Kingdom
S. Müller-Windisch & V. Daoud Henderson
Green Crowding, Cologne, Germany
A. Raguet & M.-V. Gauduchon
Lumo, La Rochelle, France
L. Pulles, M. de Jong, E. Hünewaldt & S. van Beurden
Oneplanetcrowd International, Amsterdam, Netherlands
C. Arnaud, M. Papoutsi & A. Roesch
SolarPower Europe, Brussels, Belgium
S. Wannop, A. Gregory & D. Crockford
Renewable Energy Generation, Exeter, United Kingdom
D. Maguire, L. Clifford & R. Kelly
BNRG Renewables, Dublin, United Kingdom
C. Rumolino & F. Petit
VALOREM, Carcassonne, France

ORAL PRESENTATIONS 6DO.11

15:15 - 16:45 Modelling and Optimisation Issues for BIPV

Chairpersons:
Francesco Frontini
SUPSI, Switzerland
Menno N. Van Den Donker
ECN, Netherlands

6DO.11.1 **Detailed Modelling of Building Integrated Photovoltaics (BIPV) - From Component and Environmental Data to the System Output**
J. Eisenlohr, H.R. Wilson, C. Ferrara & T.E. Kuhn
Fraunhofer ISE, Freiburg, Germany

6DO.11.2 **Effect of Module Orientation and Batteries on Performance of Building Integrated Photovoltaic Systems**
M. Lovati, L. Maturi & D. Moser
Eurac Research, Bolzano, Italy

6DO.11.3 **Innovative BIPV-Elements: Optimization of the Interconnection of PV-Active Laminates to Façade Panels**
Y. Voronko, G.C. Eder, S. Felecan & M. Tonnhofer
OFI, Vienna, Austria

6DO.11.4 **PVOPTI-Ray: Optimisation of Reflecting Materials and Photovoltaic Yield in an Urban Context**
M. Revesz, A. Schneider & S. Zamini
AIT, Vienna, Austria
H. Trimmel, S. Oswald & P. Weihs
BOKU, Vienna, Austria

6DO.11.5 **OPERASOL®: A Light Photovoltaic Panel with Integrated Connectors**
A. Boulanger, J. Gaume & F. Quesnel
CEA, Le Bourget du Lac, France
P. Ruols
2CA, Belmont-Tramonet, France
F. Rouby
2CA, Arlanc, France

6DO.11.6 **Validation of a Façade PV Potential Model Based on LiDAR Data**
S.R. Freitas, J. Segadães & M. Brito
University of Lisbon, Portugal

VISUAL PRESENTATIONS 3DV.2

15:15 - 16:45 **CI(G)S, CdTe and Related Thin Film Solar Cells and Modules (II) / Perovskite, Organic and Dye-Sensitised Devices**

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

ORAL PRESENTATIONS 2DO.3

17:00 - 18:30 **Structures with Poly-Si based High / Low Junction**

Chairpersons:
Jan Schmidt
ISFH, Germany
Pierre-Jean Ribeyron
CEA, France

2DO.3.1 **Approaching 22% Efficiency with Multicrystalline n-Type Silicon Solar Cells**
J. Benick, A. Richter, R. Müller, H. Hauser, P. Krenckel, S. Riepe, F. Schindler, M.C. Schubert, M. Hermle & S.W. Glunz
Fraunhofer ISE, Freiburg, Germany

2DO.3.2 **Material Properties of LPCVD Processed n-Type Polysilicon Passivating Contacts and Application in PERPoly Industrial Bifacial Solar Cells**
M.K. Stodolny, L.J Geerligs, G.J.M. Janssen & I. Romijn
ECN, Petten, Netherlands
B.W.H. van de Loo, J. Melskens & W.M.M. Kessels
Eindhoven University of Technology, Netherlands
R. Santbergen & O. Isabella
Delft University of Technology, Netherlands
J. Schmitz
University of Twente, Enschede, Netherlands
M. Lenes & J.R.M. Luchies
Tempress, Vaassen, Netherlands

2DO.3.3 **Evaluation of TOPCon Technology on Large Area Solar Cells**
F. Feldmann, B. Steinhauser, S. Kluska, M. Hermle & S.W. Glunz
Fraunhofer ISE, Freiburg, Germany

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2DO.3.4 **Ultrathin Silicon Oxide: What Makes It Suitable as Interlayer in Passivating Contacts for Silicon Solar Cells?**
J. Melskens, J. Palmans, S. Karwal, M. Creatore & W.M.M. Kessels
Eindhoven University of Technology, Netherlands

2DO.3.5 **Screen-Printed Metallization for p-Type Poly-Si Passivated Contacts Formed by LPCVD**
S. Mack & T. Fellmeth
Fraunhofer ISE, Freiburg, Germany
M. Lenes
Tempress, Vaassen, Netherlands
J.R.M. Luchies
Amtech, Vaassen, Netherlands

2DO.3.6 **BBr3 Emitter Passivation by Ultra-Thin Boron Doped LPCVD Polysilicon Layers**
R.C.G. Naber, M. Lenes & J.R.M. Luchies
Tempress, Vaassen, Netherlands

ORAL PRESENTATIONS 6DO.6

17:00 - 18:30 **Solar Resource and Forecasting**

Chairpersons:
Wilfried Van Sark
Utrecht University, Netherlands
Christos Protogeropoulos
EEPS, Greece

6DO.6.1 **PVGIS Version 5: Improvements to Models and Features**
T. Huld, I. Pinedo Pascua, A. Gracia Amillo & E. Dunlop
European Commission JRC, Ispra, Italy

6DO.6.2 **A New Model for the Calculation of the Diffuse Irradiance from Global Irradiance Time Series**
M. Hofmann
Valentin Software, Berlin, Germany
G. Seckmeyer
Leibniz University of Hannover, Germany

6DO.6.3 **Combine Deep Neural Network and Tree Based Machine Learning Models Using Stacked Generalization to Forecast Hourly Solar Irradiance for Tropical Regions**
Z. Dong, L. Zhao, W. Walsh & T. Reindl
SERIS, Singapore, Singapore

6DO.6.4 **Toward Improved Modeling of Spectral Solar Irradiance for Solar Energy Applications**
Y. Xie & M. Sengupta
NREL, Golden, United States

6DO.6.5 **Validation of an All Sky Imager Based Nowcasting System for Industrial PV Plants**
P. Kuhn, B. Nouri, S. Wilbert & C. Prahl
German Aerospace Center, Tabernas, Spain
T. Schmidt
CSP Services, Cologne, Germany
Z. Yasser
TSK FLAGSOL, Cologne, Germany
L. Ramirez & L. Zarzalejo
CIEMAT, Madrid, Spain
L. Vuilleumier
MeteoSwiss, Payerne, Switzerland
P. Blanc
MINES ParisTech, France
R. Pitz-Paal
German Aerospace Center, Cologne, Germany

6DO.6.6 **A Flexible Optical Model for Predicting Non-Uniform Irradiance Distributions on PV Modules**
R. Santbergen, V.A. Muthukumar, L. Manzano Chavez, E. Garcia Goma, A.H.M. Smets & M. Zeman
Delft University of Technology, Netherlands

ORAL PRESENTATIONS 7DO.9

17:00 - 18:30 **Innovative National PV Market Economics Business Cases**

Chairpersons:
Christian Breyer
Lappeenranta University of Technology, Finland
Gaetan Masson
Becquerel Institute, Belgium

7DO.9.1 **Growth Regions in Photovoltaics 2016 - Update on Latest Global Solar Market Development**
C. Werner
Chris Werner Energy Consulting, Dessau, Germany
A. Gerlach
Gerlach New Energy Consulting, Ellrich, Germany
C. Breyer
Lappeenranta University of Technology, Finland
G. Masson
Becquerel Institute, Brussels, Belgium

7DO.9.2 **ARENA's Large Scale Solar Funding Impact on Utility-Scale Solar in Australia**
B. Herteleer & L. Frearson
CAT Projects, Alice Springs, Australia
O. Boyd, A. Dobb & S. Rodgers
ARENA, Canberra, Australia

7DO.9.3 **PV in Emerging Markets: The Sustainability of Policy-Driven Demand**
S. Mondal & A. Sanyal
Vikram Solar, Kolkata, India

7DO.9.4 **Technical and Economic Potential of PV in Lebanon and Jordan Aiming for Regional Readiness Level Development**
M. Haidar, P. Baliozian & R. Preu
Fraunhofer ISE, Freiburg, Germany
S. Mourad & A. Mustafa
University of Freiburg, Germany

Thursday, 28 September 2017

7DO.9.5 **Evaluating the Effectiveness of Past and Future Feed-in Tariff Policy in Great Britain Using an Agent-Based Model**
P. Pearce & R. Slade
Imperial College London, United Kingdom

7DO.9.6 **Smart Solar Charging: The Role of Photovoltaics in the Sharing Economy**
W.G.J.H.M. van Sark & M. Gerritsma
Utrecht University, Netherlands
R. Berg
Lomboxnet, Utrecht, Netherlands
B. van der Ree & C. van Hemel
Utrecht Sustainability Institute, Netherlands
E. van Voorden
Last Mile Solutions, Rotterdam, Netherlands
M. Boheemen
Vidyn, Harderwijk, Netherlands
J. van Heesbeen
Jedlix, Rotterdam, Netherlands
H. Fidder
Stedin, Rotterdam, Netherlands
T. Wolfers & R. van der Lugt
University of Applied Sciences Utrecht, Netherlands

ORAL PRESENTATIONS 6DO.12

17:00 - 18:30 **Photovoltaics and Infrastructure**

Chairpersons:
Alessandra Scognamiglio
ENEA, Italy
(Invited)

6DO.12.1 **PV Innovations in the Transportation Sector: Opportunities for Value Creation and Further Market Expansion**
P. Malbranche
CEA, Le Bourget du Lac, France

6DO.12.2 **Photovoltaic Solar Urban Power Plants Integrated in Urban Furniture Allowing for Solar Communities within Urban Environments**
H.-J. Rodríguez San Segundo, A. Calo López & C. de Vicente Suso
The South Oracle, Sevilla, Spain

6DO.12.3 **Reference Design for a Highway Noise Barrier with Integrated Bifacial PV**
J. Kester & M.J. Jansen
ECN, Petten, Netherlands
M.M. de Jong
SEAC, Eindhoven, Netherlands
D. van der Graaf
Rijkswaterstaat, Utrecht, Netherlands

6DO.12.4 **Solar Potential on Commercial Trucks: Results of an Irradiance Measurement Campaign on 6 Trucks in Europe and USA**
M. Ebert, T. Zech & U. Eitner
Fraunhofer ISE, Freiburg, Germany
C. Schmidt & A. Watts
Fraunhofer CSE, Boston, United States

6DO.12.5 **Benefits from PV System Integration with Irrigation and Drainage Infrastructures: Case Study for Thessaloniki-Imathia-Pella Plain in Greece**
N. Chrysochoidis-Antsos
Delft, Netherlands
C. Chrysochoidis
GOEV, Thessaloniki, Greece

6DO.12.6 **PV on Landfills - A Dutch Case Study**
K. Sinapis, M.N. van den Donker & W. Folkerts
ECN, Eindhoven, Netherlands

VISUAL PRESENTATIONS 5DV.3

17:00 - 18:30 **PV Module Performance and Reliability (II) / Inverters and Balance of System Components / Sustainability and Recycling**

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

Friday, 29 September 2017

ORAL PRESENTATIONS 5EO.1

08:30 - 10:00 **Sustainability and Recycling**

Chairpersons:
Wolfram Palitzsch
Loser Chemie, Germany
Mariska De Wild-Scholten
SmartGreenScans, Netherlands

5EO.1.1 **Beyond Waste – The Fate of End-of-Life Photovoltaic Panels from Large Scale PV Installations in the EU – The Socio-Economic Benefits of High Value Recycling Compared to Re-Use**
A. Wade
First Solar, Mainz, Germany
P. Sinha
First Solar, Tempe, United States
K. Drozdiak
Ecowatt Consulting, Washington, United States

5EO.1.2 **Technology Trends in PV Module Recycling from Viewpoints of Patents and R&D Projects**
K. Komoto
Mizuho IR Institute, Tokyo, Japan
J.S. Lee
KIER, Daejeon, Korea South
A. Wade
First Solar, Mainz, Germany
G. Heath
NREL, Golden, United States

5EO.1.3 **Life Cycle Water Consumption of PV Electricity Based on Regionalised Life Cycle Inventories**
P. Stolz & R. Frischknecht
Treeze, Uster, Switzerland

5EO.1.4 **Eco-Solar Factory: Environmental Impact Optimisation of PV Production**
K. Wambach, M. Seitz & R. Peche
bifa Environmental Institute, Augsburg, Germany
M.P. Bellmann
SINTEF, Trondheim, Norway
G.S. Park
NorSun, Oslo, Norway
J. Denafas
Soli Tek, Vilnius, Lithuania
F. Buchholz
ISC Konstanz, Germany
R. Einhaus
Apollon Solar, Lyon, France
G. Noja
Garbo, Cerano, Italy
B. Ehlen
Boukje.com Consulting, Bleiswijk, Netherlands
R. Roligheten
Steuler Solar Technology, Porsgrunn, Norway
P. Romero
AIMEN, Porrino, Spain
A. Bollar
INGESEA, Elgoibar, Spain

5EO.1.5 **CABRISS: Recycling of Si-Kerf from PV**
T. Halvorsen, M. Moen & K. Mork
ReSiTec, Kristiansand, Norway
D. Grosset-Bourbange & P. Rivat
FerroPem, Chambéry, France
H. Hamza & F. Coustier
CEA, Le Bourget du Lac, France

5EO.1.6 **Development of a Modular Cradle to Cradle Process-Chain for c-Si-PV Panel Recycling**
J. Glatthaar, H. Weigand, U. Ricklefs, E.A. Stadlbauer, E. Kamdje, J. Barnikel & R. Gissel
Mittelhessen University of Applied Sciences, Giessen, Germany
M. Dax
Ruehl Solar, Lohra Kirchvers, Germany
V. Schaub
AWLD, Asslar, Germany
H.G. Stevens
SM-innotech, Bocholt, Germany
B. Jehle
ZME, Heuchelheim, Germany

ORAL PRESENTATIONS 6EO.2

08:30 - 10:00 **PV Energy System Integration into the Grid**

Chairpersons:
Ingrid Weiss
WIP - Renewable Energies, Germany
Xavier Vallvé
Trama TecnoAmbiental, Spain

6EO.2.1 **Renewable Energy High Penetration Scenarios Using Multi-Nodes Approach: Analysis for the Italian Case**
M.G. Prina & D. Moser
EURAC, Bolzano, Italy
G. Manzolini
Polytechnic University of Milan, Italy

Friday, 29 September 2017

6EO.2.2 **Decentralized Fuzzy-Based Voltage Control for LV Distribution Systems**
E. Bernal
La Salle University, Bogotá, Colombia
M. Bueno & M.M. Molinas Cabrera
NTNU, Trondheim, Norway

6EO.2.3 **Implementation of Control Strategies for PV Power Ramp-Rate Limitation Using Energy Storage: Problems and Solutions Associated with the Different Battery Charge/ Discharge Powers**
I. de la Parra, J. Marcos, M. Muñoz, M. García & L. Marroyo
UPNa, Pamplona, Spain

6EO.2.4 **Optimisation of the Load Flow Calculation Method in Order to Perform Techno-Economic Assessments of Low-Voltage Distribution Grids**
F. Carigiet, F.P. Baumgartner, P. Korba & V. Knazkins
ZHAW, Winterthur, Switzerland
M. Koller
EKZ, Zurich, Switzerland
M. Niedrist
EKS, Schaffhausen, Switzerland

6EO.2.5 **Spatial Analysis of Residential Combined Photovoltaic and Battery Potential: Case Study Utrecht, The Netherlands**
B.B. Kausika, G.B.M.A. Litjens & W.G.J.H.M. van Sark
Utrecht University, Netherlands

6EO.2.6 **Reducing the Grid Load of South African Office Building by Implementation of Energy Efficiency Measures and Installation of Demand Optimized PV**
B. Hanke, D. Peters, M. Kühnel, K. von Maydell & C. Agert
NEXT ENERGY, Oldenburg, Germany
J. Smit
Buffalo City Metropolitan Municipality, East London, South Africa
R. Wiesmann & R. Saßmannshausen
BFE-Oldenburg, Germany
R. Hentschel
City of Oldenburg, Germany

ORAL PRESENTATIONS 7EO.3

08:30 - 10:00 PV-Related Policies, Strategies and Societal Issues

Chairpersons:

Emiliano Perezagua
Consultores de Energía Fotovoltaica, Spain
Ivan Gordon
imec, Belgium

7EO.3.1 **Trends in Photovoltaic Applications - the Latest Survey Results on PV Markets and Policies from the IEA PVPS Programme**
G. Masson
Becquerel Institute, Brussels, Belgium
J. Donoso Alonso
Spanish Photovoltaic Industry Federation, Madrid, Spain
P. Hüsser
Nova Energie, Aarau, Switzerland
I. Kaizuka
RTS, Tokyo, Japan
J. Lindahl
Svensk Solenergi, Stockholm, Sweden
F. Tilli
GSE, Rome, Italy

7EO.3.2 **The Social Rate of Return of Photovoltaic Investments in Germany**
J. López Prol
University of Graz, Austria

7EO.3.3 **Lithuanian Smart Specialization and Clustering Activities in Photovoltaic Sector**
J. Ulbikas & D. Naruseviciute
PROTECH, Vilnius, Lithuania

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7EO.3.4 **SOLAR-ERA.NET - ERA-NET on Solar Electricity for the Implementation of the Solar Europe Industry Initiative**
S. Nowak & M. Gutschner
NET Nowak Energy & Technology, St. Ursen, Switzerland
S. Oberholzer
Swiss Federal Office of Energy, Bern, Switzerland
C. Hünnekes, H. Bastek, D. Brockmann, M. Schulte & J. Kutscher
Forschungszentrum Jülich, Germany
S. Rabe
CEF-NRW, Düsseldorf, Germany
K. Wikman
TEKES, Helsinki, Finland
M. Gerbaud
ADEME, Paris, France
J. Herrero
CIEMAT, Madrid, Spain
S. Falcón Morales
MINECO, Madrid, Spain
L. Polain & N. Delsaux
Public Service of Wallonia, Jambes, Belgium
E. De Clercq
VLAIO, Brussels, Belgium
M. Garliska
NCBR, Warszawa, Poland
K. Karaösz & R. Seymen
TUBITAK, Gebze, Turkey
O. Bernsen
RVO, The Hague, Netherlands
S. Tselepis
CRES, Pikermi, Athens, Greece
C. Inglis
InnovateUK, Swindon, United Kingdom
L. Antoniou & I. Sergidou-Loizou
RPF, Lefkosia, Cyprus
A. Agrimi
Regione Puglia, Bari, Italy
C. Gadaleta Caldarola
ARTI, Valenzan, Italy
D. Tornabene
Regione Sicilia, Palermo, Italy
T. Zillner
Federal Ministry of Transport, Vienna, Austria
E. Lutter & G. Wörther
Climate and Energy Fund, Vienna, Austria
P.-J. Rigole & T. Walla
Swedish Energy Agency, Eskilstuna, Sweden

7EO.3.5 **Highlights from the FP7 Project on Photovoltaics CHEETAH: More Power with Less Materials**
J.M. Kroon
ECN, Petten, Netherlands

7EO.3.6 **Café au Light: How to Improve Guinean People's Lives by Combining Coffee and PV**
J. Cárabe
CIEMAT, Madrid, Spain
N.N. Malo
UDECOM, Nzérékoré, Guinea
A. Bautista & L. Barrios
Cleanergetic, Madrid, Spain
M. Loua
Embassy of Guinea, Madrid, Spain

PLENARY SESSION 7EP.1

10:30 - 11:30 Recent Developments in Competitive PV Markets

Chairpersons:
Stefan Nowak
NET Nowak Energy & Technology, Switzerland
Pietro Menna
European Commission DG Energy, Belgium

7EP.1.1 **PV market, Business and Price Developments in Italy (i)**
L. Benedetti
GSE, Rome, Italy

7EP.1.2 **New Business Models in PV**
D. Feldman
NREL, Washington D.C., United States

7EP.1.3 **The International Solar Alliance – Creating Momentum for New Global Solar Markets (i)**
G.-C. Werlings
ISA, Paris, France

CLOSING

Key note, Highlights of the Conference, Poster Awards, Student Awards, Farewell

Visual Presentations

Monday, 25 September 2017

VISUAL PRESENTATIONS 2AV.1

13:30 - 15:00 Feedstock, Crystallisation, Wafering, Defect Engineering

2AV.1.1 **Boron Removal from Silicon by Moisturized Gases**
J. Safarian & G. Tranell
NTNU, Trondheim, Norway

2AV.1.2 **Hydrometallurgical Purification of Magnesium-Doped Silicon by Different Acids**
S. Espelien & J. Safarian
NTNU, Trondheim, Norway

2AV.1.3 **On the Fabrication of Solar Cells Based on Newly Produced Recycled Silicon Feedstocks from CABRISS – A Comparative Study between Material Properties and Solar Cells Performances**
B. Martel, K. Derbouz, C. Audoin & M. Sérasset
CEA, Le Bourget du Lac, France
H.S. Sivaramakrishnan Radhakrishnan
imec, Leuven, Belgium
J. Denafas & L. Petreniene
Soli "Tek R&D", Vilnius, Lithuania
N. Severino & N. Bednar
Vienna University of Technology, Austria
A.G. Ulyashin
SINTEF, Oslo, Norway

2AV.1.4 **Silicon Kerf as Raw Material for High-Capacity Li-Ion Battery Anodes**
T.T. Mongstad, S.Y. Lai & S.E. Foss
Institute for Energy Technology, Kjeller, Norway
E.-J. Øvrelid
SINTEF, Trondheim, Norway

2AV.1.5 **Understanding Thermal Decomposition of Monosilane by Combining Model and Experiment**
G.M. Wyller, T.J. Preston, H. Klette, O. Nordseth, T.T. Mongstad & E.S. Marstein
Institute for Energy Technology, Kjeller, Norway

2AV.1.6 **Influence of the Silicon Nitride Coating on the Material Quality of Directionally Solidified Multi-Crystalline Silicon Ingots**
S. Schwanke, C. Reimann & J. Friedrich
Fraunhofer IISB, Erlangen, Germany
M. Kuczynski, W. Gross, C. Hoislbauer & J. Sans
AlzChem, Trostberg, Germany

2AV.1.7 **Effect of Deformation and Displacement of the Seeds Junction on Dislocation of Mono-Like Crystalline Silicon**
W. Chen, Q. Wang & X. Yang
Jinko Solar, Shangrao, China

2AV.1.8 **Investigation about Classification, Generation and Evolution of Dislocation at Seed Junctions of Mono-Like Crystalline Silicon**
W. Chen, Q. Wang & X. Yang
Jinko Solar, Shangrao, China

2AV.1.10 **In-Situ Measurement of the Solid-Liquid-Interface during the Growth of Silicon Ingots by the Ultrasonic Sound Method**
M. Trempa, C. Reimann & J. Friedrich
Fraunhofer IISB, Erlangen, Germany
M. Hinderer & P. Czurratis
PVA TePla, Westhausen, Germany
I. Kupka
Fraunhofer THM, Freiberg, Germany

2AV.1.11 **Cost Effective Growth of Silicon Mono Ingots by the Application of Increased Pull Speed in Cz-Puller**
F. Mosel & A.V. Denisov
PVA TePla, Wettenberg, Germany
R. Kunert & P. Dold
Fraunhofer CSP, Halle, Germany

2AV.1.12 **Distribution of Light Element Impurities in Si Crystals Grown by Seed-Casting Method**
R. Nakayama, Y. Nakajima & A. Ogura
Meiji University, Kawasaki, Japan
K. Kutsukake
Tohoku University, Sendai, Japan
H. Ono
Kanagawa Industry Technology Center, Ebina, Japan

2AV.1.13 **Effects of Carbon Concentration on Oxygen Precipitation through Annealing Process in n-Type Cz-Si Evaluated by IR Laser Scattering Tomography**
K. Kinoshita, T. Kojima, H. Kobayashi & A. Ogura
Meiji University, Kawasaki, Japan
Y. Ohshita
TTI, Nagoya, Japan
I. Masada & S. Tachibana
Tokuyama, Yamaguchi, Japan

2AV.1.14 **Study of Impurities Diffusion in Silicon Liquid Phase in Conditions of High Turbulence of Melt**
S.M. Karabanov, D.V. Suvorov, D.Y. Tarabrin & E.V. Slivkin
RSREU, Ryazan, Russia
O.A. Belyakov & A.S. Karabanov
Helios-Resource, Saransk, Russia
V.L. Dshkhunyan
Solar Consult, Ryazan, Russia

2AV.1.15 **Thermomechanical Stress Modelling during Melting and Solidification of a Monolike Ingot Process**
A. Lantreibecq, E. Pihan & D. Pelletier
CEA, Le Bourget du Lac, France
M. Legros & J.P. Monchoux
CNRS, Toulouse, France

2AV.1.16 **Silicon Powder Melting for Kerf Recycling**
J. Altenberend & G. Chichignoud
SIMaP, Grenoble, France

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2AV.1.17 **Reusable Si3N4 Crucibles Made from Kerf-Loss Silicon for Multi-Crystalline Silicon Growth**
C.Y. Lan, C.-F. Yang & C.-W. Lan
NTU, Taipei, Taiwan
W.C. Lan & W.C. Hsu
SAS, Hsinchu, Taiwan
A. Yang
Solartech Energy, Hsinchu County, Taiwan

2AV.1.18 **Si Wafer Manufacturing by Thermal Spray of Recycled Si Powders**
M. Vardavoulias
Pyrogenesis, Lavrion, Greece
A.S. Azar, P.A. Carvalho & A. Ulyashin
SINTEF, Oslo, Norway
T. Halvorsen, M. Moen & K. Mork
ReSiTec, Kristiansand, Norway
O. Dahl
SINTEF, Trondheim, Norway

2AV.1.19 **Si Powder Based Ingots and Substrates, Processed by Spark Plasma Sintering**
T. Kaden & H.-J. Möller
Fraunhofer THM, Freiberg, Germany
A.S. Azar, M. Syvertsen, M. Fleissner Sunding & A. Ulyashin
SINTEF, Oslo, Norway
N. Abrosimov
IKZ Institute for Crystal Growth, Berlin, Germany
J. Hennicke
FCT Systeme, Rauenstein, Germany

2AV.1.20 **Multiphysics Modeling of Silicon Ingot Growth Process into a Directional Solidification Furnace**
D. Ouadjaout, F. Kerkar & H. Rahab
CRTSE, Algiers, Algeria
A. Ahmanache
CDTA, Algiers, Algeria

2AV.1.22 **Advanced Analysis of Multi Wire Wafering Processes**
R. Koepge, S. Brinnig, F. Kaule, S. Schoenfelder & H. Schwabe
Fraunhofer CSP, Halle, Germany

2AV.1.23 **Diamond Wire Process Monitoring during Monocrystalline Silicon Wafering**
F. Coustier, M. Debourdeau, R. Riva & N. Velet
CEA, Le Bourget du Lac, France

2AV.1.24 **A Comprehensive Dynamic Model of the Diamond Wire Sawing Process**
D. Treyer, S. Gaulocher & S. Niederberger
FHNW, Windisch, Switzerland
H. Rafael
Meyer Burger, Gwatt, Switzerland
A. Ams
Freiberg University of Technology, Germany

2AV.1.25 **Recycling of Kerf-Loss Silicon Powder from Diamond-Wire Cutting without Chemical Treatment**
H. Hamza, F. Coustier, V. Brizé, A. Benayad, M. Benmansour & A. Chabli
CEA, Le Bourget du Lac, France

2AV.1.26 **Mechanical Viability of Metallurgical Silicon Substrates for the Use in Ultrathin Devices**
M.E.O. de Zárate, C. Domergue, C. Alarcón Reyero & J. Barredo Egusquiza
UPM, Madrid, Spain

2AV.1.27 **Low Kerf Loss (<100 µm) High Quality Silicon Wafer Fabricated by Advanced Diamond Wire Saw**
Y. Ohshita
TTI, Nagoya, Japan
T. Kojima, K. Kinoshita, K. Nakamura & A. Ogura
Meiji University, Kawasaki, Japan
T. Kawatsu
Komatsu NTC, Toyama, Japan

2AV.1.28 **The Study of Water-Based Slurry for Wafer Slicing and the Totally Recycling of Material in Slicing Process**
T.Y. Wang
ITRI, Hsinchu, Taiwan
C.-Y. Cheng & P.-S. Huang
Green Energy Technology, Taoyuan, Taiwan

2AV.1.29 **A Novel Approach to Determine the Diamond Occupancy of Diamond Wires for Optimized Cutting Processes for Crystalline Silicon**
L. Lottspeich, M. Fuchs, L. Theophil & T. Kaden
Fraunhofer THM, Freiberg, Germany

2AV.1.30 **The Impact of Diamond Wire Quality on the Mechanical Strength of Thin Silicon Wafers for PV Cells**
T. Fukuda, N. Suzuki, K. Tanahashi, K. Shirasawa & H. Takato
AIST, Koriyama, Japan

2AV.1.31 **The Influence of Material Properties on the Wire Sawing Process of Multicrystalline Silicon**
T. Kaden, E. Ershovaa, L. Lottspeich & M. Fuchs
Fraunhofer THM, Freiberg, Germany

2AV.1.32 **Correlation of Residual Stress in Silicon Wafers with Diamond Wire Sawing Marks**
A. Kumar, R.G.R. Prasath, S.N. Melkote & S. Danyluk
Georgia Institute of Technology, Atlanta, United States

2AV.1.33 **Simple Model for the Calculation of Wire Tension Forces in the Multi Wire Sawing Process**
K. Sunder, R. Rataj & O. Anspach
PV Crystalox Solar, Erfurt, Germany

2AV.1.34 **Impact of Residual Aluminium Contamination on the Determination of Boron and Phosphorus Densities Using Hall Effect in a Solar Grade Silicon Ingot – A Comparison to Other Characterization Techniques**
A. Fauveau, B. Martel, J. Veirman, B. Drevet & H. Lignier
CEA, Le Bourget du Lac, France
A. Kaminski-Cachopo & F. Ducroquet
Grenoble Alpes University, France

2AV.1.35 **Study of H-Diffusion Mechanism from a-SiN:H Passivation Layer Towards Bulk-Silicon Within a High Temperature Annealing Process**
S. Jafari, M. Gläser & D. Lausch
Fraunhofer CSP, Halle, Germany
N. Bernhard
Anhalt University of Applied Sciences, Köthen, Germany

2AV.1.36 **Eliminating B-O CID in Commercial Solar Cells with Industrial Hydrogenation Tools**
B. Hallam, C. Chan, R. Chen, S. Wang, J. Ji, L. Mai, M. Abbott, M. Kim, D. Chen, C.M. Chong & S.R. Wenham
UNSW Australia, Sydney, Australia

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2AV.1.37 **Regeneration of Boron-Oxygen Related Degradation in Cz-Si PERC-Type Solar Cells at High Temperatures**
A. Herguth, C. Derricks & G. Hahn
University of Konstanz, Germany
M. Hentsche, M. Wagner & F. Wolny
SolarWorld Innovations, Freiberg, Germany

2AV.1.38 **Influence of Silicon Nitride and Its Hydrogen Content on Carrier-Induced Degradation in Multicrystalline Silicon**
C. Vargas Castrillon, K. Kim, D. Payne, C. Chan, S.R. Wenham & Z. Hameiri
UNSW Australia, Sydney, Australia
G. Coletti
ECN, Petten, Netherlands

2AV.1.39 **Investigating Possible Causes of Light Induced Degradation in Boron-Doped Float-Zone Silicon**
D. Sperber, A. Herguth & G. Hahn
University of Konstanz, Germany

2AV.1.40 **Impact of Temperature and Doping on LeTID and Regeneration in mc-Si**
J. Fritz, A. Zuschlag, D. Skorka, A. Schmid & G. Hahn
University of Konstanz, Germany

2AV.1.41 **Effects of Oxygen Precipitates on Stability of Metal Against Gettering in n-Type Cz Silicon**
T. Kojima, R. Suzuki, K. Kinoshita, K. Onishi, T. Nishihara & A. Ogura
Meiji University, Kawasaki, Japan

2AV.1.42 **Investigation on the Phosphorus Diffusion Gettering Mechanism of Chromium in Multi-Crystalline Silicon**
N. Khelifati, D. Bouhafs & Y. Kouhlane
CRTSE, Algiers, Algeria
S.E.H. Abaidia
Boumerdes University, Algeria

2AV.1.43 **How to Degrade Boron-Oxygen Related Defects in Silicon**
A. Herguth
University of Konstanz, Germany

2AV.1.44 **Infrared Image Processing Algorithm for Solar Cell Defect Assessment**
A. Hovhannisyan
National Polytechnic University of Armenia, Yerevan, Armenia
A. Petrosyan
NAS RA, Ashtarak, Armenia

VISUAL PRESENTATIONS 2AV.2

15:15 - 16:45 Homojunction Solar Cells

2AV.2.1 **22% Efficient n-Type Rear Junction PERT Solar Cell with 100µm-Thin Industrial Monocrystalline Silicon Wafers**
T. Kim, Y.S. Choi, J. Lee, J. Lee, M. Hwang & S. Lee
Hyundai Heavy Industries, Yongin-si, Korea South

2AV.2.2 **Optimization and Application of a Single-Stage Co-Diffusion Process for Industrial n-Type Silicon Solar Cells**
N. Wehmeier, A. Nowack, S. Dorn, F. Kiefer, T. Brendemühl & S. Kajari-Schröder
ISFH, Emmerthal, Germany

2AV.2.3 **N-Type Monolike Silicon Bifacial Solar Cell: An Alternative Way of High Efficiency and Low Cost**
C.-L. Lin, Y.-T. Cheng, Y.-H. Huang, C.-C. Wang, C.-P. Tsao & J.-W. Chien
Inventec Solar Energy, Taoyuan, Taiwan

2AV.2.5 **Investigation of In-Situ Annealing during Physical Vapour Deposition of Al Rear Contacts on n-PERT Back-Junction Crystalline Silicon Solar Cells**
Z.-W. Peng, T. Buck & R. Kopecek
ISC Konstanz, Germany
M. Dörr, A. Hain & P. Wohlfart
Singulus Technologies, Kahl am Main, Germany
H. Nagel & P. Hartmann
Fraunhofer ISE, Freiburg, Germany

2AV.2.6 **Selective Epitaxy as Contact Passivation Approach in Bifacial n-Type PERT Solar Cells**
M. Récaman Payo, I. Kuzma-Filipek, Y. Li, S. Singh, A. Sharma, E. Cornagliotti, S. Jambaldinni, J. John, F. Duerinckx, J. Szlufcik & J. Poortmans
imec, Leuven, Belgium

2AV.2.7 **Gettering Efficacy of APCVD PSG and BSG Layers in mc-Si**
C. Fischer, A. Zuschlag & G. Hahn
University of Konstanz, Germany

2AV.2.8 **Preclusion of Light Induced Degradation in Multi-Crystalline by Low Temperature Metallization**
N. Western & S.P. Bremner
UNSW Australia, Sydney, Australia

2AV.2.9 **Enhancing Performance of Upgraded Metallurgical Grade Silicon Solar Cells Nano-Textured by Using Metal Catalyzed Chemical Etching**
V. Hoffmann & J.M. Míguez Novoa
Silicio FerroSolar, Arteixo, Spain
S. Zou & X. Su
Soochow University, Suzhou, China

2AV.2.10 **Impact of Glass Chemistry on Contact Formation for Silver Metallization Pastes**
L. Karpowich, R. Mayberry & M. Hörteis
Heraeus Precious Metals, West Conshohocken, United States

2AV.2.11 **Industrially MCCE Texutured Multicrystalline PERC with 19.8% Efficiency**
Z. Xu, H. Wang, Y. Wang, F. Li, J. Shi & D. Song
Yingli Green Energy, Baoding, China

2AV.2.12 **Laser Ablation Induced Recombination Losses of nPERT-BJ Solar Cells**
Z.-W. Peng, J. Theobald, V.D. Mihailetchi, T. Buck & R. Kopecek
ISC Konstanz, Germany

2AV.2.13 **Novel Wet Chemical Cleaning Concepts for High Efficiency Silicon Solar Cells**
M. Haslinger, S. Robert, S. Jambaldinni, J. Szlufcik, J. Poortmans & J. John
imec, Leuven, Belgium
M. Soha
University of Debrecen, Hungary
A. Hajjiah
Kuwait University, Safat, Kuwait

2AV.2.14 **Suitability of Low Recombinative POCl3 Diffusion Processes with In-Situ Oxidation for Forming Laser-Doped Selective Emitters**
S. Werner, E. Lohmüller, J. Weber & A. Wolf
Fraunhofer ISE, Freiburg, Germany

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2AV.2.15 **HNO3-Free Electrochemical Inline Approach for Diamond-Wire-Sawed Multi-Crystalline Material (DWS-mc) Texturing**
B. Straub, J. Burschik, H. Kühnlein & S. Queißer
RENA, Freiburg, Germany

2AV.2.16 **Fully Ion Implanted n-Type Silicon Bifacial Solar Cell with 20.1% Efficiency**
K. Tanahashi, M. Moriya, S. Simayi, Y. Kida, S. Utsunomiya, K. Shirasawa & H. Takato
AIST, Koriyama, Japan

2AV.2.17 **Rear-Surface Laser Contact Opening Design Optimization for PERC Solar Cells**
E. Picard, M. Pirot & S. Dubois
CEA, Le Bourget du Lac, France

2AV.2.18 **Optimization of the Optoelectronic Properties of Maskless Inductively Coupled Plasma Textures by the FSTD Method**
J. Hirsch, M. Gaudig, B. Köhler & N. Bernhard
Anhalt University of Applied Sciences, Köthen, Germany
D. Lausch
Fraunhofer CSP, Halle, Germany

2AV.2.19 **Double Side Cu-Plated Technology on Front Junction n-PERT Solar Cells**
K.-C. Lai, Y.-L. Lee, M.-S. Lin, C.-C. Chuang & C.-H. Li
Motech Industries, Tainan, Taiwan

2AV.2.20 **Bifacial PERC+ Solar Cells and Modules: An Overview**
T. Dullweber, H. Schulte-Huxel, C. Kranz, S. Blankemeyer, U. Baumann, R. Witteck, R. Peibst, M. Köntges & R. Brendel
ISFH, Emmerthal, Germany

2AV.2.21 **Integration of Epitaxially Grown Emitter Processed at Low Temperature (<300°c) by PECVD into n-PERT Architecture**
R. Peyronnet & T. Blévin
IPVF, Antony, France
R. Léal, F. Lebreton, G. Poulain & E. Drahi
TOTAL, Paris, France
N. Vaissiere, F. Silva & P. Roca i Cabarrocas
CNRS, Palaiseau, France
S. Pouliquen, Y. Marot & A. Zauner
Air Liquide, Jouy-en-Josas, France
M. Lemiti
INSA Lyon, Villeurbanne, France

2AV.2.23 **Effects of Tellurium Oxide in Silver Paste on the Electrical Losses in Silicon Solar Cells**
T. Aoyama & Y. Yoshino
Noritake, Miyoshi, Japan
M. Aoki, I. Sumita & Y. Ohshita
TTI, Nagoya, Japan
A. Ogura
Meiji University, Kawasaki, Japan

2AV.2.24 **Optimized Back Side Reflectance for Copper Electroplated Metallization p-Type Bifacial PERC Solar Cells**
S.-Y. Chen, Y.-H. Lin, J.-F. Huang & C.-H. Du
ITRI, Hsinchu, Taiwan

2AV.2.25 **Al-BSF Solar Cell Properties Using Screen-Printed Cu Paste and a Diffusion Barrier Layer**
T. Saito, H. Tri Hai, D. Ando, Y. Sutou, K. Shirasawa & J. Koike
Tohoku University, Sendai, Japan
T. Fukuda & Y. Kurimoto
Material Concept, Sendai, Japan

2AV.2.26 **Paste Development for Electrochemical Screen Printing to Structure Metal Layers of Back Contact Solar Cells**
K. Gensowski, M. Kamp, R. Efinger, M. Klawitter, M. Pospischil, J. Eckert & J. Bartsch
Fraunhofer ISE, Freiburg, Germany

2AV.2.27 **nPERT Solar Cells with a High Bifaciality > 93%**
P.-K. Chang, L.-T. Wang, S.-W. Chiu, Y.-J. Lin, W.-T. Chung, C. Kuo & C.-C. Li
Motech Industries, Tainan, Taiwan

2AV.2.28 **Full Area Emitter IBC Cells Fabricated with Point-Contacting by Localized Dielectric Breakdown**
A. Liao, N.J. Western & S.P. Bremner
UNSW Australia, Sydney, Australia

2AV.2.30 **Study of Electrode-Silicon Interface with Low Fire-Through Paste for Crystalline Si Solar Cell**
H. Hiyama, T. Kojima, K. Nakamura & A. Ogura
Meiji University, Kawasaki, Japan
K. Muramatsu & A. Tanaka
Namics, Niigita, Japan

2AV.2.31 **A Simple B/P Thermal Diffusion Approach for n-Type PERT Solar Cell**
S. Zhang, S. Zhang, C. Wu, Q. Wei, J. Lu, W. Lian & P. Ni
Talesun Solar, Suzhou, China

2AV.2.32 **New Chemical Attack of Ag-Catalyzed on Si in HF-H2O2-AGNO3 Medium. Application to Si Solar Cells Treatment**
W. Bodian & D. Kobor
UASZ, Ziguinchor, Senegal
J.-M. Joubert & S. Bastide
CNRS, Thiais, France

2AV.2.33 **Silicon Surfaces Nanotextured Using Tailored Voltage Waveform- Plasmas: Impact of Ion Bombardment Energy on Etching Dynamics and Passivation**
G. Fischer
IPVF, Antony, France
E. Drahi, F. Lebreton & G. Poulain
Total, Paris, France
P. Bulkin & E.V. Johnson
CNRS, Palaiseau, France

2AV.2.34 **Electroless-Plated Metallization for n-Type Silicon Solar Cells**
Y.-L. Lee, M.-S. Lin, K.-C. Lai, C.-C. Chuang & C.-C. Li
Motech Industries, Tainan City, Taiwan

2AV.2.36 **Fashioning “Black” Silicon by Nickel-Film Assisted Chemical Etching**
M. Treideris, A. Reza, M. Kamarauskas, V. Agafonov & A. Setkus
FTMC, Vilnius, Lithuania

2AV.2.38 **c-Si Surface Passivation Optimization of PECVD and ALD Al2O3 Deposited Layers**
R. Monna, C. Denis, A. Veau & S. Dubois
CEA, Le Bourget du Lac, France
B. Semmache, S. Tran & G. Lazzarelli
SEMCO, Montpellier, France
L. Bounaas
ECM Greentech, Grenoble, France

2AV.2.40 **19.75% Crystalline Silicon Solar Cells by Ceramic Roller Type Diffusion**
W. Hu, X. Li, G. Dong, X.H. Zhao, Y. Mai & Y. Xu
Hebei University, Baoding, China

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2AV.2.41 **Industrial Plasma-Less Dry Texturing Method for Diamond Wire Cut mc-Si Wafers**
L. Clochard
Nines Photovoltaics, Dublin, Ireland

2AV.2.42 **Optimized PERC Ag Paste for High Efficiency Emitters**
G. Scardera, R. Petres & S. Dugan
DuPont, Sunnyvale, United States
C.C. Torardi, P.D. VerNooy, Q. Guo & B.J. Laughlin
DuPont, Wilmington, United States

2AV.2.43 **Point Contact Formation Using Silicon Nanoparticle Dispersed SiO2**
H. Nagayoshi & H. Demura
TNCT, Tokyo, Japan
A. Ulyashin
SINTEF, Oslo, Norway

2AV.2.44 **Effect of Laser Ablation Process on High Efficiency Silicon Solar Cells**
M.-S. Lin, Y.-L. Lee, K.-C. Lai, C.C. Chuang & C.-C. Li
Motech Industries, Tainan City, Taiwan

2AV.2.45 **Fine Line Cu Plated Silicon Solar Cells**
L.-Y. Li, C.-K. Peng & C.-H. Du
ITRI, Hsinchu, Taiwan
P. Yu
National Chiao Tung University, Hsinchu, Taiwan

2AV.2.46 **Maskless Texturing of Diamond Wire Sawn Multicrystalline Silicon Wafers by SF6/O2 Inductively Coupled Plasma (ICP)**
B. Köhler, M. Gaudig & N. Bernhard
Anhalt University of Applied Sciences, Köthen, Germany
J. Hirsch
Fraunhofer CSP, Köthen, Germany
F. Kaule, S. Timmel, S. Meyer & D. Lausch
Fraunhofer CSP, Halle, Germany

2AV.2.47 **Development of Mono and Bifacial Solar Cells from 100µm n-Type Silicon Wafers**
T. Blévin & R. Peyronnet
IPVF, Antony, France
Y. Marot, A. Zauner, F. Coeuret, J.-Y. Letellier & S. Pouliquen
Air Liquide, Jouy-en-Josas, France
E. Drahi
TOTAL, Paris, France

2AV.2.48 **Investigation on Different Surface Modifications Using Laser Texturing**
B. Radfar, F. Es & R. Turan
METU, Ankara, Turkey

2AV.2.49 **Impact of UV Exposure on the Anti-Reflection Coating of an Unencapsulated Silicon Solar Cell**
V. Guiheneuf, F. Delaleux, O. Riou, P.-O. Logerais & J.-F. Durastanti
University Paris-Est Créteil, Lieusaint, France
S. Pouliquen
Air Liquide, Jouy en Josas, France

2AV.2.50 **Broadband Ultralow Reflectance of Hexagonal Arrays Consisting of Round-Head Silicon Nanopillars with Feature Size of 200 nm**
W. Yan, S. Dottermusch & B.S. Richards
Karlsruhe Institute of Technology, Germany

2AV.2.51 **Selective Emitter Solar Cells with Anti-Reflection Coating Fabricated by PECVD Silicon Nitride and Silicon Oxynitride Stacks**
S. Park, H. Park, K.N. Kim, S.J. Park, S. Kim, D. Kim, H.-S. Lee & Y. Kang
Korea University, Seoul, Korea South
D.S. Kim, J. Nam & D. Lee
Samsung SDI, Cheonan, Korea South
J. Yang
Kunsan National University, GunsanSi, Korea South
B.K. Min
KIST, Seoul, Korea South
D. Suh
Hoseo University, Asan, Korea South

VISUAL PRESENTATIONS 2AV.3

17:00 - 18:30 Heterojunction Solar Cells

2AV.3.1 **Low-Temperature Soldering for Silicon Heterojunction Solar Cells**
A. De Rose, D. Erath, A. Kraft & U. Eitner
Fraunhofer ISE, Freiburg, Germany

2AV.3.2 **Excellent Silicon Surface Passivation by TiOx: Aiming for Electron Selectivity by Atomic Layer Deposition**
J. Melskens, R.W.H.S. Scheerder, W.-J.-H. Berghuis, B.W.H. van de Loo, B. Macco & W.M.M. Kessels
Eindhoven University of Technology, Netherlands
P.C.P. Bronsveld & P. Spinelli
ECN, Petten, Netherlands

2AV.3.3 **Nanocrystalline vs. Amorphous n-Type Silicon Front Surface Field Layers in Silicon Heterojunction Solar Cells: Role of Thickness and Oxygen Content**
A.B. Morales-Vilches, L. Mazzarella, M. Hendrichs, L. Korte, R. Schlatmann & B. Stannowski
HZB, Berlin, Germany

2AV.3.4 **Mixed-Phase Silicon Oxide Layers with Phosphorus and Boron Doping for Co-Annealed Transparent Passivating Front and Rear Contacts**
J. Stuckelberger, P. Wyss, I. Mack, G. Nogay, A. Ingenito, Q. Jeangros, F.-J. Haug, P. Löper & C. Ballif
EPFL, Neuchâtel, Switzerland
J. Horzel, C. Allebé & M. Despeisse
CSEM, Neuchâtel, Switzerland

2AV.3.5 **Design, Fabrication and Characterization of Si Tunnel Diode for c-Si Based Tandem Solar Cell**
A. Fave, F. Mandorlo, F. Boyer & M. Lemiti
INSA Lyon, Villeurbanne, France

2AV.3.6 **Analysis of MF Sputtered Indium Tin Oxide Layers for Silicon Heterojunction Solar Cells**
S. Bose, W. Wolke & J. Rentsch
Fraunhofer ISE, Freiburg, Germany

2AV.3.7 **Effective Surface Passivation of c-Si by Atomic Layer Deposited MoOx Layers for Hole-Selective Contacts**
B. Macco, B.W.H. van de Loo, J. Melskens & W.M.M. Kessels
Eindhoven University of Technology, Netherlands
P.C.P. Bronsveld & P. Spinelli
ECN, Petten, Netherlands

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2AV.3.8 **Sputter Deposition Induced Damage to a-Si:H / c-Si Passivation Quality**
L. Tutsch, M. Bivour, M. Hermle & J. Rentsch
Fraunhofer ISE, Freiburg, Germany

2AV.3.9 **Development of Inline PECVD Deposition of a-Si Layers for Heterojunction Solar Cells on an Industrial Scale**
J. Temmler, A. Moldovan, D. Putra, M. Bivour & J. Rentsch
Fraunhofer ISE, Freiburg, Germany

2AV.3.10 **Low-Cost Fabrication of Patterned Electrodes in Hetero-Junction Back-Contact Silicon Solar Cells by Plasma Ion-Implantation**
K. Koyama, K. Ohdaira & H. Matsumura
JAIST, Ishikawa, Japan

2AV.3.11 **Effect of Sputtered a-Si on Effective Carrier Lifetime of c-Si with Ultra-Thin SiO2 Structure**
K. Gotoh, I. Takahashi, Y. Kurokawa & N. Usami
Nagoya University, Japan

2AV.3.12 **A Successful Conversion of Silicon Thin-Film Solar Module Production to High Efficiency Heterojunction Technology**
D. Andronikov, A. Abramov, S. Abolmasov, K. Emtsev, G. Ivanov, I. Nyapshaev, D. Orekhov, A.V. Semenov, G. Shelopin, E. Terukova, E.I. Terukov & A. Titov
TFTE, St-Petersburg, Russia
N. Belkova, A. Dubrovskiy, P. Ishmuratov, A. Ivanov, D. Saykin, I. Shakhray, A. Smirnov, V. Tarasov, V. Timakov & A. Tomchinsky
Hevel Solar, Novocheboksarsk, Russia
G. Kekelidze
Moscow Technological Institute, Russia

2AV.3.13 **Improvement of Silicon Heterojunction Solar Cells with Argon Plasma Treatment**
A. Neumüller, O.V. Sergeev, M. Vehse & C. Agert
NEXT ENERGY, Oldenburg, Germany

2AV.3.14 **Heterojunction IBC Solar Cells on Thin (< 50µm) Epitaxial Si Foils Produced from Kerfless Layer Transfer Process**
H. Sivaramakrishnan Radhakrishnan, M. Xu, T. Bearda, M. Filipic, K. Van Nieuwenhuysen, V. Depauw, I. Gordon, M. Debucquoy, J. Szlufcik & J. Poortmans
imec, Leuven, Belgium

2AV.3.15 **Amorphous Silicon Deposited with Plasma Excitation Frequencies Larger Than 100 MHz for Heterojunction Solar Cells**
C. Strobel, B. Leszczynska, S. Leszczynski, M. Albert & J.W. Bartha
Technical University of Dresden, Germany
F. Stahr & J. Kuske
FAP, Dresden, Germany

2AV.3.16 **MoOx as Dopant-Free Hole Collector in p-Type Si Heterojunction Solar Cells**
L.V. Mercaldo, E. Bobeico, I. Usatii, M. Della Noce, L. Lancellotti & P. Delli Veneri
ENEA, Portici, Italy

2AV.3.17 **Dopant-Free Multilayer Back Contact Silicon Solar Cells Employing V2Ox/Metal/V2Ox as an Emitter**
W. Wu, W. Lin, J. Bao, Z. Liu, Y. Zhao, K. Qiu, L. Cai, J. Zhou & H. Shen
Sun Yat-sen University, Guangzhou, China

2AV.3.18 **Effect of Nanocrystalline Si- and SiOx-Based Doped Layers on p-Type Si Heterojunction Solar Cells with AZO**
L.V. Mercaldo, E. Bobeico, I. Usatii, M. Della Noce, L. Lancellotti & P. Delli Veneri
ENEA, Portici, Italy
L. Serenelli, M. Izzi & M. Tucci
ENEA, Rome, Italy

2AV.3.19 **Passivated Rear and Front Contacts (PeRFeCT) Solar Cells: the Poly-Poly and the Hybrid Approaches**
G. Limodio, G. Yang, H. Ge, A. Weeber, O. Isabella & M. Zeman
Delft University of Technology, Netherlands

2AV.3.20 **SiOx:H Passivation Layer Fabricated by Atomic Layer Deposition for Heterojunction Solar Cells**
M. Lozach, S. Nunomura, H. Sai, T. Matsui & K. Matsubara
AIST, Tsukuba, Japan

2AV.3.22 **Copper Plating Chemistry for Solar Cells**
A. Lachowicz, J. Geissbühler, A. Faes, J. Horzel, M. Despeisse & C. Ballif
CSEM, Neuchâtel, Switzerland

2AV.3.23 **ITO Sputtering Damage to Silicon Heterojunction Solar Cells with Cat-CVD a-Si Films and Its Recovery**
T. Konishi & K. Ohdaira
JAIST, Ishikawa, Japan

2AV.3.24 **Fabrication and Simulation of ZnS/p-Si Heterojunction Solar Cells**
K. Qiu & H. Shen
Sun Yat-sen University, Guangzhou, China
D. Qiu
Sun Yat-sen University, Shunde, China

2AV.3.26 **Fabrication of Silicon Heterojunction Cells on 50µm Epitaxial Substrates**
T. Bearda, A. Umer, S. Jambaldinni, M. Filipic, K. Van Nieuwenhuysen, H. Sivaramakrishnan Radhakrishnan, V. Depauw, I. Gordon, M. Debucquoy, J. Szlufcik & J. Poortmans
imec, Leuven, Belgium
Y. Abdulraheem
Kuwait University, Safat, Kuwait

2AV.3.27 **Fabrication and Characterization of 20%+ Efficient Silicon Heterojunction Solar Cells with Direct Rear Aluminum Metallization**
J. Bryan, Z.J. Yu, J. Shi, W. Weigand, M. Leilaeioun, K.C. Fisher & Z.C. Holman
Arizona State University, Tempe, United States

2AV.3.28 **Fundamental Constraints Imposed by Thermionic Emission Barrier at the Hetero-Interface and by pn Junction Diffusion Barrier on the Fill Factor and Efficiency of SHJ Cells**
M.Y. Ghannam & Y. Abdulraheem
Kuwait University, Safat, Kuwait

2AV.3.29 **Silver Material for Next Generation Heterojunction Solar Cells**
L. Serenelli, M. Izzi & M. Tucci
ENEA, Rome, Italy
M. Miliciani
Chimet, Viciomaggio, Italy

2AV.3.30 **Comparison between a-SiOx:H and a-Si:H as Passivation Buffer Layer for Heterojunction Solar Cells**
L. Martini, L. Serenelli, F. Menchini, M. Izzi & M. Tucci
ENEA, Rome, Italy
R. Asquini
University of Rome "La Sapienza", Italy

2AV.3.31 **The Performances of Heterojunction Interdigitated Back-Contact (HBC) Solar Cell with Intrinsic Amorphous Silicon as Front Surface Passivation Layer**
R. Jia, K. Tao, Q. Li, C. Sun, X. Dai, X. Liu & Z. Jin
CAS, Beijing, China

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2AV.3.32 **Performance of Encapsulated Reactive Silver Ink Metallized Solar Cells**
A.M. Jeffries, A. Mamidanna, O. Hildreth & M.I. Bertoni
Arizona State University, Tempe, United States

2AV.3.34 **A Novel Bifacial c-Si Cell Structure and Process for High Efficiency and Low Cost**
H. Huang, G. Tian, J. Yuan, W.R. Fahrner & L. Zhou
Nanchang University, China
W. Zhang & X. Li
GCL System Integration Technology, Shanghai, China
W. Chen & R. Liu
Hareon Solar Technology, Taicang, China

2AV.3.36 **Reducing Surface Defects and Absorption of Organic Material in High Performance Organic/Silicon Nanostructure Hybrid Solar Cells**
Y. Lai, H.-J. Syu & C.-F. Lin
NTU, Taipei, Taiwan

2AV.3.37 **A Novel Procedure for Fabricating Sub-Micron Textures on Various Thick Crystalline-Silicon Solar Cells Down to 50µm with Low-Reflectivity in Wide Wavelength**
C.T. Nguyen, K. Koyama, T.C.T. Huynh, S. Terashima & H. Matsumura
JAIST, Ishikawa, Japan

2AV.3.38 **Fabrication of High Density Nano-Micro Hierarchical Subwavelength Structure for Enhancing Light Trapping Properties in a Few Seconds**
H.A. Chaliyawala, A. Ray, R. Pati & I. Mukhopadhyay
PDP University, Gandhinagar, India

2AV.3.39 **Influence of DC-Sputtered ITO Layers on Performance of Silicon Heterojunction Solar Cells**
S. Abramov, D. Andronikov, K. Emtsev, G. Ivanov, I. Nyapshaev, D. Orekhov, A. Semenov, G. Shelopin & E. Terukov
RAS/ Ioffe, St. Petersburg, Russia
S. Abolmasov
RAS/ Ioffe, St-Petersburg, Russia

2AV.3.40 **Carrier Dynamics Investigation of c-Si/MoOx Junction for Dopant Free Silicon Heterojunction Solar Cells: Impact of Sputter Deposited MoOx Process Temperature and SiOx Buffer Layer**
P.K. Parashar & V.K. Komarala
IIT Dehli, New Dehli, India

2AV.3.41 **Effect of ALD Grown Al2O3 as Interfacial Layer in Graphene/Silicon Schottky Barrier Solar Cells**
A. Alnuaimi, I. Al Mansouri & A. Nayfeh
Masdar Institute, Abu Dhabi, United Arab Emirates

2AV.3.42 **Transverse-Collection Mechanisms in Silicon-Heterojunction Solar Cells**
A. Casado, R. Barrio Martin, J.J. Gandía & J. Cárabe
CIEMAT, Madrid, Spain

2AV.3.43 **Electronic Properties of Ultrathin a-Si:H Passivation Layers for Silicon Heterojunction Solar Cells**
S. Nunomura, I. Sakata & K. Matsubara
AIST, Tsukuba, Japan

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VISUAL PRESENTATIONS 6BV.1

08:30 - 10:00 Design and Operation of PV Systems (I)

6BV.1.1 **Experimental and Theoretical Investigation of Fixed and Tracking PV Panel Performance in Tehran through Techical and Economic Aspects**
S. Eslami & A. Bakhtiari
Shahid Beheshti University, Tehran, Iran
M. Bahrami
University of Lorraine, Vandoeuvre-lès-Nancy, France

6BV.1.5 **Shading Impact on 10 kWp Rooftop Grid Connected Photovoltaic System**
R. Silva Simplicio, R. Herrero Alonso, C. Biasi de Moura & M. Knörich Zuffo
University of São Paulo, Brazil

6BV.1.7 **A Robust Sliding Mode MPPT Controller Applied to a Stand-Alone Photovoltaic System**
H. Yatimi & E. Aroudam
Abdelmalek Essaadi University, Tetouan, Morocco

6BV.1.8 **Degradation Analysis of PV Modules Applied to Microgrid PV Plants Connected to the Low-Voltage Power Grid**
A.M. Silva, D.B. Tsukamoto, A.C. Souza, F. Cardoso Melo & L.C. Gomes de Freitas
Federal University of Uberlândia, Brazil

6BV.1.9 **Implementation of Artificial Intelligence Methods for the Management of a Multi-Source Renewable Energy System**
B. Aoukach & B. Oukarfi
University of Hassan II, Casablanca, Morocco

6BV.1.10 **Operational Fault-Mode Differentiation in a Large-Scale Photovoltaic Power Plant with Fault-Diagnostic Function**
T. Kohno, H. Shitanishi, M. Toyosaki, K. Gokita, T. Nakamura & Y. Nagayama
Hitachi, Tokyo, Japan
K. Morikawa
TEPCO, Yokohama, Japan
M. Hatano
Tokyo Institute of Technology, Japan

6BV.1.11 **Innovative Simulation Tools for an Exhaustive and Synthetic Characterization of the Glare Occurrences for the Design and the Administrative Instruction of Large-Scale Photovoltaic Plants**
C. Vernay, A.M. Realpe, D. de Gabaï & S. Pitaval
SOLAÏS, Sophia Antipolis, France

6BV.1.12 **Modeling and Experimental Validation of Power Estimation of a Multi-Crystalline Silicon Photovoltaic System Using Four and Five Parameter Solar Cell Models under Real Field Conditions**
M. Kumar & A. Kumar
IIT Roorkee, India

6BV.1.13 **Performance Analysis of Multi-Photovoltaic (PV)-Grid Tied Plant in Malaysia**
L.M. Halabi & S. Mekhilef
University of Malaya, Kuala Lumpur, Malaysia

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6BV.1.14 **A Sensitivity Analysis and a Calibration of a Numerical Code for the Prediction of Power from a Photovoltaic Plant**
M. Carmassi, D. Binesti, H. Bouia, M. Chiodetti & A. Lindsay
EDF R&D, Moret-sur-Loing, France
E. Parent & P. Barbillon
AgroParisTech, France
M. Keller
EDF R&D, Chatou, France

6BV.1.15 **PV-Battery and Diesel Hybrid System for Irrigation of a Farm in Patagonia**
R. Knecht & F.P. Baumgartner
ZHAW, Winterthur, Switzerland

6BV.1.16 **Comparison of Performance and Degradation of Different PV Plant Configurations in Johannesburg, South Africa**
T. Serameng
Eskom, Cleveland, South Africa
K.T. Roro
CSIR, Pretoria, South Africa
E.E. van Dyk, J. Crozier & F. Vorster
NMMU, Port Elizabeth, South Africa

6BV.1.17 **Economic Analysis of a Typical Photovoltaic Power Plant in Turkey**
A.B. Karaveli, B.G. Akinoglu & U. Soytas
METU, Ankara, Turkey

6BV.1.19 **Estimation of the Final Yield of Grid Connected PV System in the Eastern Africa Region**
F. Habyarimana
University of Rwanda, Kigali, Rwanda
H.G. Beyer
University of the Faroe Islands, Torshavn, Faroe Islands

6BV.1.21 **Real-Life Performance of a 10-MW Single-Axis Tracking Photovoltaic Plant in Kuwait Oil Company for the Operation of Electric Submersible Pumps**
R.A. Sherif, A. Al-Qudaihi, L. Al-Bairami, A. Najaf & R. Al-Ajmi
Kuwait Oil Company, Ahmadi, Kuwait

6BV.1.22 **Computational Tool for the Modelling and Simulation of Grid-Connected Photovoltaic Solar Systems**
A. Cardoso Ferreira, L.C. Macedo Blasques, M.A. Barros Galhardo & J. Tavares Pinho
UFPA, Belém, Brazil

6BV.1.23 **PV Powered Battery-Less Reverse Osmosis Desalination System Operating at Variable Pressure Conditions and Controlled by a Multi-Agent Decentralized Energy Management System**
C.-S. Karavas, K.G. Arvanitis, G. Kyriakarakos & G. Papadakis
Agricultural University of Athens, Greece
D.D. Piromalis
Piraeus University of Applied Sciences, Greece

6BV.1.24 **A 360 kWp PV Irrigation System to a Water Pool in Spain**
I.B. Carrêlo, R.H. Almeida, L.M. Carrasco, F. Martinez-Moreno & L. Narvarte
UPM, Madrid, Spain

6BV.1.25 **A 160 kWp Constant Pressure PV Irrigation System in Spain**
I.B. Carrêlo, R.H. Almeida, F. Martinez-Moreno, L.M. Carrasco & L. Narvarte
UPM, Madrid, Spain

6BV.1.26 **Large-Scale Hybrid PV-Grid Irrigation System**
R.H. Almeida, I.B. Carrêlo, L.M. Carrasco, F. Martinez-Moreno & L. Narvarte
UPM, Madrid, Spain

6BV.1.27 **A 140 kW Hybrid PV-Diesel Pumping System for Constant-Pressure Irrigation**
R.H. Almeida, I.B. Carrêlo, F. Martinez-Moreno, L.M. Carrasco & L. Narvarte
UPM, Madrid, Spain

6BV.1.28 **A New Metric for Assessing Local Mechanical Load Scenarios for PV Modules at Specific Locations**
C. Camus, P. Offermann, C. Buerhop-Lutz & J. Hauch
ZAE Bayern, Erlangen, Germany
M. Weissmann
LMU Munich, Germany
C.J. Brabec
University of Erlangen-Nuremberg, Germany

6BV.1.29 **System Sizing for Residential PV and EES Systems**
T. Melloh, T. Fehling, G. Kleiss & B. Nacke
University of Hannover, Germany

6BV.1.30 **Effect of Operational Parameters on the Production of a Solar Distiller Coupled to a Hybrid Photovoltaic Thermal Collector**
L. Maifi & T. Kerbache
University Constantine, Algeria

6BV.1.31 **Energy Performance of a 1.2 MWp Photovoltaic System Distributed over Nine Buildings at Utrecht University Campus**
W.G.J.H.M. van Sark, A.C. de Waal, J. Uithol, N. Dols, F. Houben, R. Kuepers & M. Scherrenburg
Utrecht University, Netherlands
B. van Lith
BAM, Bunnik, Netherlands
F. Benjamin
ProfiNRG, Harmelen, Netherlands

6BV.1.33 **Evaluating the Performance of PV Module & System under Field Conditions**
J.-K. Lim, M. Kim, S. Yoon, J.H. Ahn, M.-I. Hwang & S. Lee
Hyundai Heavy Industries, Yongin, Korea South

6BV.1.34 **The Practicability of Outdoor Measurement Methods for Photovoltaic Installations**
W. Mühleisen, L. Neumaier & C. Hirschl
CTR, Villach, Austria
M. Spielberger
PVSV, Guttaring, Austria
H. Sonnleitner
ENcome, Klagenfurt, Austria
Y. Voronko & G. Eder
OFI, Vienna, Austria
B. Kubicek & R. Ebner
AIT, Vienna, Austria

6BV.1.35 **The Use of Logistic Regression for Evaluating Climate-Relevant PV Module Failures**
N. Vollert, L. Neumaier, W. Mühleisen & C. Hirschl
CTR, Villach, Austria
M. Halwachs
AIT, Vienna, Austria
L. Maul
University of Applied Sciences Vienna, Austria
Y. Voronko
OFI, Vienna, Austria
A. Mihaljevic
PCCL, Leoben, Austria

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6BV.1.37 **Fire Safety of PV Modules and Buildings: Overviews, Bottlenecks and Hints**
P. Bonomo, E. Saretta, F. Frontini, M. Caccivio & G. Bellenda
SUPSI, Canobbio, Switzerland
G. Manzini
RSE, Milan, Italy
P. Cancelliere
Italian National Fire Services, Rome, Italy

6BV.1.38 **Building a Renwable Island System - A Simulation-Based Case Study for the Greek Island of Tilos**
S. Zurmühlen, G. Angenendt, J. Badeda & D.U. Sauer
RWTH Aachen University, Germany

6BV.1.40 **Floating Photovoltaic Module Temperature Operation Characteristics**
W.C. Lawrence, C.-S. Won, D.-C. Kim, K.-W. Kim, B.-R. Kang & G.-H. Lee
LSIS, Anyang-Si, Korea South
O. Kwon & S. Lee
K-water, Daejeon, Korea South

6BV.1.41 **Design, Implementation and Performance Analysis of an Efficient Sub-Degree Solar Tracker System**
M. Hesham, M. Taha, I.M. Mahmoud, A. Sahbel, S. Abdelatif & H. Ghali
The British University in Egypt, Cairo, Egypt

6BV.1.42 **Performances of Grid-Connected PV Systems in Operation on the Island of Maui**
S. Busquet
University of Hawaii, Honolulu, United States

6BV.1.43 **Investigating a Potential Linear Model for Prediction of Monthly Snow-Induced Production Losses for Rooftop PV**
M. van Noord & T. Berglund
Esam AB, Stockholm, Sweden
M. Murphy
Umeå University, Sweden

6BV.1.44 **Statistical Analysis of Infrared-Inspections of PV-Plants**
C. Buerhop-Lutz, T. Pickel, H. Scheuerpflug, C. Camus & J. Hauch
ZAE Bayern, Erlangen, Germany
C.J. Brabec
University of Erlangen-Nuremberg, Germany

6BV.1.45 **Reverse Voltage Simulation of Crystalline Silicon PV Module with Damaged Bypass Circuit**
N. Oka, Y. Takahashi, K. Fujiwara & Y. Ishihara
Doshisha University, Kyotanabe, Japan
S. Nishikawa
Nihon University, Tokyo, Japan

6BV.1.46 **Potential Induced Degradation Occurrence in Photovoltaic Power Plant**
J. Hylsky, D. Strachala, J. Vanek & J. Mucha
Brno University of Technology, Czech Republic

6BV.1.47 **Feasibility Evaluation of Installing Photovoltaic Mounting System on Recycling Water Reservoir in Iran: A Case Study in Petrochemical Industry**
M. Nazififard
University of Kashan, Iran

6BV.1.48 **Soiling in the Atacama Desert: Characterisation of Soiling Rates and Their Geographic Variation**
P. Darez, C. Darr & J. Atkinson-Willes
350renewables, Las Condes, Chile

6BV.1.49 **An Adaptive PSO-Based Approach for Optimal Energy Harvesting in PV Systems**
S.Z. Mirbagheri Golroodbari & W.G.J.H.M. van Sark
Utrecht University, Netherlands

6BV.1.51 **A Computational Study for Enhancing the Output Power of a Photovoltaic Panel Based on Various Back Pipe Structures**
A. Bayoumi & S. Abdelatif
BUE, Cairo, Egypt
A.S.G. Khalil
AASTMT, Giza, Egypt
O.E. Abdellatif
Banha University, Benha, Egypt
M. Abdelrasheed & N.A. Mahmoud
Ain Shams University, Cairo, Egypt

VISUAL PRESENTATIONS 6BV.2

13:30 - 15:00 Design and Operation of PV Systems (II)

6BV.2.2 **Comparison of Measured Field Performance of a Grid Connected CdTe Photovoltaic System to Expected Performance via PlantPredict Software**
A. Benazzouz, Z. Naimi & B. Ikken
IRESEN, Rabat, Morocco
J. Sorensen & K. Passow
First Solar, Perrysburg, United States

6BV.2.3 **Web Application for Yield Optimization of Photovoltaic Systems**
H. te Heesen & M. Rumpler
Trier University of Applied Science, Neubrücke, Germany

6BV.2.4 **Laboratory Infrastructure for Research and Capacity Building on Isolated and Grid-Connected Smart Micro-Grids**
A.R. Arrifano Manito, K. Novaes, A.R. Mocelin, T.A.F. Melendez & R. Zilles
University of São Paulo, Brazil
J.T. Tavares Pinho
UFPA, Pará, Brazil

6BV.2.6 **Defect Detection in Solar Cells Using Electroluminescence Imaging and Image Processing Algorithms**
F. Farress, A. El Hassani El Alaoui, Z. Naimi & A. Bennouna
IRESEN, Rabat, Morocco
M.N. Saidi & A. Tamtaoui
INPT, Rabat, Morocco

6BV.2.8 **Analysis and Investigation of a Grid Connected Photovoltaic Installation Located in North of Morocco**
I. Baghdadi, A. El Yaakoubi, K. Attari, Z. Leemrani & A. Asselman
Abdelmalek Essaadi University, Tetouan, Morocco

6BV.2.9 **Very Short-Term Solar Irradiation Forecasting Method Using State Estimation Based on Kalman Filters for PV-Diesel Hybrid Systems**
J.A. Notholt
Reutlingen University, Germany

6BV.2.10 **Quick and Effective Plant Evaluation Using Dark IV String Curves**
K. Mertens & A. Arnds
Münster University of Applied Sciences, Steinfurt, Germany
M. Diehl
photovoltaikbuero, Rüsselsheim, Germany

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6BV.2.11 **Novel Soiling Detection System for Solar Panels**
M. Korevaar, J. Mes & X. van Mechelen
Kipp & Zonen, Delft, Netherlands

6BV.2.12 **Improvements of Photovoltaic Systems by Using Solar Tracking in Equatorial Regions**
F. Ordóñez, C. Morales & S.D. Vaca
Escuela Politecnica Nacional, Quito, Ecuador

6BV.2.13 **Advanced Failure Detection Algorithms and Performance Outlier Decision Classification for Grid-Connected PV Systems**
A. Livera, G. Makrides & G.E. Georghiou
University of Cyprus, Nicosia, Cyprus
J. Sutterlueti
Gantner Instruments, Schruns, Austria

6BV.2.14 **Characterization of a Stand-Alone PV Cooling/Heating System**
C. Lorenzo Navaro & L. Narvarte
UPM, Madrid, Spain
M.A. Bofill
Domus Ingeniería Energética, Elda, Spain

6BV.2.15 **Development and Integration of a PV Smart Home in Colombia**
L.A. García Gutiérrez, M. Bressan, J.F. Jiménez Vargas & A.I. Cadena
University of Los Andes, Bogotá, Colombia
C. Alonso
LAAS, Toulouse, France

6BV.2.17 **Solar Photovoltaic Panels Failures Causing Power Losses: A Review**
G.-J.-P. Tevi, M.E. Faye, M. Sene & A. Seidou Maiga
Gaston Berger University, Saint-Louis, Senegal

6BV.2.18 **A Monitoring Architecture Proposition for Photovoltaic Plants**
S. Sarikh, M. Raoufi & A. Bennouna
Cadi Ayyad University, Marrakech, Morocco
A. El Hassani El Alaoui & A. Benlarabi
IRESEN, Rabat, Morocco

6BV.2.19 **Solar Farm Cleaning Robot: Eco-Friendly Cleaning of Solar Farms with Reduced Energy and Water Consumption**
K. Molnar, Z. Bilau & I. Bogar
ProDSP Technologies, Budapest, Hungary
M.P. Bellmann, B. Ryningen & W.R. Glomm
SINTEF, Trondheim, Norway
S. Arbab
NTNU, Trondheim, Norway

6BV.2.20 **Development of an RTC Based Multilevel Solar Panel System**
T. Debnath, S.N. Imtiaz, S.F. Nawaz, A. Al Mahmud & M. Rahman
BRAC University, Dhaka, Bangladesh

6BV.2.21 **Descriptive Statistics on the Climate Related Performance and Reliability Issues from Global PV Installations**
M. Halwachs, K.A. Berger, M. Schwark & R. Ebner
AIT, Vienna, Austria
L. Maul
UAS Technikum Wien, Vienna, Austria
L. Neumaier, N. Vollert, W. Mühleisen & C. Hirschl
CTR, Villach, Austria
Y. Voronko
OFI, Vienna, Austria
A. Mihaljevic
PCCL, Leoben, Austria

6BV.2.22 **The Development and Test of the PV Concentrator System Witn Electrical and Thermal Output**
A.V. Okhorzina & A.V. Yurchenko
Tomsk Politechnical University, Russia
N. Bernhard
Anhalt University of Applied Sciences, Köthen, Germany

6BV.2.23 **Harmonising Data Collection from the Field to Determine Long Term Reliability Trends**
L. Azpilicueta
EVASA, Brussels, Belgium
L. Garreau-Iles
DuPont, Meyrin, Switzerland
G. Masson
Becquerel Institute, Brussels, Belgium

6BV.2.24 **Autonomous Solar-Wind Power Forecasting Systems**
A.V. Yurchenko, A. Bikbulatov & A.V. Okhorzina
Tomsk Politechnical University, Russia

6BV.2.26 **PHSO: A Graphic User Interface Optimizer for the Sizing Design of PV Hybrid Systems**
C.D. Rodríguez Gallegos, O. Gandhi, T. Reindl & S.K. Panda
SERIS, Singapore, Singapore

6BV.2.27 **Fault Diagnosis, Identification and Localization of Photovoltaic Plants through Infrared Thermography, Review of the International IEC 62446-3**
G. Vannier, C. El Mkadmi, L. Ha Duy & F. Al Shakarchi
CEA, Le Bourget du Lac, France

6BV.2.29 **Luminescence Imaging Strategies for Drone-Based PV Array Inspection**
G.A. dos Reis Benatto, N. Riedel, S. Thorsteinsson, P.B. Poulsen, A. Thorseth, O. Bjarlin Jensen, C. Dam-Hansen, C. Mantel & S. Forchhammer
Technical University of Denmark, Roskilde, Denmark
K.H.B. Frederiksen
Kenergy, Horsens, Denmark
J. Vedde
SiCon, Birkerod, Denmark
M. Petersen
Skive Kommune, Denmark
H. Voss & M. Messerschmidt
Sky-Watch, Nordjylland, Denmark
H. Parikh, S.V. Spataru & D. Sera
Aalborg University, Denmark

6BV.2.30 **Towards Automated Design of Optimal Photovoltaic Systems**
M. van Hoolwerff, J. Donker, J. Bronkhorst & J.P. Versluijs
Solar Monkey, Delft, Netherlands
M. van Til & S. Briels
Readaar, Amsterdam, Netherlands
O. Tsafarakis & W.G.J.H.M. van Sark
Utrecht University, Netherlands
O. Isabella & M. Zeman
Delft University of Technology, Netherlands

6BV.2.31 **Influence of Small Defects on the Production and the Safety of PV Plants**
M. Pinho Almeida, A.R. Arrifano Manito, G. Figueiredo & R. Zilles
University of São Paulo, Brazil

6BV.2.32 **A Comparative Study of Two Models for Evaluating the Power of Photovoltaic Modules in a Standalone Power Plant**
A. El Fathi, M. Akhsassi, A. Bennouna & A. Outzourhit
Cadi Ayyad University, Marrakech, Morocco

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6BV.2.33 **Experimental Yield Study of Bifacial PV Modules in Nordic Conditions**
E. Molin & E. Wäckelgård
Dalarna University, Falun, Sweden
B. Stridh
Mälardalen University, Västerås, Sweden
A. Molin
PPAM Solkraft, Ljungsbro, Sweden

6BV.2.34 **Early Degradation of Photovoltaic Modules Based on n Type Solar Cells**
G. Figueiredo, R. Zilles & M. Pinho Almeida
University of São Paulo, Brazil

6BV.2.35 **A Detailed Performance Model for Bifacial PV Modules**
C.W. Hansen, D.S. Riley, M. Lave & J.S. Stein
Sandia National Laboratories, Albuquerque, United States
C. Deline
NREL, Golden, United States
A. Asgharzadeh & F. Toor
The University of Iowa, Iowa City, United States

6BV.2.36 **Detection of Premature Degradation in Utility Scale PV Plants Based on Advanced Monitoring Data Analysis**
G. Mütter, B. Eizinger & R. Vallavanti
Alternative Energy Solutions, Vienna, Austria

6BV.2.37 **Where Has All the Power Gone? A Health Check of Italian Solar Electricity in 2016**
A. Virtuani, M. Marzoli & M. Pravettoni
O'Sole, Milan, Italy
A. Skoczek & J. Betak
Solargis, Bratislava, Slovakia

6BV.2.38 **Performance and Reliability of a Professional Small-Island Hybrid PV-System**
H.A. Ossenbrink
Band Gap, Bad Feilnbach, Germany

6BV.2.39 **Improved Method of Levenberg-Marquardt Combined with Simulated Annealing for Parametric Identification of Solar Cell Double Diode Model**
F. Dkhichi, B. Oukarfi, Y. El Kouari & A. Fakkar
University of Hassan II, Mohammédia, Morocco

6BV.2.40 **Design and Performance of a Real Scale Refrigerated Photovoltaic Plant Installed in a Hydroelectric Plant**
V.O. Silva, A.L. Veiga Gimenes, S. Gomes Relva, M.E. Morales Udaeta & L.C. Ribeiro Galvão
University of São Paulo, Brazil

6BV.2.41 **Development of Robust Algorithm for Autonomous System Health Monitoring of Large-Scale Based Solar Farm**
S. Arosh, K. Ghosh, S. Prakash & S.P. Duttagupta
IIT Bombay, Mumbai, India

6BV.2.42 **A Quantitative Study of Variable Orientation Methods for Enhancing Solar Power Generation on Tethered Aerostats**
S. Gupta, S.P. Duttagupta, L. Vachhani & M. Mitra
IIT Bombay, Mumbai, India

6BV.2.44 **Agrovoltaic Solution: Benefits of Bifacial Modules in Greenhouses**
L. Bothorel & L. Weiss
Voltec Solar, Dinsheim sur Bruche, France

6BV.2.45 **On the Calculation of the STC Power of PV Generators by Using Typical Monitoring System Data**
M. Muñoz, M. García, I. de la Parra, J. Marcos & L. Marroyo
UPNa, Pamplona, Spain

6BV.2.46 **High-Fidelity Solar Power Income Modeling for Solar-Electric Aircraft: Development and Flight Test Based Verication**
P. Oettershagen & R. Siegwart
ETH Zurich, Switzerland

6BV.2.47 **Consumer-Friendly Application for Off-Grid Solar Design**
A. Gritzman, T. Kurien, T. Chiwewe & J. Ditsela
IBM Research, Johannesburg, South Africa

6BV.2.48 **Development of a Model-Based Control Application Compliant with IEC 61499 for Building Energy Systems with a Focus on Photovoltaics**
M. Jakobi, T. Tjaden & V. Quaschning
Berlin University of Applied Sciences, Germany
U. Stöckli & L. Meier
Vela Solaris, Winterthur, Switzerland

6BV.2.49 **Power Performance Analysis of Transparent DSSC BIPV Window Based on 2 Years Measurement Data in Full Scale Test Facility**
J. Yoon, H. Lee, S. Kim, R. Lee & M.-J. Choi
Hanbat National University, Daejeon, Korea South

6BV.2.50 **Techno-Economical Analysis of Off-Grid Photovoltaic LED Road Lighting Systems for Turkey**
A.C. Duman & O. Güler
Istanbul Technical Unversity, Turkey

6BV.2.51 **Optimization of Solar PV Systems for Demand Profile Matching**
J. Alshahrani & P. Boait
De Montfort University, Leicester, United Kingdom

6BV.2.52 **Solar Photovoltaic for Sustainable Use in Trituration Oil Olive Unit and Energy Efficiency in Cold and Hydric Storage**
S. Mounir
National School of Fez, Morocco
S. Ladouy, A. Khabbazi & Y. Maaloufa
University Mohammed V-Agdal, Rabat, Morocco
K. Harrouni
National School of Rabat, Morocco

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VISUAL PRESENTATIONS 6BV.3

15:15 - 16:45 **Solar Resource and Forecasting / Building, Infrastructure and Landscape Applications / Grid and Energy System Integration**

6BV.3.1 **Implementing Procedures for Building a Bankable Dataset and Smart Solar Resource Assessment**
M.H. Bouhamidi & A. Amar
Masen, Rabat, Morocco

6BV.3.2 **Solar Resource for High Penetration and Large Scale Applications – A New Joint Task of IEA PVPS and IEA SolarPACES**
J. Remund
Meteotest, Bern, Switzerland
L. Ramirez
CIEMAT, Madrid, Spain
S. Wilbert
German Aerospace Center, Almeria, Spain
P. Blanc
MINES ParisTech, France
E. Lorenz
Fraunhofer ISE, Freiburg, Germany
D. Renné
Clean Power Research, Boulder, United States

6BV.3.4 **A Global Hourly Solar Radiation Data Set Using Satellite and Reanalysis Data**
T. Huld & A.M. Gracia Amillo
European Commission JRC, Ispra, Italy
J. Trentmann
German Meteorological Service, Offenbach, Germany

6BV.3.5 **Assessment of the Optimal Data Sampling Criteria for a Sub Second ISO 9060 Secondary Standard Pyranometer**
J.M. da Costa Pó & K. Hoogendijk
EKO Instruments, The Hague, Netherlands
W. Beuttell
EKO Instruments, San Jose, United States
A. Akiyama
EKO Instruments, Tokyo, Japan

6BV.3.6 **Map of Atmospheric Clarity Index for Colombia**
D.J. Rodriguez Patarroyo, J. Hernández & A. Jaramillo
District University of Bogotá, Colombia

6BV.3.7 **Comparison of Historical Satellite Based Estimates of Solar Radiation Resources with Radiometric Measures for Colombia Conditions**
D.J. Rodriguez Patarroyo, J. Hernández & F. Santamaría
District University of Bogotá, Colombia

6BV.3.8 **Solar Irradiance Forecast Using Satellite Images: The Benefits of Autoregressive Algorithms**
S. Cros, M. Turpin, M. De Roubaix & N. Schmutz
Reuniwatt, Sainte-Clotilde, Reunion

6BV.3.10 **Comprehensive Analysis of Solarimetry Elements for Primary Energy Forecasting Methodologies Related to Photovoltaic Power Plants**
S. Gomes Relva, M.E. Morales Udaeta, V.O. Silva, A.L. Veiga Gimenes & L.C. Ribeiro Galvão
University of São Paulo, Brazil

6BV.3.11 **Best Practices Guide to Uncertainty Estimation for the National Solar Radiation Database (NSRDB 1998-2015)**
A. Habte & M. Sengupta
NREL, Golden, United States

6BV.3.12 **A New Method of Segmentation and Classification of Global Solar Radiation Sequences**
T. Soubdhan
University of Antilles Guyane, Pointe à Pitre, France

6BV.3.13 **Analytic Correlation Function for Clouds for the Analysis of PV System Power Fluctuations**
B. Elsinga & W.G.J.H.M. van Sark
Utrecht University, Netherlands

6BV.3.14 **Intra-Day Forecasts of PV Power with Numerical Weather Prediction Data and Machine Learning in Kyushu, Japan**
J.G.S. Fonseca Jr. & K. Ogimoto
University of Tokyo, Japan
F. Uno & T. Oozeki
AIST, Tsukuba, Japan

6BV.3.15 **Statistical Techniques Used to Improve Solar Resource Assessments for Photovoltaic Plants Applications**
C.M. Clohessy, E.E. van Dyk, G.D. Sharp & J. Hugo
NMMU, Port Elizabeth, South Africa

6BV.3.16 **A New Approach for Regional Photovoltaic Power Estimation and Forecast**
M. Pierro & C. Cornaro
University of Rome II, Italy
M. De Felice
ENEA, Rome, Italy
E. Maggioni, A. Perotto & F. Spada
Ideam, Cinisello Balsamo, Italy
D. Moser
EURAC, Bolzano, Italy

6BV.3.17 **A Hybrid Solar Radiation Forecasting Based on Data Mining and Wavelet Analysis**
R. Kumar & V. Vijay
IIT Jodhpur, India

6BV.3.19 **Forecasting PV Generation**
Y.F. Siew, J. Taylor, C. Allen, Q. Huxley, J. Briggs & A.R. Buckley
University of Sheffield, United Kingdom

6BV.3.20 **SolTrack: A Free, Fast and Accurate C/C++ Routine to Compute the Position of the Sun**
M.V. van der Sluys & P.J.M. van Kan
HAN University of Applied Sciences, Arnhem, Netherlands

6BV.3.21 **A Multifunctional Low-Cost Scalable Field Monitoring System**
C. Montes, O. González, G. Moncho, M. Padrón, J. Fernández, J. Rodríguez, M. Friend & M. Cendagorta
ITER, Granadilla de Abona, Spain
S. González-Pérez, B. González-Diaz, C. Hernandez-Rodriguez, J. Sanchiz & R. Guerrero-Lemus
ULL, La Laguna, Spain

6BV.3.24 **Evaluation and Comparisons of the Models to Calculate Solar Irradiation on Inclined Solar Panels for Ankara**
T. Özden, A.B. Karaveli & B.G. Akinoglu
METU, Ankara, Turkey

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6BV.3.25 **A Review of Daily Global Solar Radiation Modeling Using Different Statistical Methods Based on Sunshine Duration in Gran Canaria Island**
F. Díaz, L. Mazorra Aguiar & F. Déniz Quintana
ULPGC, Las Palmas de Gran Canaria, Spain

6BV.3.28 **Site-Specific Evaluation of Errors and Uncertainty in Irradiance Measurements**
A. Driesse
PV Performance Labs, Freiburg, Germany
J.S. Stein
Sandia National Laboratories, Albuquerque, United States

6BV.3.29 **Solar Energy Resource Anywhere in New Zealand**
B. Liley
NIWA, Omakau, New Zealand

6BV.3.32 **Estimation of Rooftop Potentials for PV in the Education City of Qatar Foundation-Doha, Qatar**
Y.E. Mohieldeen, A. Elrayyah, M. Ayoub, A. Al Marri & H. Al Hajri
Qatar Foundation, Doha, Qatar

6BV.3.33 **A Framework for Rating the Rooftop Solar PV Suitability of a Building Considering the Geographic and Technical Potential in Urban Areas**
T. Hong, M. Lee, K. Jeong, J. Oh & M. Kong
Yonsei University, Seoul, Korea South

6BV.3.34 **Building Rooftops Photovoltaic Potential in Mountainous Regions: A Case Study from the Pyrenees**
O. Travesset-Baro, G. Francisco, M. Vilella & M. Pons
OBSA, Sant Julià de Lòria, Andorra

6BV.3.35 **Performance Analysis of the Domestic Hot Water Production with PV Panels and a Heat Pump**
F.J. Aguilar Valero & P.G. Quiles
University Miguel Hernández, Elche, Spain
S. Aledo Vives
Prointer, Elche, Spain

6BV.3.36 **Analysis of Past and Current BIPV and xIPV Policies and Competitiveness Situation in Key European Countries**
P. Macé, G. Masson & A. El Gammal
Becquerel Institute, Brussels, Belgium
F. Tilli
GSE, Rome, Italy
F. Frontini
SUPSI, Canobbio, Switzerland
F. Gérard
EDORA, Brussels, Belgium

6BV.3.39 **Integration of Renewable Energy Technologies in the Community of the Agricultural University of Athens**
C.-S. Karavas & G. Papadakis
Agricultural University of Athens, Greece

6BV.3.40 **Reliability and Durability of Complete Polymer Materials for BIPV Application**
S. Boddaert
CSTB, Sophia Antipolis, France
L. Bailly & C. Baguenard
CANOE, Pessac, France
M. Chaillou
INNOVEOX, Paris, France
S. Bourrigaud
Arkema, Colombes, France

6BV.3.41 **Defining a Neighbourhood Profile to Prepare More Area for Integration of Photovoltaic in Residential Sector**
A. Rahmani & R. Wagner
Karlsruhe Institute of Technology, Germany

6BV.3.42 **Graffiti on Solar Noise Barriers, a Case Study**
C. Tzikas, M.M. de Jong & W. Folkerts
SEAC, Eindhoven, Netherlands
L.H. Slooff
ECN, Petten, Netherlands
M.G. Debije
Eindhoven University of Technology, Netherlands
S. Verkuilen
Heijmans Wegen, Rosmalen, Netherlands

6BV.3.44 **An Overview of Solar Noise Barriers in the Netherlands**
M.M. de Jong, M.N. van den Donker & W. Folkerts
SEAC, Eindhoven, Netherlands

6BV.3.45 **Assessing Façade-Integrated Photovoltaics: A Methodology for Their Preliminary Assessment**
S.P. Borg & Y. Zammit
University of Malta, Msida, Malta

6BV.3.46 **Performance of a Building Integrated Semitransparent Photovoltaic Façade on a Residential House in Northern Europe**
A. Jagomägi & M. Thalfeldt
Tallinn University of Technology, Estonia
A. Wimmer
University of Applied Sciences Upper Austria, Wels, Austria

6BV.3.47 **Introducing the Advanced Active Façade: Towards Near-Zero Buildings Incorporating Building Integrated Photovoltaics Expressive Issues**
A. Clua Longas, S. Lufkin & E. Rey
EPFL, Lausanne, Switzerland

6BV.3.48 **Evaluation of Thermal Properties for BIPV in Glass Façade**
H. Ishii
LIXIL, Tokyo, Japan

6BV.3.49 **An In-Depth Comparison of PV Modules in a BIPV Facade Test Setup**
J. Lehmann, W. Parys, J. Goncalves, K. Baert & D. Saelens
KU Leuven, Heverlee, Belgium
J. Govaerts & H. Goverde
imec, Leuven, Belgium

6BV.3.50 **Experimental Investigation and Characterization of Building Integrated Photovoltaic/Thermal Envelope System with Thermal Enhancements, for Roof and Curtain Wall Applications**
E.D. Rounis, Z. Ioannidis, K. Kapsis, R. Dumoulin & A. Athienitis
Concordia University, Montreal, Canada

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6BV.3.51 **Transmittance-Tunable Photovoltaic Window Based on Thin-Film Solar Cells and Polymer Dispersed Liquid Crystal Films**
Y. Gao, F.T. Si, O. Isabella, R. Santbergen, G. Yang, G. Zhang & M. Zeman
Delft University of Technology, Netherlands
J. Dong
CAS, Suzhou, China

6BV.3.52 **Energy Performance of a Building with Split Tandem Photovoltaic Windows**
M. Jobin & B. Grandjean
HES-SO, Geneva, Switzerland

6BV.3.53 **Smart Windows Based on Nanoparticles Solar Concentrators**
A. Zapico, P. Sánchez-Friera & B. Puerto
Fundación PRODINTEC, Gijon, Spain
J. Alarcón & R. Garcia Alvarado
Universidad del Bío-Bío, Concepcion, Chile
H. Aguilar
Nanolayer Coating Technologies, Vila Nova de Famalicão, Portugal
C. Silva, J. Gomes, M. Gonçalves, M. Ornelas, D. Sousa & A. Barros
CeNTI, Vila Nova de Famalicão, Portugal
C. García
UNEV, Santo Domingo, Dominican Republic

6BV.3.54 **Assessment of Smart PV-Windows for Nzeb in Santiago of Chile**
J. Alarcón & R. Garcia Alvarado
Universidad del Bío-Bío, Concepción, Chile
A. Zapico & P. Sánchez-Friera
Fundación PRODINTEC, Gijón, Spain
H. Aguilar
Nanolayer Coating Technologies, Vila Nova de Famalicão, Portugal
C. Silva
CeNTI, Vila Nova de Famalicão, Portugal
C. García
UNEV, Santo Domingo, Dominican Republic

6BV.3.55 **Photovoltaic Electrochromic Module with Uniform Color Change**
L.-M. Huang, C.-Y. Peng, C.-H. Chen, H.-C. Liu & C.-J. Huang
ITRI, Hsinchu, Taiwan

6BV.3.56 **Design, Fabrication and Evaluation of Solar Energy Conversion System Based on Flexible Solar Panels**
M. Esmaeili Shayan, G. Najafi & A. Banakar
Tarbiat Modares University, Tehran, Iran

6BV.3.57 **Designed BIPV-Elements with Printed Front-Glass: Simulation and Experimental Evaluation of the Effect of Printing on the Electrical Performance**
G.C. Eder
OFI, Vienna, Austria
K. Knöbl & L. Maul
UAS Technikum Wien, Vienna, Austria
M. Aichinger
Ertex-Solartechnik, Amstetten, Austria
G. Peharz & W. Nemitz
JOANNEUM RESEARCH, Weiz, Austria
K.A. Berger
AIT, Vienna, Austria

6BV.3.58 **Performance Assessment of a New Air-Based Building-Integrated Photovoltaic Thermal Solar Collector**
V. Delisle, A. Gagne & J. Ayoub
Natural Resources Canada, Varennes, Canada
J.T. Kim & J.H. Kim
National University of Kongju, Cheonan, Korea South

6BV.3.59 **Thermal Properties of Photovoltaic Modules: The Double Function of BIPV Systems**
C.A. Toledo Arias, R. López Vicente, J. Abad & A. Urbina
UPCT, Cartagena, Spain

6BV.3.60 **Temperature and Performance Monitoring of White Panels in Facade Configuration**
K. Söderström, V. Musolino & L.-E. Perret-Aebi
CSEM, Neuchâtel, Switzerland

6BV.3.61 **A Building-Integrated Semi-Transparent PV-Generator Endowed with a Mono-Axial Solar Traker**
R. Carbone
University "Mediterranea" of Reggio Calabria, Italy

6BV.3.62 **Hail Resistance of BIPV Composite-Based Lightweight Modules**
A.C. Oliveira Martins, V. Chapuis, A. Virtuani & C. Ballif
EPFL, Neuchâtel, Switzerland
L.-E. Perret-Aebi
CSEM, Neuchâtel, Switzerland

6BV.3.63 **Power Loss through Decorative Elements in the Front Glazing of BIPV Modules: A Systematic Approach**
M. Ebert, M. Wiese, H.R. Wilson, U. Eitner & M. Mittag
Fraunhofer ISE, Freiburg, Germany

6BV.3.64 **Performace Evaluation of Different Architectural Forms and Electrical Topologies for BIPV Parking Lots**
C. Biasi de Moura, S. Shimura, R. Silva Simplicio, R. Herrero Alonso & M. Knörich Zuffo
University of São Paulo, Brazil

6BV.3.65 **BIPV Affordability**
L. Maturi, J. Adami, M. Lovati & D. Moser
EURAC, Bolzano, Italy

6BV.3.67 **The Contribution of Façades to the PV Potential for Sites with High Diffuse Fraction**
S.R. Freitas & M. Brito
University of Lisbon, Portugal

6BV.3.69 **Analysis of the Impact Resolution Has on Load Matching in the Norwegian Context**
K. Sørnes, I. Sartori, K. Tunheim & E. Fredriksen
SINTEF, Oslo, Norway

6BV.3.70 **Morpho Butterfly Inspired Coloured BIPV Modules**
B. Bläsi, T. Kroyer, O. Höhn & T.E. Kuhn
Fraunhofer ISE, Freiburg, Germany

6BV.3.71 **Use of the Slopes of the Cirsures Sanitary Landfill for Installation of Photovoltaic Panels: A Preliminary Analysis of Infitial Parameters to be Evaluated**
V. De Brida, F. Soares dos Reis & A.C. Pan
PUCRS, Porto Alegre, Brazil

6BV.3.74 **From PV Systems to Energy Solutions Part II - From the Concept to Reality**
T. Nordmann, R. Lingel & S. Fehling
TNC Consulting, Feldmeilen, Switzerland

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6BV.3.75 **Improve Distribution Grid Hosting Capacity with Optimised PV Deployment**
M. Bledzinska
Warsaw University of Technology, Poland
G. Barchi & D. Moser
EURAC, Bolzano, Italy

6BV.3.77 **Mapping of the Potential Capacity of Grid-Connected PV Systems in Indonesia: A Comparison of Two Methods**
K. Kunaifi & A.H.M.E. Reinders
University of Twente, Enschede, Netherlands

6BV.3.78 **On the Development of Long-Term PV Generation Time Series Using PVGIS Model for European Power System Analysis**
I. Moustafelou, I. Gonzalez-Aparicio, P. Alves Dias & A. Zucker
European Commission JRC, Petten, Netherlands
T. Huld
European Commission JRC, Ispra, Italy

6BV.3.79 **Application of Battery Energy Storage System to Facilitate and Improve the LV Distribution Network in a Community with Photovoltaic Systems for a Future Load Scenario**
A.H. Zenan, E. Christopher & M. Sumner
University of Nottingham, United Kingdom

6BV.3.80 **Study and Estimation of the Photovoltaics Optimum Share in Microgrid Based on Renewable Energy Sources for Small Rural Settlements in Central European Part of Russia**
P.P. Bezrukikh
JSC ENIN, Moscow, Russia
S.M. Karabanov & D.V. Suvorov
RSREU, Ryazan, Russia
P.P.jr. Bezrukikh
LUCOIL JSC, Moscow, Russia
A.S. Karabanov
Helios-Resource, Saransk, Russia

6BV.3.81 **Demand Side Management Using PV, Heat Pumps and Batteries – Effects on Community and Building Level**
R. Luthander & J. Widén
Uppsala University, Sweden
E. Psimopoulos & C. Bales
Dalarna University, Borlänge, Sweden

6BV.3.82 **Modelling of PV Prosumers Using a Stationary Battery, Heat Pump, Thermal Energy Storage and Electric Vehicle for Optimizing Self-Consumption Ratio and Total Cost of Energy**
D. Keiner
OTH Regensburg, Germany
C. Breyer
Lappeenranta University of Technology, Finland

6BV.3.83 **Design, Construction and Testing of a Hybrid Grid-Photovoltaic Thermoelectric Device for Cooling, Heating and Dehumidication**
K. Daoudi, N. Mbodji, T.A.A. Arisily & A. Hajji
Agronomic and Veterinary Institute Hassan II, Rabat, Morocco

6BV.3.84 **Integration of Self-Supply Rooftop Solar Systems (PV & Hot Water) with Battery Storage to Reduce Grid-Buy Electricity by >80% and Eliminate Evening & Morning Energy Peaks: A Case Study for Residential Hawaii**
J. Borland
J.O.B. Technologies, Aiea, United States
J. Moore & C. Poncho
Poncho's Solar, Honolulu, United States
T. Tanaka & H. McClure
Tabuchi Electric, San Jose, United States

6BV.3.86 **A Comparison of Strategies for Net Demand Forecasting in Case of PV Power Production and Electricity Consumption**
D. van der Meer, J. Widén & J. Munkhammar
Uppsala University, Sweden

6BV.3.87 **Online and Offline PV Power Forecasts for Optimal Control of Storage Systems**
J. Barry & J. Thomas
Karlsruhe Institute of Technology, Eggenstein-Leopoldshafen, Germany

6BV.3.88 **Computationally Inexpensive PV System Model as a Simulation Agent for Large Scale Integration Analysis**
C. Levis & M. Hill
Cork Institute of Technology, Ireland

6BV.3.90 **Use of Load Profiles to Optimize Micro Grids of Non-Residential Environments**
J. da Costa Fernandes & M. Schmidt
University of Applied Sciences Offenburg, Germany

6BV.3.92 **Bidirectional Electric Vehicles Stores PV Energy and Creates New Business Cases for PV - Can This Replace the Stationary Batteries?**
U. Muntwyler & B. Ulrich
BUAS, Burgdorf, Switzerland

6BV.3.93 **Potential Applications of a Load-Managing Photovoltaic System**
J.A. Azzolini & M. Tao
Arizona State University, Tempe, United States

6BV.3.94 **Compensation of Forecast Error in Large PV Plants with Battery Storage: Associated Strategies**
J. Marcos, I. de la Parra, M. Muñoz, M. García & L. Marroyo
UPNa, Pamplona, Spain

6BV.3.95 **Sizing of Urban Distribution Transformers in a Neighbourhood with PV Generation and Energy Storage**
S.R. Freitas & M. Brito
University of Lisbon, Portugal

6BV.3.96 **PV as Major Energy Source for the Energy Supply of Urban Residential Districts in Central Europe**
J.-S. Telle, R. Völker, T. Kilper & K. von Maydell
NEXT ENERGY, Oldenburg, Germany

6BV.3.98 **Intelligent Distributed Energy Production System Using Photovoltaic's with Storage of Energy in Hydrogen**
G. Mantescu, N. Olariu & A. Oprea
Valahia University of Targoviste, Romania
H.M. Schuster
ARENA INNOVATION, Stuttgart, Germany
V.T. Petcu
GCI Management & Advisory, Bucharest, Romania

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6BV.3.100 **Operation of the High Temperature NaNiCl2 Batteries Storage System for Management of Photovoltaic Production**
T. Delaplagne, F. Bourry, M. Jung & A. Plissonnier
CEA, Le Bourget du Lac, France
S. Darivon, L. Bellemare & C.-E. Baltide
AME, Ducos, Martinique
X. Le Pivert
Steadysun, Le Bourget du Lac, France

6BV.3.101 **Comparative Experimental Investigation of Photovoltaic Panels with and without Thermal Management System Using Phase Change Material**
S. Preet
BCET, Gurdaspur, India

6BV.3.102 **Influence of PV Battery and Thermal Storage Systems Using Heterogeneous Demand Patterns**
G.B.M.A. Litjens, W.G.J.H.M. van Sark & E. Worrell
Utrecht University, Netherlands

6BV.3.104 **Experimantal Study of a BIPV/T Air System Used for Direct Space Heating / Cooling of a House in Sydney**
M. Farshchimonfared, J.I. Bilbao & A.B. Sproul
UNSW Australia, Sydney, Australia

6BV.3.105 **Sun Hub – Energy Hub for Outdoor Tables**
P.B. Poulsen, G.A. dos Reis Benatto, N. Riedel, S. Thorsteinsson, A. Alejo Santamaria Lancia & J.K. Symonowicz
Technical University of Denmark, Roskilde, Denmark
K. Retoft & I. Mogensen
Outsider, Copenhagen, Denmark

VISUAL PRESENTATIONS 5BV.4

17:00 - 18:30 **PV Module Performance and Reliability (I)**

5BV.4.1 **A Review of Semi Emerging Photovoltaic Standards: 2013–2017**
S.-T. Hsu, Y.-S. Long, T.-C. Wu & H.-H. Hsieh
ITRI, Hsinchu, Taiwan

5BV.4.2 **Modelling and Parameter Identification Using Reduced I-V Data**
H.C.S. Tay
ST Kinetics, Singapore, Singapore
I. Lim
University of Glasgow, Singapore, Singapore
Z. Ye
REC Solar, Singapore, Singapore

5BV.4.3 **Note on Cole-Cole Diagrams of Photovoltaic Modules Evaluation**
L. Cerná, T. Finsterle, P. Hrzina & V. Benda
Czech Technical University of Prague, Czech Republic

5BV.4.4 **Concept of a Photoluminescence Measurement System**
R. Ebner, G. Újvári & B. Kubicek
AIT, Vienna, Austria

5BV.4.5 **Comparison and Combination of Primary and Secondary Solar Cell Calibration Methods in Order to Reduce the Uncertainties for Photovoltaic Reference Solar Cells**
T. Fey, I. Kröger & S. Winter
PTB, Braunschweig, Germany
T.R. Betts
Loughborough University, United Kingdom
W. Zaaiman & D. Pavanello
European Solar Test Installation, Ispra, Italy
H. Müllejans
European Commission JRC, Ispra, Italy

5BV.4.6 **Feasibility Study for PV Measurements at Varying Irradiances on a Large-Area Steady-State Solar Simulator**
I. Sharlandzhiev, M. Field & E. Salis
European Commission JRC, Ispra, Italy

5BV.4.7 **A Camera-Based Characterization Method for Solar Simulators**
S. Riechelmann & F. Plag
PTB, Braunschweig, Germany

5BV.4.8 **Multifunctional LED-Based Facility: Integral and Spectral Characterization of Solar Cells**
A. Schweitzer, F. Witt, S. Riechelmann & S. Winter
PTB, Braunschweig, Germany
T. Schulze-Bubert
Newport Spectra-Physics, Stahnsdorf, Germany

5BV.4.9 **Towards Accurate, High-Frequency I-V Curve Measurements of Photovoltaic Modules Applying Electronic Loads**
K. Spiliotis, G. Van den Broeck, G.H. Yordanov, K. Baert & J. Driesen
KU Leuven, Belgium
H. Goverde
imec, Leuven, Belgium

5BV.4.10 **Evaluation of a Comprehensive I-V Outdoor-Characterization Method for Photovoltaic Modules**
L. Gottschalk & B. Hüttl
University of Applied Sciences Coburg, Germany
A. Schulze
Rosenheim University of Applied Sciences, Germany
F. Becker & M. Queck
Calyxo, Bitterfeld-Wolfen, Germany

5BV.4.13 **Proposal and Investigation of Novel Portable Degradation Diagnosis System for PV Module in Actual Operation**
T. Tanaka, T. Nagayama, T. Hayashi & T. Yanagidaira
Ibaraki University, Hitachi, Japan
Y. Inui
University of Shiga Prefecture, Hikone, Japan

5BV.4.14 **Outdoor Characterization of CdTe Technology and Seasonal Performance Analysis at Different Latitudes in Europe**
C. Cornaro & M. Pierro
University of Rome Tor Vergata, Italy
D. Moser
EURAC, Bolzano, Italy
G. Nofuentes Garrido
University of Jaén, Spain
C.A. Gueymard
Solar Consulting, Colebrook, United States

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5BV.4.15 **Light-Soaking Effects on the Electrical Characteristics of Multicrystalline PV Devices**
A.T. Alasfour & F.G. Alzubi
KISR, Safat, Kuwait

5BV.4.16 **Web-Based Analysis and Management of Monitoring and Meta Data from Outdoor and Laboratory Tests of Solar Energy Systems**
S. Wiesmeier, M. Köhl & K.-A. Weiß
Fraunhofer ISE, Freiburg, Germany

5BV.4.17 **An Inexpensive and Accurate Solar Irradiance Sensor Based on a Small Calibrated PV Module**
N. Erraissi, N. Aarich, M. Akhsassi, M. Raoufi & A. Bennouna
Cadi Ayyad University, Marrakech, Morocco

5BV.4.18 **Filtering Outdoor Current-Voltage Data by Shape**
B.E. Pieters
Forschungszentrum Jülich, Germany

5BV.4.20 **Performance Prediction of PVT Modules – The Link between Thermal and Electrical Operation**
U. Fritzsche, M. Schweiger & F. Reil
TÜV Rheinland Energy, Cologne, Germany

5BV.4.21 **Do Thin Film PV Modules Offer an Advantage under Partial Shading Conditions?**
C. Tzikas, M. van den Donker & W. Folkerts
SEAC, Eindhoven, Netherlands
E. Gomez & A.H.M. Smets
Delft University of Technology, Netherlands

5BV.4.22 **Quantification of Shading Tolerability for Photovoltaic Modules**
H. Ziar, B. Asaei & S. Farhangi
University of Tehran, Iran
M. Korevaar
Kipp & Zonen, Delft, Netherlands
O. Isabella & M. Zeman
Delft University of Technology, Netherlands

5BV.4.23 **Analysis of PV Module Output Characteristic Based on Laboratory Simulation under Partial Shading Condition**
R. Chen, Y. Sun & Z. Jie
ShunDe SYSU Institute, Foshan, China

5BV.4.24 **Estimation of Local Deterioration Factor in Crystalline Si PV Module by Partial Shading**
T. Tanase, Y. Takahashi & K. Fujiwara
Doshisha University, Kyotanabe, Japan

5BV.4.25 **Energy Yield Field Data of Heterojunction – Smartwire PV Modules**
H. Colin, D.R. Heslinga, L. Sicot & G. Razongles
CEA, Le Bourget du Lac, France

5BV.4.26 **A Comparative Study of PV Modules Performance between Prediction Models and Experience in the Green Energy Park: Crystalline Technology**
A. Benlarabi, B. Ikken, Z. Naimi & A. Ghennioui
IRESEN, Rabat, Morocco
M. Akhsassi & A. Bennouna
Cadi Ayyad University, Marrakech, Morocco
M. Maaroufi
University Mohammed V-Agdal, Rabat, Morocco
C. Hajjaj
University of Chouaib Doukkali, El Jadida, Morocco

5BV.4.27 **Techno-Commercial Performance Evaluation of 5 Different PV Technologies in Same Weather Conditions - A One Year Practical Case Study**
R. Bohra, R.G. Gowda & M.R. Krishnan
Infosys, Bangalore, India

5BV.4.28 **Illumination Homogeneity of Bifacial Systems – Outdoor Measurements with Systematically Varied Installation Conditions**
T. Baumann, M. Klenk, N. Keller, F.P. Baumgartner & H. Nussbaumer
ZHAW, Winterthur, Switzerland

5BV.4.29 **Potential for Photo-Generated Current for Bifacial PV Modules in the Atacama Desert**
P. Ferrada, F. Araya & A. Marzo
University of Antofagasta, Chile
P. Besson
Fraunhofer Chile, Santiago, Chile
E. Cabrera
ISC Konstanz, Germany

5BV.4.30 **Shading Effects of the Mounting Structure of Bifacial PV Modules and Impact to the Bypass Diode Lifetime**
S. Voswinckel, V. Wesselak, S. Münter & L. Gerstenberg
Nordhausen University of Applied Sciences, Germany

5BV.4.31 **Impact of Inhomogeneous Irradiance at the Rear of Panels on Modelled Bifacial Energy Yield**
G.J.M. Janssen, R.S.R. Gali, K. de Groot, A.J. Carr, B.B. Van Aken & I.G. Romijn
ECN, Petten, Netherlands

5BV.4.32 **IV Measurement of Bifacial Modules: Bifacial vs. Monofacial Illumination**
A. Schmid, G. Baarah, G. Dülger & U. Kräling
Fraunhofer ISE, Freiburg, Germany

5BV.4.33 **Outdoor Performance Analysis of the Si-Heterojunction Modules with Different Cell and Module Designs**
K. Emtsev, D. Malevskiy, D. Andronikov, A. Abramov, A. Titov, E. Terukov & D. Orekhov
RAS/ Ioffe, St. Petersburg, Russia
B. Bulygin & A. Dubrovskiy
Hevel Solar, Novocheboksarsk, Russia

5BV.4.34 **The Features of Using Two-Way Sensitivity Solar Modules FSM 280-30D in Central Kazakhstan**
A.D. Mehtiyev & F.N. Bulatbaev
Karaganda State Technical University, Kazakhstan
A.D. Daulethanova & E.G. Neshina
Tomsk Politechnical University, Russia

5BV.4.35 **Development of Characterization Techniques and Applications of Bifacial Solar Cells and Modules**
S. Dittmann, S. Krause & J. Bagdahn
Anhalt University of Applied Sciences, Köthen, Germany
H. Park, M.-S. Kim, W.-S. So, S.-Y. Oh, W.K. Kim & C. Park
Yeungnam University, Gyeongsan, Korea South
T. Brammer
Wavelabs Solar Metrology Systems, Leipzig, Germany
B.S. Kim & S. Chang
LG Electronics, Gumi, Korea South

5BV.4.36 **Influence of Optical Characteristics at Rear Side on Performance of Bifacial PV Modules**
Y. Min, I.-A. Kim, J.-H. Chio, C.-H. Kim, E.-J. Lee, S. Ryu & D.-S. Kim
Shinsung Solar Energy, Eumseong-gun, Korea South

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5BV.4.39 **Comparison of Bifacial Module Laboratory Testing Methods**
B. Newman, A.J. Carr, K.M. de Groot, N.J.J. Dekker & B.B. Van Aken
ECN, Petten, Netherlands
A.H.G. Vlooswijk
Tempress, Vaassen, Netherlands

5BV.4.42 **A Novel Heat Dissipating Material for Enhancing the Performance of Photovoltaic Panels**
M.-A. Tsai, H.-S. Wu & T.-C. Wu
ITRI, Hsinchu, Taiwan
C.-Y. Chen, L.-C. Chen, Y.-T. Chen & C.-H. Liu
Big Green Environmental Technology, New Taipei City, Taiwan

5BV.4.43 **Performance of Multi Busbar PV Modules**
Y. Xie, S. Zhang, H. Huang, J. Xu, Z. Feng & P.J. Verlinden
Trina Solar Energy, Changzhou, China

5BV.4.45 **Accurately Simulating PV Energy Production: Exploring the Impact of Module Build Up**
H. Goverde, D.G. Anagnostos, J. Govaerts, P. Manganiello, E. Voroshazi, J. Szlufcik, F. Catthoor & J. Poortmans
imec, Leuven, Belgium
K. Baert & J. Driesen
KU Leuven, Belgium

5BV.4.46 **Monitoring Temperature and Yield through Numerical Simulations and Experiments for Commercial Photovoltaics in Desert Environment**
S. Ahzi, N. Barth, S.P. Aly, B.W. Figgis, A.A. Abdallah & A. Ennaoui
QEERI, Doha, Qatar
Z.S. Al-Otaibi
KACST, Riyadh, Saudi Arabia

5BV.4.48 **The Effect of Non-Uniform Temperature Distribution in PV Cells and Their Interconnections**
P. Wolf
Czech Technical University of Prague, Bustehrad, Czech Republic
V. Benda
Czech Technical University of Prague, Czech Republic

5BV.4.49 **Comparison of Optical Gains and Electrical Losses in Modules with Different Designs of Partial Cells in Desert Regions**
H. Hanifi, J. Schneider & M. Turek
Fraunhofer CSP, Halle, Germany
J. Bagdahn
Anhalt University of Applied Sciences, Koethen, Germany

5BV.4.50 **Cell to Module Gains for High Efficiency Back Contact Cells**
N. Guillevin, B. Newman, E.E. Bende, L.A.G. Okel, M.J. Jansen & N.J.J. Dekker
ECN, Petten, Netherlands
W. Eerenstein
Exasun, The Hague, Netherlands

5BV.4.51 **The Study on the Impact of the WVTR of the Backsheet to the Anti-PID Performance of the Module**
G. Chen, Z. Ni, C. Huang, X. Cai, W. Zhang & Z. Mou
Talesun Solar Technologies, Changshu, China

5BV.4.52 **Accelerated on-Site PID Testing of c-Si PV Modules in Solar Power Plants**
V. Naumann, D. Lausch & C. Hagendorf
Fraunhofer CSP, Halle, Germany
N. Schüler
Freiberg Instruments, Germany

5BV.4.53 **Exploring Suitable Conditions for PID Testing of CIGS PV Modules**
K. Sakurai, K. Ogawa, H. Shibata & A. Masuda
AIST, Ibaraki, Japan
H. Tomita, D. Schmitz & S. Tokuda
Solar Frontier, Atsugi, Japan

5BV.4.54 **A Comparison of Potential-Induced Degradation Recovery Methods in Mono-Crystalline Modules**
A. El Hassani El Alaoui & A. Bouaichi
IRESEN, Rabat, Morocco
M. Maaroufi
University Mohammed V-Agdal, Rabat, Morocco

5BV.4.55 **Electrical Performance Evaluation of c-Si Solar Cell Subjected to Potential Induced Degradation**
Z. Purohit, M. Kumar & B. Tripathi
PDPU, Gandhinagar, India

5BV.4.56 **Forecasting Power Losses due to Potential-Induced Degradation (PID)**
J. Slamberger & M. Schwark
AIT, Vienna, Austria

5BV.4.57 **PV Silicon Module Degradation under High Positive Voltage Bias**
K. Brecl, M. Bokalic & M. Topic
University of Ljubljana, Slovenia

5BV.4.58 **Potential Induced Degradation Effect and Reversibility for Crystalline Based PV System under Outdoor Climate of Mid-South Western–Morocco**
A. Bouaichi, C. Messaoudi & A. El Amrani
OATE, Errachidia, Morocco
A. Benazzouz, A. El Hassani El Alaoui, Z. Naimi & B. Ikken
IRESEN, Rabat, Morocco
A. Bennouna
Cadi Ayyad University, Marrakech, Morocco

5BV.4.59 **A Review of Potential Induced Degradation in Thin-Film Plants**
T. Weber, C. Hinz, S. Koch & L. Podlowski
PI Berlin, Germany

5BV.4.60 **Field Detection of Potential Induced Degradation for Crystalline Silicon Photovoltaic Moduels Using Dark Current**
W. Oh & N. Park
KETI, Seongnam, Korea South

5BV.4.61 **Early Potential Induced Degradation (PID) Detection in the Field: Open Circuit Voltage Method**
M. Florides, G. Makrides & G.E. Georghiou
University of Cyprus, Nicosia, Cyprus

5BV.4.63 **Imaging Inspection System and Methodology for Evaluation of Inhomogeneities in PV Modules – a Case of Multicrystalline Silicon**
M. Bokalic, K. Brecl & M. Topic
University of Ljubljana, Slovenia

5BV.4.64 **Digital Image Processing Algorithms for Quality-Enhancement of Electroluminescence Picturing in PV-Fields**
G. Behrens & A. Domnik
University of Applied Sciences Bielefeld, Minden, Germany
K. Mertens & A. Arnds
Münster University of Applied Sciences, Steinfurt, Germany
M. Diehl
photovoltaikbüro, Rüsselsheim, Germany

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5BV.4.65 **Efficient Detection of Finger Interruptions from Photoluminescence Images**
I. Zafirovska, M.K. Juhl & T. Trupke
UNSW Australia, Sydney, Australia

5BV.4.67 **Long Term Reliability Evaluation for Silicon Photovoltaic Modules through Novel Sequential Tests**
C. Lien, Y.-H. Lee, C.-F. Hsieh, K.-W. Lu, H.-H. Hsieh, W.-L. Yang, H.-S. Wu & T.-C. Wu
ITRI, Hsinchu, Taiwan

5BV.4.68 **Applicability of Highly Accelerated Thermal Cycling Testing for Multiple Types of Polycrystalline Silicon Photovoltaic Modules**
M. Fujimori & T. Kohno
Hitachi, Tokyo, Japan
Y. Tsuno & K. Morita
TÜV Rheinland, Yokohama, Japan

5BV.4.69 **Non-Uniform Mechanical Loads due to Wind Effect on Photovoltaic Module**
S.-T. Hsu & H.-H. Hsieh
ITRI, Hsinchu, Taiwan

5BV.4.70 **Effect of Light Irradiation Treatment on Hygrothermal Degradation of Crystalline Silicon Photovoltaic Modules**
Y. Kobayashi, H. Morita & K. Mori
Toray Industries, Otsu, Japan
A. Masuda
AIST, Tsukuba, Japan

5BV.4.71 **Reliability Investigation of the Rear Side Metallization of PERC Cells**
T. Urban & J. Heitmann
Freiberg University of Technology, Germany
S. Großer & M. Turek
Fraunhofer CSP, Halle, Germany

5BV.4.72 **Long Term Development of Photovoltaic Module Failures during Accelerated Aging Tests**
C. Hirschl, L. Neumaier & W. Mühleisen
CTR, Villach, Austria
G.C. Eder & Y. Voronko
OFI, Vienna, Austria
R. Ebner, B. Kubicek & K.A. Berger
AIT, Vienna, Austria

5BV.4.73 **Monitoring of Moisture Ingress in PV Module Laminates during Accelerated Aging Tests**
L. Neumaier, W. Mühleisen & C. Hirschl
CTR, Villach, Austria
G.C. Eder
OFI, Vienna, Austria
M. Aichinger
Ertex Solar, Amstetten, Austria
L. Plessing
Crystalsol, Vienna, Austria
A. Zimmermann
Sunplugged, Wildermieming, Austria

5BV.4.74 **Damp-Heat Test Analysis of Flexible Amorphous Silicon Thin-Film Solar Mini-Modules**
N. Reininghaus, A. Leon, M. Vehse & C. Agert
NEXT ENERGY, Oldenburg, Germany

5BV.4.75 **Experimental Characterization and Numerical Simulation of PV Cells Humidity-Induced Corrosion**
M. Gagliardi, I. Berardone, P. Lenarda & M. Paggi
IMT Institute for Advanced Studies, Lucca, Italy

5BV.4.76 **Change in Output Power by Light Soaking for High Efficiency Crystalline Silicon Photovoltaic Modules**
R. Sato, S. Choi, Y. Chiba & A. Masuda
AIST, Tosu, Japan
T. Ishii
CRIEPI, Yokosuka, Japan

5BV.4.77 **Image Blur Reduces Resolution in Outdoor EL**
P. Koelblin, L. Stoicescu & M. Reuter
Solarzentrum Stuttgart, Germany

5BV.4.78 **Indoor Measurement of Angle Resolved Light Absorption by Antireflective Glass in Solar Panels**
M. Wubishet Amdemeskel, G.A. dos Reis Benatto, N. Riedel, P.B. Poulsen, S. Thorsteinsson, A. Thorseth & C. Dam-Hansen
Technical University of Denmark, Roskilde, Denmark
B. Iandolo, R. Schmidt Davidsen & O. Hansen
Technical University of Denmark, Kongens Lyngby, Denmark

5BV.4.79 **Impact of Degradation and Failure Mechanisms in Photovoltaic Modules: Analysis from Outdoor Luminescence Images**
L.F. Jeng, M. Sakhuja, A. Singh Rajput, P. Krishnan Krishnakumary, T. Congyi, Z. Yin, J. Ha, J. Wong, A.G. Aberle & T. Reindl
SERIS, Singapore, Singapore

5BV.4.80 **Simulating CTM Power Ratio: A Step towards Achieving CTM Power Gain and Designing Better PV Modules**
P.D. Mujumdar & A. Sanyal
Vikram Solar, Kolkata, India

5BV.4.81 **Effect of Accelerated Aging on the Photovoltaic Encapsulation/Glass Interface**
A. Dadaniya & N.V. Datla
IIT Dehli, New Dehli, India

5BV.4.82 **Study on Potential-Induced Degradation and Recovery of n-Type Single Crystalline Si Photovoltaic Modules**
M.A. Islam & Y. Ishikawa
NAIST, Ikoma, Japan
H. Nakahama
Nisshinbo Mechatronics, Aichi, Japan

5BV.4.83 **Comparison of the Electrical Power Estimated by Different Mathematical Models with the One Produced by the Solar Photovoltaic Generators Connected to the Electric Grid at ENSA-Safi**
L. Boukhattem, N.-E. Id Omar, F. Oudrhiri Hassani & M. Akhsassi
Cadi Ayyad University, Marrakech, Morocco
A. Ouknnou
National High School for Electricity and Mechanics, Casablanca, Morocco

5BV.4.84 **Performance of Different PV Module Technologies under Hot Climate Condition**
A. Al-Qattan, M. Adouane & A. Fakhraldeen
KISR, Safat, Kuwait

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VISUAL PRESENTATIONS 3CV.1

08:30 - 10:00 CI(G)S, CdTe and Related Thin Film Solar Cells and Modules (I)

3CV.1.1 **Study of Micro-Structural Properties of ZnO and WO3 Thin Films Grown by Spin Coating**
G. Gordillo, J. Estrada, C.A. Otálora & L.C. Luis
National University of Colombia, Bogotá, Colombia

3CV.1.2 **Stability of Cu(In,Ga)Se2 Solar Cells: A Literature Review**
M. Theelen
TNO, Eindhoven, Netherlands

3CV.1.3 **Effects of Sulfurization Conditions on Crystallization of Cu(In,Ga)S2 Thin Films Prepared by Deposition of Cu-In-Ga Stacked Metallic Precursor**
C.-W. Chang, W.-S. Lin, Y.-T. Liu, C.-C. Li, S.-W. Chan, T.-P. Hsieh, S.-Y. Tsai & F.-M. Lin
ITRI, Hsinchu, Taiwan

3CV.1.6 **Cost-Benefit Balances of Innovation Strategies**
J. van Deelen
Solliance/TNO, Eindhoven, Netherlands

3CV.1.7 **Reduced Reflection with Front and Back Textured CIGS Cells**
J. van Deelen, M. Burghoorn, M. Simor, K. van der Werf, M. Barink, Z. Vroon & P. Buskens
TNO, Eindhoven, Netherlands

3CV.1.8 **CIGS Thin-Film Solar Cell with a Conversion Efficiency of 15% Grown by Coevaporation Method**
H. Li, F. Qu, H. Gu & W. Wang
CAS, Beijing, China
H. Yao
CAS, Lanzhou, China

3CV.1.9 **Performance Evaluation of Zn(O,S) Buffer Layer Deposited by CFR-Spin Process on CIGS Solar Cells**
D.H. Park, H.Y. Jun & S.O. Ryu
Yeungnam University, Gyeongsan, Korea South

3CV.1.11 **Overview of Inkjet Printed Compound Semiconductors for Photovoltaics: An Example of Inkjet Printing for CIGS and CZTS Solar Cells**
A. Ennaoui
QEERI, Doha, Qatar
X. Lin
Sun Yat-sen University, Guangzhou, China
L. Wang & M.C. Lux-Steiner
HZB, Berlin, Germany

3CV.1.12 **Thin Film CdTe Solar Cell on Cerium Doped Ultra-Thin Glass - Flight Test Performance Data**
D. Lamb & S.J.C. Irvine
Swansea University, St. Asaph, United Kingdom
C.I. Underwood & A. Dyer
University of Surrey, Guildford, United Kingdom
J. Hall
Qioptiq, St. Asaph, United Kingdom

3CV.1.13 **Plasma Enhanced CSS-Deposition of CdS Window Layers for CdTe Solar Cells**
D. Hirsch, O. Zywitzki, T. Modes, T. Kopte & C. Metzner
Fraunhofer FEP, Dresden, Germany
B. Späth, B. Siepchen, C. Kraft, C. Drost & K. Krishnakumar
CTF Solar, Dresden, Germany

3CV.1.14 **Optimization of CdTe Solar Cells with Oxygenated CdS Window Layers**
C. Kraft, C. Drost, V. Krishnakumar, B. Siepchen & B. Späth
CTF Solar, Dresden, Germany
S. Peng
Triumph International Engineering, Shanghai, China

3CV.1.15 **Earth-Abundant Thin Film Solar Cells Based on Cu2MnSnS4**
A. Le Donne, S. Binetti & M. Acciarri
University of Milan, Italy
S. Marchionna
RSE, Milan, Italy

3CV.1.16 **Investigation of Diffusion Profiles in CdTe Thin Film Solar Cells by Glow Discharge Optical Emission Spectrometry**
O. Zywitzki, T. Modes, D. Hirsch, C. Metzner & T. Kopte
Fraunhofer FEP, Dresden, Germany
B. Siepchen, B. Späth, C. Kraft, C. Drost & V. Krishnakumar
CTF Solar, Dresden, Germany

3CV.1.17 **Influence of Different Prepared Electron Reflectors on the Performance and Stability of CdTe Thin Film Solar Cells**
B. Späth, C. Drost, C. Kraft, V. Krishnakumar & B. Siepchen
CTF Solar, Dresden, Germany
O. Zywitzki, T. Modes, D. Hirsch, T. Kopte & C. Metzner
Fraunhofer FEP, Dresden, Germany
S. Peng
CTIEC, Shanghai, China

3CV.1.19 **Improving the Efficiencies and the Properties of Impurity-Doped ZnO Electrode Layers for CIGS Solar Cells via Structural Correlation with the Transparent Buffer Window Layers**
W.M. Kim, S.Y. Kim & J.-H. Jeong
KIST, Seoul, Korea South
I.-G. Lee
Korea Aerospace University, Goyang, Korea South

3CV.1.21 **Vacancy Migration and Associated Charge-Transfer at the ZnS/CZTS Interface**
F. Bahrani, J. Goss, P. Briddon & M. Rayson
Newcastle University, United Kingdom

3CV.1.25 **Effect of Thickness and Position of Sb-Doping Layer on the Properties of CIGS Thin Films by e-Beam Evaporation**
J. Chen, H. Shen, Z. Zhai, J. Li & Y. Li
NUAA, Nanjing, China

3CV.1.26 **1D Mathematical CIGS Selenization Model**
J. Emmelkamp, J. de Cloet, A. Mannheim & O. van der Heide
TNO/Solliance, Eindhoven, Netherlands

3CV.1.27 **Organic Poly(9,9-di-n-octylfluorenyl-2,7-diyl) Contact Layers for CdTe Solar Cells**
T.P. Shalvey, L.J. Phillips, K. Durose & J.D. Major
University of Liverpool, United Kingdom

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3CV.1.28 **Role of Na in Solution-Processed CuInSe2 Devices: A Different Story for Efficiency Improvement**
S. Rehan, J. Moon, Y.-J. Eo, A. Cho, J. Gwak, S.K. Ahn & S.J. Ahn
KIER, Daejeon, Korea South

3CV.1.29 **Fabrication and Characteristics of CuO Thin Films as an Absorber Layer in Solar Cells Applications**
A. Moumen, B. Hartiti & S. Fadili
University Hassan II, Mohammedia, Morocco
M. Siadat & P. Thevenin
University of Lorraine, Metz, France

3CV.1.30 **The Influence of Na Incoporation on Nanoscopic Electrical Characteristics of Cu(In,Ga)Se2 Surfaces**
F. Qu, H. Li, H. Gu, W. Wang, H. Zhang & F. Ding
CAS, Beijing, China

3CV.1.31 **Microstructural, Electrical and Optical Properties of Bifacial CIGS-Based Solar Cells Prepared on Transparent Conducting Oxide Back Contacts by Co-Evaporation**
J.H. Jo, K. Kim, J. Gwak, J.H. Yun, J.S. Yoo, S.K. Ahn, A. Cho, J.H. Park & J.-S. Cho
KIER, Daejeon, Korea South

3CV.1.32 **Characterization of MoOx and WOx Thin Films Deposited by Magnetron Sputter Deposition from Oxide Targets**
E. Franzke, J. Winkler, C. Linke & C. Adelhelm
PLANSEE, Reutte, Austria
J. Pachlhofer, R. Franz & C. Mitterer
University of Leoben, Austria

3CV.1.34 **Enhanced Performance in Cu(In,Ga)Se2 Solar Cell Fabricated by Sputtering Quaternary Targets due to Potassium Fluoride Post Deposition Treatment**
X. Lyu, D. Zhuang, M. Zhao, L. Ouyang, R. Sun, L. Guo, L. Zhang, Y. Wei & X. Peng
Tsinghua University, Beijing, China

3CV.1.35 **Physical Property Improvement of One Step RF Sputtered CZTSe Films through Annealing in Se Atmosphere**
T. Guo, Z. Yu, L. Liu & Y. Zhao
Southwest Jiaotong University, Chendu, China

3CV.1.37 **Chemically Deposited Earth-Abundant Cu2ZnSn(S,Se)4 Solar Cell Absorber**
D.S. Dhawale & A. Ennaoui
QEERI, Doha, Qatar
N.M. Shinde & C.D. Lokhande
Shivaji University, Kolhapur, India

3CV.1.38 **Dynamics of Alkali-Metals Diffusion in CuInSe2**
E. Ghorbani
Technical University of Darmstadt, Germany
J. Kiss
IST Austria, Klosterneuburg, Austria
H. Mirhosseini & C. Felser
MPI CPFS, Dresden, Germany
T. Kühne
University of Paderborn, Germany

3CV.1.39 **Influence of Reversed Bias Voltages on CIGS Solar Cells**
K. Bakker & A.W. Weeber
ECN, Eindhoven, Netherlands
S. Mortazavi & M. Theelen
TNO/Solliance, Eindhoven, Netherlands

3CV.1.41 **(AgxCu1-X)2ZnSnS4 Thin-Films Prepared by Spray Pyrolysis**
L. Dermenji, M. Guc, N. Curmei, L. Bruc, D.A. Sherban, A.V. Simashkevich & E. Arushanov
Academy of Sciences of Moldova, Chisinau, Moldova
G. Gurieva, S. Levcenko & S. Schorr
HZB, Berlin, Germany

3CV.1.42 **The Effects of Impurity Phase Marcasite on the Properties of Pyrite Thin Films**
D.G. Moon, S. Rehan, Y.-J. Eo, A. Cho, J. Gwak & S.J. Ahn
KIER, Daejeon, Korea South
S.Y. Lim, D. Nam & H. Cheong
Sogang University, Seoul, Korea South
I. Seo & Y. Lee
Soongsil University, Seoul, Korea South
Y.S. Cho
Yonsei University, Seoul, Korea South

3CV.1.43 **Fabrication of Beyond 10% Efficient CZTSSe Solar Cells by Two-Step CdS Deposition Process**
Y. Wei, D. Zhuang, M. Zhao, L. Ouyang, L. Guo, R. Sun, L. Zhang, S. Zhan, X. Lyu & X. Peng
Tsinghua University, Beijing, China

3CV.1.45 **Swift Heavy Ion Irradiation Induced Modification in CuInSe2 Thin Films**
K. Rawat, G. Shishodia & P.K. Shishodia
University of Delhi, India
F. Singh
Inter University Accelerator Center, Delhi, India

3CV.1.46 **Preliminary Results on a Novel In-Situ XRD Setup Mimicking Industrial-Scale Fast Chalcogenisation Furnaces**
R. Aninat, J.J. Schermer & E. Vlieg
Radboud University, Nijmegen, Netherlands
F. van den Bruele, J. Emmelkamp & M. Theelen
TNO/Solliance, Eindhoven, Netherlands

3CV.1.47 **Effect of the Chemical Composition Ratio Cu/(Zn+Sn) and Cu/Zn onto the Structural, Morphological and Optical Properties of Cu2ZnSnS4 (CZTS) Thin Films for PV Applications**
K. Abouabassi, H. Kirou, L. Atourki, A. Elfanaoui, K. Bouabid, M. Nya & A. Ihlal
University of Agadir, Morocco
M.Y. Messous
CNESTEN, Rabat, Morocco
A. Al Magoussi
Cadi Ayyad University, Marrakech, Morocco
X. Portier
CNRS, Chatou, France

3CV.1.48 **Micro Concentrator Concept for Cost Reduction and Efficiency Enhancement of Thin-Film Chalcopyrite Photovoltaics: Results from EU Joint Research Program CHEETAH**
M. Schmid, X. Lin, L. Wang, R. Klenk, B. Heidmann, T. Köhler, D. Sancho-Martinez & M.C. Lux-Steiner
HZB, Berlin, Germany
E. Lotter
ZSW, Stuttgart, Germany
K. Eylers, F. Ringleb & T. Boeck
IKZ Institute for Crystal Growth, Berlin, Germany
G. Nenna, F. Loffredo & F. Villani
ENEA, Portici, Italy
T. Raadik, J. Krustok & M. Grossberg
Tallinn University of Technology, Estonia

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3CV.1.49 **AZO Deposition by Reactive Sputtering from Metallic Zn:Al Target Further Improved by Means of FLA Post-Treatment**
C. David, P. Prunici, J. Weber, L. Behnke, A. Panckow & F. Schwarz
Solayer, Kesselsdorf, Germany

3CV.1.50 **Growth and Properties of Cu2ZnSnSe4 Films on Flexible Metallic Substrates**
V.F. Gremenok, A.V. Stanchik & S.A. Bashkirov
NASB, Minsk, Belarus
R. Juskenas
Center for Physical Sciences and Technology, Vilnius, Lithuania
T.V. Petlitskaya, A.N. Piatlitski & V.A. Solodukha
JSC “INTEGRAL”, Minsk, Belarus

3CV.1.51 **Influence of Alkali Treatment on Kesterite Solar Cells**
E. Ahlswede, F. Huber, W. Kogler & T. Schnabel
ZSW, Stuttgart, Germany

3CV.1.52 **100 MW Production of CdTe Thin Film Solar Modules in Chengdu, China**
B. Siepchen, B. Späth, J.P. Heimfarth, C. Drost, K. Krishnakumar, C. Kraft, S. Frauenstein & M. Harr
CTF Solar, Dresden, Germany
S. Peng
Triumph International Engineering, Shanghai, China

3CV.1.53 **Growth of p-Type CdZnTe Thin Films as an Prospective Absorber Layer for Photovoltaic Application**
F.M. Tahzib Enam, K.S. Rahman, M. Akhtaruzzaman, K. Sopian, N. Amin & M.A. Islam
National University of Malaysia, Bangi, Malaysia

3CV.1.55 **Fabrication of Sputterred Cu2ZnSnSe4 Solar Cell by Selenisation with Novel Precursors**
F.-I. Lai
Yuan Ze University, Taoyuan, Taiwan
J.-F. Yang & S.-Y. Kuo
Chang Gung University, Taoyuan, Taiwan

3CV.1.56 **Simulation of Chalcopyrite-Based Dual-Junction Tandem Solar Cells Using SCAPES-1D**
K. Kim, J.S. Yoo, J.-S. Cho, J. Gwak, S.K. Ahn, Y.-J. Eo, J.H. Park, S.J. Ahn, A. Cho, K.S. Shin, K.H. Yoon & J.H. Yun
KIER, Daejeon, Korea South

3CV.1.57 **Effect of Copper Concentration on Photovoltaic Characteristics of High Efficiency Cu2ZnSnSe4 Solar Cells**
F.-I. Lai
Yuan-Ze University, Taoyuan, Taiwan
J.-F. Yang & S.-Y. Kuo
Chang Gung University, Taoyuan, Taiwan

3CV.1.58 **Lab-Scale Vacuum Equipment for HJT Solar Cell Production**
E. Khokhlov, S. Nastochkin, A. Yasunas, V.Y. Shiripov & K. Miasnikov
Izovac Technologies, Minsk, Belarus
S.Y. Herasimenka & M. Reginevich
Regher Solar, Tempe, United States

3CV.1.59 **Monolithic Integration Scheme for CIGS Micro Concentration Solar Cells**
G. Farías Basulto, T. Köhler, B. Stannowski, C.A. Kaufmann & R. Klenk
HZB, Berlin, Germany

3CV.1.60 **On the Electronic Properties of CdTe1-xSex Absorber Layers with Substitutional Doping on Cd or Te Site**
M. Lingg, S. Buecheler & A.N. Tiwari
EMPA, Duebendorf, Switzerland

3CV.1.61 **Light Induced Degradation of Cu(In,Ga)Se2 Thin Films and Solar Cells**
T. Hölscher, T. Schneider, S. Förster, M. Maiberg, W. Widdra & R. Scheer
Martin Luther University, Halle, Germany

3CV.1.62 **Analysis of the Local Composition of CIGS after Laser Processing**
A. Deswaziere, N. Debernardi, M. Le Ster & M. Theelen
TNO/Solliance, Eindhoven, Netherlands
B. Vermang
imec, Leuven, Belgium
B. Dunne
NEXCIS, Rousset, France
J. Bosman
ECN, Eindhoven, Netherlands

3CV.1.63 **Cu(In,Ga)Se2 Thin Films and Modules Fabricated on Polyimide Foils by the In-Line Evaporation Process Using Thermal Cracked Selenium**
H. Wang, Y.T. Yang, L.Y. Yao, H. Zhang, R.B. Liu, Z.B. Xiao & Q. Sun
Tianjin Institute of Power Sources, China

VISUAL PRESENTATIONS 2CV.2

13:30 - 15:00 **Thin Film and Foil-Based Solar Cells / Characterisation & Simulation Methods / Manufacturing & Production**

2CV.2.1 **Optimal Surface Texturing in Highly Dilute KOH Solution: A Comparison with Plasma Texturing for Thin Silicon Solar Cells with Light Trapping**
A.T. Hajjiah & O.T. Hamdan
Kuwait University, Safat, Kuwait

2CV.2.2 **Formation of Poly-Si Films by the Crystallization of Silicon Oxide Films**
J.-H. Yoon
Kangwon National University, Chuncheon, Korea South

2CV.2.3 **Effect of ITO Embedded Electrode on the Micro and Nano-Textured Crystalline Si Solar Cells**
H.Y. Ji, S.G. Ryu, M.J. Kim & J.H. Peck
KITECH, Cheonan, Korea South
K. Kim
Chonbuk National University, Jeonju, Korea South

2CV.2.5 **Kerf-Less Silicon Wafers by Spalling Method from Ni Electrodeposition**
H.-S. Yang, J. Kim & J.-H. Lim
KIMS, Changwon, Korea South
S.H. Park
Pukyong National University, Pusan, Korea South

2CV.2.6 **Thin IBC c-Si Solar Cells Based on Conventional Technologies**
C. Jin, I. Martín, E. Calle, P. Ortega, G. López & R. Alcubilla González
UPC, Barcelona, Spain

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2CV.2.7 **In-Situ Characterization of the Proton Irradiation Induced Degradation of Thin Film Liquid Phase Crystallized Silicon on Glass Based Heterojunction Solar Cells with Interdigitated Back Contacts**
H.C. Neitzert, C. Pellegrino & G. Landi
University of Salerno, Fisciano, Italy
J. Bundesmann, S. Seidel, A. Denker, T. Frijnts & S. Gall
HZB, Berlin, Germany

2CV.2.8 **Achieving Extremely High Reflectance Haze in Chemically Textured AZO Based Back Reflectors for Thin Film Solar Cells**
Z. Demircioglu, H. Nasser, E. Özkol & R. Turan
METU, Ankara, Turkey

2CV.2.9 **Bifacial, Colored, Transparent Thin-Film a-Si:H Solar Cells for Round-the-Clock Power Generation**
G. Kim, J.-W. Lim, S.H. Lee & S.J. Yun
ETRI, Daejeon, Korea South
M. Shin, G. Lee & J. Jo
Korea Aerospace University, Goyang, Korea South

2CV.2.10 **Preparation of Highly Efficient Semi-Transparent Silicon Thin-Film Solar Cells by Plasma-Enhanced Chemical Vapor Deposition**
E. Jang, J.S. Yoo, S.K. Ahn, J.H. Park, G.-S. Shin & J.-S. Cho
KIER, Daejeon, Korea South

2CV.2.11 **Laser-Induced Crystallization of Sputtered Unhydrogenated Silicon at Low Temperatures**
E. Saugar Gotor, J.P. González, S. Fernández, J.J. Gandía, J. Cárabe, F. García-Pérez & M.B. Gómez-Mancebo
CIEMAT, Madrid, Spain
D. Canteli, M. Morales & C. Molpeceres
UPM, Madrid, Spain

2CV.2.13 **Improvement of Bifacial Performance of Multicrystalline Si Thin-Film Solar Cells**
G. Jia, A. Gawlik, J. Plentz & G. Andrä
IPHT, Jena, Germany

2CV.2.14 **Top Cell Analysis for Micromorph Silicon Solar Cell Optimisation**
R.S. van Schie, R.A.C.M.M. van Swaaij, F.T. Si, O. Isabella & M. Zeman
Delft University of Technology, Netherlands

2CV.2.15 **Growth of Silicon on Reorganized Porous Silicon Substrates by Steady-State Solution Growth for Photovoltaic Applications**
C. Ehlers, R. Bansen, D. Uebel, T. Teubner & T. Boeck
IKZ Institute for Crystal Growth, Berlin, Germany

2CV.2.16 **A Lightweight Flexible Amorphous Silicon Photovoltaic Module**
Y. Vygranenko
CTS-UNINOVA, Caparica, Portugal
M. Fernandes, P. Louro & M. Vieira
ISEL, Lisbon, Portugal

2CV.2.19 **Interdigitated Laser-Contacted Solar Cell on Liquid-Phase Crystallized Silicon on Glass**
M. Vetter & G. Andrä
IPHT, Jena, Germany
G. López, P. Ortega & I. Martín
UPC, Barcelona, Spain

2CV.2.23 **Understanding Contact Formation on n-PERT Back Junction Solar Cells**
C. Comparotto, J. Theobald, J. Lossen & V.D. Mihailetchi
ISC Konstanz, Germany

2CV.2.24 **Impact of the Infrared Response of Crystalline Silicon Solar Cells on Temperature Coefficient and Energy Yield**
J. Haschke, J. Cattin, O. Dupré, M. Boccard & C. Ballif
EPFL, Neuchâtel, Switzerland
L. Barraud & M. Despeisse
CSEM, Neuchâtel, Switzerland
A.A. Abdallah, B. Aissa & N. Tabet
QEERI, Doha, Qatar

2CV.2.25 **Evaluations of Passivated Silicon Surfaces with Laser Terahertz Emission Microscope (LTEM) and Corona Charging**
T. Mochizuki, J. Mitchell, K. Tanahashi, M. Moriya, Y. Kida, K. Shirasawa & H. Takato
AIST, Koriyama, Japan
A. Ito & H. Nakanishi
SCREEN, Kyoto, Japan
I. Kawayama & M. Tonouchi
Osaka University, Japan

2CV.2.26 **Cross Characterization Methodology for the Optimization of Passivation Layers and Their Interfaces in c-Si Solar Cells**
A. Loubat, M. Bouttemy, M. Frégnaux, D. Aureau & A. Etcheberry
CNRS-UVSQ, Versailles, France
T. Blévin
IPVF, Antony, France
Y. Marot, A. Zauner & S. Pouliquen
Air Liquide, Jouy-en-Josas, France
C. Eypert
HORIBA, Palaiseau, France
S. Gaiaschi & P. Chapon
HORIBA, Longjumeau, France

2CV.2.27 **Dry Etch Black Silicon with Low Surface Damage: Effect of Low Capacitively Coupled Plasma Power**
B. Iandolo, M. Plakhotnyuk, R. Schmidt Davidsen & O. Hansen
Technical University of Denmark, Lyngby, Denmark
M. Gaudig
Anhalt University of Applied Sciences, Köthen, Germany
D. Lausch
Fraunhofer CSP, Halle, Germany

2CV.2.28 **Simulation on Silicon Solar Cell with Polysilicon Tunneling Oxide Emitters**
Y.-W. Peng & J.-Y. Gan
NTHU, Hsinchu, Taiwan

2CV.2.29 **Characterization of the Silicon Surface Quality for PV Applications Based on Minority Carrier Lifetime Measurements**
N. Schüler, K. Dornich & J.R. Niklas
Freiberg Instruments, Germany

2CV.2.30 **Oxygen-Related Defect Characterization Using Correlative Microscopy**
A. Youssef, E.E. Looney, M.A. Jensen, A.E. Morishige, S. Wieghold, J.R. Poindexter & T. Buonassisi
MIT, Cambridge, United States
S. Mack
Fraunhofer ISE, Freiburg, Germany
H.S. Laine & H. Savin
Aalto University, Espoo, Finland
B. Lai
Argonne National Laboratory, United States

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2CV.2.33 **The SPEER Solar Cell – Simulation Study of Shingled Bifacial PERC Technology Based Stripe Cells**
N. Wöhrle, T. Fellmeth, E. Lohmüller, A. Fell, J. Greulich & R. Preu
Fraunhofer ISE, Freiburg, Germany

2CV.2.34 **Auger Recombination Impact for Limiting Efficiency of Silicon Solar Cells**
J. Lee, M.K. Cotton, Y. Zou & C.B. Honsberg
Arizona State University, Tempe, United States

2CV.2.36 **A Detailed Analysis of Edge-Related Losses in Half-Cells**
A. Fell, H. Steinkemper, J. Schön, M. Hermle, M.C. Schubert & S.W. Glunz
Fraunhofer ISE, Freiburg, Germany
H. Sträter, M. Müller, R. Schiepe & D.H. Neuhaus
SolarWorld Innovations, Freiberg, Germany

2CV.2.37 **2D/3D Simulations of Black-Silicon Interdigitated Back-Contacted c-Si(n) Solar Cells**
E. Calle, D. Carrió, P. Ortega, I. Martín & R. Alcubilla González
UPC, Barcelona, Spain
G. von Gastrow & H. Savin
Aalto University, Espoo, Finland

2CV.2.38 **Simulating the Effect of Partial Rear Contacts on Si Solar Cells by a Finite Element Circuit Simulator**
Y.-H. Lin & H.-Y. Chen
Motech Industries, Tainan, Taiwan

2CV.2.39 **The PC1D Diffusion Model in Thin-Film Solar Cells**
L. Abenante
ENEA, Rome, Italy

2CV.2.40 **Impact of Different Treatment Technology and Highly Accelerated Stress Test for the Mono Silicon PERC Solar Cells**
C.-W. Kuo, T.-M. Kuan, L.-G. Wu, C.C. Huang & C.-Y. Yu
TSEC, Hsinchu, Taiwan

2CV.2.41 **Review of Tools and Approaches for In-Line Quality Control in High Efficiency Silicon Solar Cell Production**
J. Haunschild, J. Greulich, H. Höffler, S. Wasmer, G. Emanuel, A. Krieg, L. Friedrich & S. Rein
Fraunhofer ISE, Freiburg, Germany

2CV.2.43 **Comparison of Inline Hot Spot Detection and Evaluation Algorithms for Crystalline Silicon Solar Cells**
S. Wasmer, I. Geisemeyer, J.M. Greulich & S. Rein
Fraunhofer ISE, Freiburg, Germany
D. Pfengler
InfraTec, Dresden, Germany

2CV.2.44 **Cell Design Optimization for Shingled Modules**
D. Rudolph, J. Rabanal-Arabach, I. Ullmann, A. Halm & A. Schneider
ISC Konstanz, Germany
T. Fischer
Teamtechnik, Freiberg, Germany

2CV.2.45 **Optical Simulation of Bifacial Silicon Solar Cells at Module Level**
F. Duerinckx, M. Aleman, E. Voroshazi & J. Szlufcik
imec, Leuven, Belgium

2CV.2.46 **A One-Sun Spectrum-Splitting Minimodule Using Prismatic Encapsulation: Simulation and Outdoor Testing**
B. Concha-Ramon, M.J. Keevers, Y. Jiang & M.A. Green
UNSW Australia, Sydney, Australia

2CV.2.47 **Rapid Testing of Optical Quality and Internal Quantum Efficiency Using LED Solar Simulators**
K. Sporleder, T. Luka & M. Turek
Fraunhofer CSP, Halle, Germany

2CV.2.48 **Rapid Optical Modelling of Plasma Textured Silicon**
D. Payne, A. Claville Lopez, Y. Zeng & D.M. Bagnall
UNSW Australia, Sydney, Australia
M.D. Abbott & K.R. McIntosh
PV Lighthouse, Coledale, Australia
J. Cruz-Campa
1366 Technologies, Bedford, United States
R. Schmidt Davidsen & M. Plakhotnyuk
University of Denmark, Lyngby, Denmark

2CV.2.49 **Fast Optical Measurement System: Enabling Ultrafast External Quantum Efficiency Measurements on Crystalline Silicon Solar Cells**
J. Melskens, S.G.M. Heirman, R. Koornneef & M. Schouten
Delft Spectral Technologies, Netherlands

2CV.2.50 **Emissivity Control in Textured Silicon Solar Cells**
D. Alonso-Álvarez, A. Mellor & N.J. Ekins-Daukes
Imperial College London, United Kingdom
L. Ferre-Llin & D.J. Paul
University of Glasgow, United Kingdom
A. Riverola & D. Chemisana
UDL, Lleida, Spain

2CV.2.51 **Lambertian Optics in Textured Si Solar Cells with Not-Randomizing Front Surface**
L. Abenante
ENEA, Rome, Italy

2CV.2.52 **Development of an AFM/KFM System Capable of Cross-Sectional Workfunction Measuring of Solar Cell Structures under Light Illumination**
F. Yamada, T. Kamioka, Y. Ohshita & I. Kamiya
TTI, Nagoya, Japan

2CV.2.54 **Sub-Micrometer Resolved Light-Coupling Efficiency and Charge-Carrier Generation in Silicon-Based Thin-Film Solar Cells**
K. Bittkau, Z. Cao, M. Ermes & R. Carius
Forschungszentrum Jülich, Germany
G. Köppel & C. Becker
HZB, Berlin, Germany

2CV.2.55 **Screen Printed Mono-Crystalline Si Solar Cells: Assessing the Microstructure and Dopant Concentration at the Front Side Metallization Interface by Electron Microscopy and NanoSIMS**
P. Kumar, M. Pfeffer & O. Eibl
University of Tübingen, Germany
S. Eswara, L. Yedra, J.N. Audinot & T. Wirtz
LIST, Belvaux, Luxembourg

2CV.2.56 **Measurement Setup for In-Situ Quantum Yield Characterization of Solar Cells during High Energy Particle Irradiation**
H.-C. Neitzert, V. Carrano & G. Landi
University of Salerno, Fisciano, Italy
L. Gialanella
INFN, Napoli, Italy

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2CV.2.57 **Capacitance-Voltage and Current-Voltage Characterization to Determine Carrier Concentrations in Quantum Dot Embedded Solar Cells**
M. Elborg, T. Noda & Y. Sakuma
NIMS, Tsukuba, Japan

2CV.2.61 **Electrical and Optical Characterization of Crystalline Silicon Solar Cells Using Luminescent Down-Shifting of MAPbBr3 Perovskite Nanophosphors Deposited by Spin-on Film Technique**
Z.-X. Lin, W.-J. Ho, G.-Y. Li, B.-J. You & J.-J. Liu
NTUT, Taipei, Taiwan

2CV.2.63 **Validation of Analytic Modelling of Local Rear Contacts in PERC/PERL Solar Cells**
P. Saint-Cast, N. Wöhrle & J. Greulich
Fraunhofer ISE, Freiburg, Germany

2CV.2.64 **Front Side Metallization of p- and n-Type Si Solar Cells: Microstructure of the Glass Layer**
P. Kumar, M. Pfeffer & O. Eibl
University of Tübingen, Germany

2CV.2.65 **Increasing the Efficiency of Industrial Multicrystalline Silicon PERC Solar Cells from Currently 19 to 20%**
J. Greulich, E. Lohmüller, P. Saint-Cast, S. Werner, S. Wasmer, A.J.C. van der Horst & R. Preu
Fraunhofer ISE, Freiburg, Germany

2CV.2.66 **Numerical Analysis of Silicon Heterojunction Solar Cell Based on Molybdenum Oxide as a Back Surface Field (BSF)**
H. Mehmood
NUST, Islamabad, Pakistan
H. Nasser, E. Özkol & R. Turan
METU, Ankara, Turkey
T. Tauqeer
Information and Technology University, Lahore, Pakistan

2CV.2.70 **A Cost-Driven Research Strategy towards Industrially Feasible High-Efficiency Back-Contact Back-Junction Silicon Solar Cells**
J.D. Huyeng, A. Spribille, R. Efinger, R. Keding & F. Clement
Fraunhofer ISE, Freiburg, Germany
O. Doll
Merck, Darmstadt, Germany

2CV.2.71 **p-Si Based Bifacial Solar Cell with Improved PERT Structure**
Y. Eisenberg, L. Kreinin, N. Bordin & N. Eisenberg
Sol-Around, Jerusalem, Israel
J. Arumughan
ISC Konstanz, Germany

2CV.2.72 **AMPERE: A New Project for Innovative Heterojunction Manufacturing Solutions to Improve Competitiveness of the European PV Manufacturing Industry**
A. Battaglia
3SUN, Catania, Italy
C. Gerardi, S. Scalari & F. Bizzarri
ENEL Green Power, Rome, Italy
B. Strahm
Meyer Burger, Hauterive, Switzerland
T. Söderström
Meyer Burger, Gwatt, Switzerland
D. Muñoz & P.J. Ribeyron
CEA, Le Bourget du Lac, France
M. Izzi, M. Tucci & P. Delli Veneri
ENEA, Rome, Italy
M. Despeisse & L.-E. Perret-Aebi
CSEM, Neuchâtel, Switzerland
C. Ballif
EPFL, Neuchâtel, Switzerland
O. Nielsen
NorSun, Oslo, Norway
B. Hartlin & C. Aquino
ERM, London, United Kingdom
O. Zink & B. Melzer
Jonas & Redmann, Berlin, Germany
M. Tallián
Semilab, Budapest, Hungary
S. Lombardo
CNR, Catania, Italy
M. Balucani
RISE TECHNOLOGY, San Martino di Lupari, Italy
J. Rentsch
Fraunhofer ISE, Freiburg, Germany

2CV.2.73 **A Micro-Droplet Etching Approach for Texturization of Diamond Wire Sawn Multi-Crystalline Silicon Wafers**
L. Zhou, Z. Xiao, Z. Yue, H. Huang & W. Chen
Nanchang University, China
S. Jin & L. Gong
GCL Photovoltaic Technology, Suzhou, China

2CV.2.74 **Fast Alkaline Texturing Process for High Throughput PERC Solar Cell Manufacturing**
F. Strinitz, F. Schoerg, M. Fuerst & A. El Jaouhari
RENA, Berg, Germany
H. Kühnlein
RENA, Freiburg im Breisgau, Germany

2CV.2.76 **High Quality Industrial Phosphorus Emitter Doping Obtained with Innovative Plasma Immersion Ion Implantation (PIII) Processes**
T. Desrues, J.-F. Lerat, A. Veau, A. Lanterne & S. Dubois
CEA, Le Bourget du Lac, France
T. Michel & L. Roux
Ion Beam Services, Peynier, France
M. Coig, F. Milesi & F. Mazen
CEA, Grenoble, France

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2CV.2.77 **Low Recombination Emitter Profile with In-Situ Oxide Passivation for Multi-Crystalline Solar Cells**
F. Buchholz, P. Preis, S. Eisert & E. Wefringhaus
ISC Konstanz, Germany
J. Denafas & V. Cyras
Soli Tek R&D, Vilnius, Lithuania
M.P. Bellmann
SINTEF, Trondheim, Norway

2CV.2.78 **A New Direct Parallel-Plate PECVD for AlOx and SiNx Passivation Layer**
C. Zhou
CAS, Beijing, China
X. Cao, C. Chen & X. Deng
Xunlight, Kunshan, China

2CV.2.79 **Upgrade of an Industrial Al-BSF Solar Cell Line into PERC Using '3600 Wafers/Hour ALD Al2O3+SiNx Solution Ramp-Up'**
F. Souren, B. Dielissen, X. Gay & R. Görtzen
SoLayTec, Eindhoven, Netherlands
P.R. Venema & M.R. Renes
Tempress, Vaassen, Netherlands
J.R.M. Luchies
Amtech, Vaassen, Netherlands

2CV.2.80 **High Power Impulse Magnetron Sputtering for Photovoltaic Applications**
W. Gajewski, P. Rozanski, P. Lesiuk & P. Ozimek
TRUMPF Huettinger, Zielonka, Poland

2CV.2.81 **Practical Guide for Boosting the Efficiency of an Industrial-Scale Production Line**
J. Denafas
Soli "Tek R&D", Vilnius, Lithuania
T. Bathon, M. Deckelmann & M. König
Heraeus, Hanau, Germany

2CV.2.82 **Easy Plating – Study on Contact Interface Properties of Parasitic Plating-Free Ni/Cu Plated Solar Cells**
B. Grübel, A. Büchler, S. Kluska, J. Bartsch, G. Cimiotti, A.B. Brand & M. Glatthaar
Fraunhofer ISE, Freiburg, Germany

2CV.2.84 **Industrial Solutions for Light Induced Degradation in p-Type mc-Si PERC Solar Cell**
J. Dong, J. Lv, W. Wang, Q. Ye, Y. Yang, W. Cai, H. Zhang, Z. Shen, G. Chen, W. Gu, X. Chen, J. Sheng, J. Yang, C. Zhang, X. Zhou & J. Zheng
GCL, Suzhou, China

2CV.2.85 **Development of an Accelerated Light-Induced Degradation (LID) Test for Silicon Solar Cells**
C.-M. Lin, M. Gläser & N. Bernhard
Anhalt University of Applied Sciences, Köthen, Germany
E. Malguth & S. Uredat
LayTec in-line, Berlin, Germany
D. Lausch
Fraunhofer CSP, Halle, Germany

2CV.2.86 **Accelerated Electrical Regeneration of Silicon Solar Cells for Mass Production**
D. Lausch & J. Dwan
Fraunhofer CSP, Halle, Germany
M. Gläser, C.-M. Lin, S. Jafari & N. Bernhard
Anhalt University of Applied Science, Köthen, Germany

2CV.2.87 **Comparison of Industrial Solutions to Light Induced Degradation of High Efficiency Cz PERC Cells**
H. Li, J. Xu, K. Chen, H. Fan, S. Ma, C. Yu, C. Xu, Q. Xu & X. Ruan
Dongfang Huansheng Photovoltaic, Yixing, China

2CV.2.88 **Yield Maximization by Early Process Control: Automatic Optical Inspection for Interdigitated Back Contact Solar Cells**
C. Berge & E. Rüland
ISRA VISION, Konstanz, Germany
H. Chu
ISC Konstanz, Germany

2CV.2.90 **Thermal Simulation of the Thermal Laser Separation Process in Relation to the Crack Propagation at the Wafer Edge**
J. Röth
Anhalt University of Applied Sciences, Köthen, Germany
C. Belgardt
3D-Micromac, Chemnitz, Germany

2CV.2.91 **Method to Counter Warpage due to Stringing for Back Contact Solar Cells**
A. Halm, E. Lemp, R. Farneda, J. Theobald & R. Harney
ISC Konstanz, Germany

2CV.2.92 **New Module Safety Standards and Silicone Encapsulant Properties: Opportunities for Improved PV Modules**
G. Beaucarne & H. Meynen
Dow Corning, Seneffe, Belgium

2CV.2.93 **Achieving Faster Lamination Process for Crystalline Photovoltaic Modules by Using Latest Lamination Technologies**
S. Sraisth
Robert Bürkle, Freudenstadt, Germany

VISUAL PRESENTATIONS 1CV.3

15:15 - 16:45 Fundamental Studies / New Materials and Concepts for Cells and Modules

1CV.3.1 **Accurate Model of Photovoltaic Module According to Experimental Data**
M. Bahrami
University of Lorraine, Vandoeuvre-lès-Nancy, France
S. Eslami & M. Zandi
Shahid Beheshti University, Tehran, Iran

1CV.3.3 **3D Cylindrical Approach to Determine the Excess Minority Carriers' Density of an n+-p Solar Cell under Constant Monochromatic Illumination**
A. Diouf, A. Diao & G. Sissoko
UCAD, Dakar, Senegal
S.N. Leye & S. Mbodji
University of Alioune DIOP, Bambey, Senegal

1CV.3.4 **Using a 3D Cylindrical Model for the Solar Cell's Diffusion Capacitance Study**
S.N. Leye & S. Mbodji
University of Alioune DIOP, Bambey, Senegal
A. Diouf & G. Sissoko
UCAD, Dakar, Senegal

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1CV.3.5 **Parameter Extraction of Oxidized Ni/Au and Ni-Only Transparent Conducting Oxides (TCOs) on n-Type GaN Schottky Barrier Diode with Bias Dependence Barrier Height and Ideality Factor at Different Temperatures**
A. Hajjiah & A.A. Alkhabbaz
Kuwait University, Safat, Kuwait
N.P. Allen & L.J. Guido
Virginia Tech, Blacksburg, United States

1CV.3.6 **Photovoltaics: Upconversion Configurations Versus Tandem Cells**
J. van Deelen
Solliance/TNO, Eindhoven, Netherlands

1CV.3.7 **Nanoscience and Nanophotonics for Improved Solar Energy Conversion**
E.C. Garnett
AMOLF, Amsterdam, Netherlands

1CV.3.9 **Dielectric and Electric Modulus Studies of the Cu2SnS3 Nanopowder Synthesized by Hydrothermal Technique for Photovoltaic Application**
S. Lahlali, L. Essaleh, M. Belaqziz & H. Chehouani
Cadi Ayyad University, Marrakech, Morocco
K. Djessas
University of Perpignan, France

1CV.3.10 **Self-Consistent Evaluation of Optical Path Length Factor, Z, in Si Solar Cells**
L. Abenante
ENEA, Rome, Italy

1CV.3.11 **On the Effect of In, P Surfactants on the GaAs PV Cell Formation**
A. Vlasov, L.B. Karlina, B. Ber, D.Y. Kazantsev, N.K. Timoshina, M.M. Kulagina & A. Smirnov
RAS/ Ioffe, St. Petersburg, Russia
F. Komissarenko
ITMO University, St. Petersburg, Russia

1CV.3.12 **Sequential GD-OES/XPS Profiling of III-V Based Solar Cells: Study of the GD-OES Crater Chemistry for XPS Analyses Reliability**
A. Loubat, M. Bouttemy, M. Frégnaux & A. Etcheberry
UVSQ, Versailles, France
C. Eypert
HORIBA, Palaiseau, France
S. Gaiaschi & P. Chapon
HORIBA, Longjumeau, France

1CV.3.13 **Improved Electronic Transport Properties of Tin-Halide Perovskites**
G. Berdiyorov, M. El-Amine Madjet & F. El-Mellouhi
QEERI, Doha, Qatar

1CV.3.14 **FTIR and Raman Study of Rapid Thermal Annealing Effects on Carbon-Rich SixC1-X Thin Films Deposited by R.F Co-Sputtering**
A.-I. El Khalfi, E.M. Ech-Chamikh, Y. Ijdiyaou, M. Azizan, A. Essafti, L. Nkhaili, A. El Kissani & A. Outzourhit
Cadi Ayyad University, Marrakech, Morocco
E. Tomasella
CNRS, Aubière, France

1CV.3.15 **Origin of the Rashba Effect in Lead-Iodide Based Perovskites**
B. Daiber, T. Wang & B. Ehrler
AMOLF, Amsterdam, Netherlands
D. McMeekin & H. Snaith
University of Oxford, United Kingdom

1CV.3.16 **Structural and Optical Analysis of Sputtered BaSi2 Thin Films**
Y. Tian, R. Vismara, S. van Doorene, O. Isabella & M. Zeman
Delft University of Technology, Netherlands
P. Sutta
University of West Bohemia, Plzen, Czech Republic

1CV.3.18 **Effect of Annealing Temperatures on Transmittance of SiO2 Antireflection Coating**
W. Zhang, J. Tu, W. Long, W. Lai, Y. Sheng & T. Guo
Yunnan Normal University, Kunming, China

1CV.3.19 **The SPARC Cathodoluminescence System: A Platform for Nanoscale Semiconductor Studies**
T. Coenen
DELMIC, Delft, Netherlands

1CV.3.20 **Material Selection for Delafossite Crystal based Window Layer of Thin Film Solar Cells**
S. Mitra & N. Gupta
Birla Institute of Technology & Science, Pilani, India

1CV.3.21 **Effect of Cu Deficiency on the Optical Properties of Dual Ion Beam Sputtered CZTSSe Thin Film**
B.S. Sengar, V. Garg, V. Awasthi & S. Mukherjee
IIT Indore, India
S. Kumar
RRCAT, Indore, India

1CV.3.22 **An Alternative Methodology to Investigate Properties of Minority Carriers: Effects of n-Dopant Species**
H. Sodabanlu, A. Delamarre, K. Watanabe, M. Sugiyama & Y. Nakano
University of Tokyo, Japan

1CV.3.23 **Waveguide-Based Spectrum-Splitting Concept for Parallel-Stacked Tandem Solar Cells**
T.P.N. Veeken, M.W. Knight & A. Polman
AMOLF, Amsterdam, Netherlands
J. van de Groep
Stanford University, Palo Alto, United States

1CV.3.25 **Comparative Study of the Performances of Biomimetic Antireflective Structures Designed for Crystalline Silicon Solar Cells**
D. Dieng, M. Beye, M.E. Faye & A. Seidou Maiga
Gaston Berger University, Saint-Louis, Senegal

1CV.3.26 **Light Trapping Simulated by Fast and Accurate Transfer Matrix Approach**
J. Holovsky
ASCR, Prague, Czech Republic
R. Nevyhosteny
CTU, Prague, Czech Republic

1CV.3.27 **Study of the SPR Tunability of Graphene Coated Metal Nano-Spheres Utilizing Graphene-Perovskite Interaction: Application in Photovoltaic**
S. Bhardwaj, R. Uma & R.P. Sharma
IIT Dehli, New Dehli, India

1CV.3.28 **The Mechanism and Damage of Snail Trails**
S. Zhou, Y. Zeng & R. Wang
Guangzhou Bothleader Electrical Material, China

1CV.3.29 **Indirect to Direct Bandgap Transition in Methylammonium Lead Halide Perovskite**
T. Wang, B. Daiber, S.A. Mann, E.C. Garnett & B. Ehrler
AMOLF, Amsterdam, Netherlands
J.M. Frost & A. Walsh
Imperial College London, United Kingdom

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1CV.3.35 **DSM Light Trapping Technology for Optimised Output of Bifacial PV Technology**
M. Mrcarica & P. Pasmans
DSM, Geleen, Netherlands
J. Rabanal-Arabach, A. Halm & A. Schneider
ISC Konstanz, Germany

1CV.3.38 **Silicon Quantum Dot Nanostructures as Passivating Contacts for Carrier Selective Contact Cells**
G.J. Conibeer, I. Perez-Wurfl & B. Puthen-Veetil
UNSW Australia, Sydney, Australia

1CV.3.39 **Sputter-Instigated Plasmonic Features in TCO for Ultrathin Photovoltaics: A Case Study for Ga-Doped ZnO**
V. Garg, B.S. Sengar, V. Awasthi & S. Mukherjee
IIT Indore, India
S. Kumar
RRCAT, Indore, India

1CV.3.40 **50-Layer Stacked InGaAs/GaAs Quantum Dot Solar Cell with Light Scattering Structure**
Y. Shoji, K. Watanabe, A. Ogura & Y. Okada
University of Tokyo, Japan

1CV.3.41 **Effect of Sputtering and Annealing Parameters on Properties of Silicon Quantum Dot Matrix**
M.K. Sahoo, J.P. Kar & P.G. Kale
NIT Rourkela, India

1CV.3.42 **ZnO Nanorods Based Inorganic Core-Shell Solar Cells with an Extremely Thin Absorber**
G. Kartopu, A.K. Gürlek & S.J.C. Irvine
Swansea University, St. Asaph, United Kingdom
W. Hadibrata, S. Yerci, H.E. Ünalan & R. Turan
METU, Ankara, Turkey
V. Barrioz, Y. Qu & P. Maiello
Northumbria University, Newcastle upon Tyne, United Kingdom
L. Bowen
Durham University, United Kingdom

1CV.3.45 **Advance in Development of Hot Carrier Solar Cell with Semi-Infinite Energy Filtering**
I. Konovalov & V. Emelianov
University of Applied Sciences Jena, Germany

1CV.3.46 **Self-Organization of Metal-Semiconductor Microstructures for Plasmonic Photovoltaics**
I.M. Dmitruk, N.I. Berezovska, K.O. Maiko & O.A. Yeshchenko
Taras Shevchenko National University of Kiev, Ukraine
N.L. Dmitruk, I.B. Mamontova, S.V. Mamykin & I.V. Blonskiy
NAS ISP, Kiev, Ukraine

1CV.3.47 **BaBiO3: Novel Absorber for All-Oxide Photovoltaic**
A.S. Chouhan, E. Athresh, R. Ranjan, S. Raghavan & S. Avasthi
Indian Institute of Science, Bangalore, India

1CV.3.50 **Effective SiC–SiO2 Nanocomposite Anti-Reflection Layer for Crystalline Silicon Solar Cells**
A. Jannat, Z.Y. Li, M.S. Akhtar, D.-H. Lee & O.-B. Yang
Chonbuk National University, Jeonju, Korea South

1CV.3.51 **A New POLYOLEFIN BACKSHEET Concept Meeting Future Demands**
M. Edler, W. Krumlacher & M. Plank
ISOVOLTAIC, Lebring, Austria
K. Bernreitner & M. Sandholzer
Boralis Polyolefine, Linz, Austria

1CV.3.52 **Both Surface Textured Glass: A New, Innovative and Effective Approach to Improve the Performances of Superstrate Type Thin Film Solar Cells**
G. Das, J. Roy Sharma, S. Bose, S. Dhar, S. Mandal, S. Mukhopadhyay & A.K. Barua
IIEST Shibpur, Howrah, India
C. Banerjee
NISE, Gurgaon, India

1CV.3.53 **All Acrylic-Based Solar Panels: A New Photocurable Material and Associated Process**
L. Bailly & C. Baguenard
CANOE, Pessac, France
S. Boddaert
CSTB, Sophia Antipolis, France
S. Bourrigaud
Arkema, Lacq, France

1CV.3.55 **Efficient Light Harvesting in Surface Barrier Solar Cells with Quasiperiodical Microrelief and Metal Nanowires**
N.L. Dmitruk, A.V. Korovin, O.Y. Borkovskaya, I.B. Mamontova, S.V. Mamykin, N. Kotova & V. Romanyuk
NAS ISP, Kiev, Ukraine

1CV.3.56 **Solight®: A New Lightweight PV Module Complying IEC Standards**
J. Gaume, F. Quesnel & S. Guillerez
CEA, Le Bourget du Lac, France
N. Le Quang, S. Williatte & G. Goaer
EDF ENR PWT, Bourgoin Jallieu, France

1CV.3.57 **Features of Si+ Implanted n-GaSb (100) Photosensitive Structure**
R.V. Ghita, C. Logofatu & C.C. Negrila
NIMP-Bucharest, Romania
D. Pantelica & P. Ionescu
IFIN HH, Bucharest, Romania
P. Cristea
University of Bucharest, Romania

1CV.3.59 **Quantum Dot Luminescent Solar Concentrator: Optimization of Concentration and Thickness**
M. Rafiee, S. Chandra, H. Ahmed & S.J. McCormack
Trinity College Dublin, Ireland

1CV.3.60 **Thickness Effect on the Structural, Morphological and Optical Properties of Al2O3, TiO2 and ZnO Nanocoating Films for an Enhanced Self Cleaning Effect of PV Surfaces**
A. Khaldoun & H. Ennaceri
Al Akhawayn University, Ifrane, Morocco
A. Benyoussef
University Mohammed V-Agdal, Rabat, Morocco
A. Taleb
CNRS, Paris, France
A. Ennaoui
QEERI, Doha, Qatar

1CV.3.61 **Performance Characterization of Crystalline Silicon Solar Cells Based on Combination of Plasmonics Silver Nanoparticles and Luminescent Downshifting Eu-Doped Phosphor-Particles**
B.-J. You, W.-J. Ho, S.-K. Feng, Z.-X. Lin & J.-J. Liu
NTUT, Taipei, Taiwan

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1CV.3.62 **Phosphorescent Passive Layer of Polysiloxane Material and Rare-Earth Complexes for the Enhancement of Photovoltaic Cell Performance**
M. Gomes de Oliveira, S. Chandra, H. Ahmed & S.J. McCormack
Trinity College Dublin, Ireland

1CV.3.63 **Graphene Based Materials and Composites for Hybrid Solar Cells**
B.M. Mothudi, F.V. Molefe, M. Khenfouch & M.S. Dhlamini
University of South Africa, Johannesburg, South Africa

1CV.3.64 **Enhancement of Photoelectrochemical Water Splitting Using Au Nanoparticle Decorated TiO2 Nano-Tube**
J.-Y. Choi, H.-J. Choi, Y.D. Kim, M. Byun, D. Huh & H. Lee
Korea University, Seoul, Korea South

1CV.3.65 **Effects of Sulfurization Time on MoS2 Absorber Layer for Thin Films Solar Cells Applications**
H. Rashid, K.S. Rahman, N. Amin & M.A. Islam
National University of Malaysia, Bangi, Malaysia
M.I. Hossain, F.H. Alharbi & N. Tabet
QEERI, Doha, Qatar

1CV.3.67 **Investigation of the Effect of Phase Change Material on the Performance of Photovoltaic Cell in Natural Mode**
N. Choubineh
Shahid Beheshti University, Teharn, Iran
A. Kasaeian
University of Tehran, Iran

1CV.3.68 **Novel ZnxSn1-xSe Absorber for Use in Thin-Film Solar Cells**
T.M. Razykov, B. Ergashev, K.M. Kouchkarov & R. Yuldashev
Academy of Sciences of Uzbekistan, Tashkent, Uzbekistan
E. Artegiani & A. Romeo
University of Verona, Italy
A. Bosio & N. Romeo
University of Parma, Italy

1CV.3.69 **Record-Light Weight c-Si Modules Based on the Small Unit Compound Approach – Mechanical Load Tests and General Results**
H. Nussbaumer, M. Klenk, N. Keller, P. Ammann & J. Thurnheer
ZHAW, Winterthur, Switzerland

1CV.3.70 **With a Maximum of Flexibility - Customized PV-Panels with Silicon Interlayer**
C. Erban & H. Ley
Sunovation, Aschaffenburg, Germany

1CV.3.71 **Next Generation Interconnection by Cost Effective Conductive Adhesives**
D. Holzmann, M. König, J. Strueben & S. Fritzsche
Heraeus, Hanau, Germany
D. Eberlein & A. Kraft
Fraunhofer ISE, Freiburg, Germany

1CV.3.72 **Outdoor and Indoor Testing of Transparent Antisoiling Coating Based Fluorine-Doped Tin Oxide for Solar Energy Applications**
K. Belrhiti Alaoui, A. Alami Merrouni, Z. Naimi & B. Ikken
IRESEN, Rabat, Morocco
A. Outzourhit
Cadi Ayyad University, Marrakech, Morocco
B. Kharbouch
Abdelmalek Essaadi University, Tetouan, Morocco

1CV.3.73 **Effect of Multiple Organic Dyes in a Polymer Thin Film for Luminescent Down-Shifting Layers Application**
S. Gilligan, H. Ahmed, S. Chandra & S.J. McCormack
Trinity College Dublin, Ireland

1CV.3.74 **Improving Mathematical Model of Luminescent Down-Shifting Layers by Counting Matrix Material's Loss Mechanisms**
M. Rafiee, H. Ahmed, S. Chandra & S.J. McCormack
Trinity College Dublin, Ireland

1CV.3.75 **Enhanced Photovoltaic Performances of Inverted Polymer Solar Cells Utilizing MoS2 Interlayer**
C.H. Lee, H.I. Lim & D.I. Son
KIST, Wanju-gun, Korea South
J.Y. Lee
O-sung, Jeollabuk-do, Korea South
H.Y. Kim
Chonbuk National University, Jeonju, Korea South

1CV.3.76 **Low Temperature Deposition of Conductive Indium Oxide Films for Solar Cell Applications**
Y. Vygranenko, M. Fernandes, M. Vieira, G. Lavareda & C. Nunes de Carvalho
UNINOVA, Caparica, Portugal
P. Brogueira & A. Amaral
University of Lisbon, Portugal

1CV.3.77 **Anti-Soiling Coatings for PV Applications**
C. Carcouet, G. Draaisma, P. Tummers, I.J. Bennett, N. Voicu & Y. Li
DSM, Geleen, Netherlands

1CV.3.78 **Process Method and Tool for Lamination of BIPV Modules**
G. Cattaneo, C. Antonin, L.-E. Perret-Aebi & C. Ballif
CSEM, Neuchâtel, Switzerland
C. Biba
SPF, Rapperswil, Switzerland
M. Gisler
Megasol Energie, Deitingen, Switzerland

1CV.3.80 **Investigation of Different Back-Sheet Materials in Terms of PV-Module Reliability, Safety and Performance**
P. Hülsmann
Bischof + Klein, Lengerich, Germany

1CV.3.81 **Investigation of Enhancement of Fluorescence Emission of Different Luminescent Species due to Au and Ag NRs for LSC and LDS Application**
A. Sethi, S. Chandra, H. Ahmed, S.J. McCormack & S. Gilligan
Trinity College Dublin, Ireland

1CV.3.83 **Device Characterization of Heterojunction Solar Cells Using Rare-Metal-Free Compound ZnSnP2**
S. Nakatsuka & Y. Nose
Kyoto University, Japan
S. Akari, J. Chantana & T. Minemoto
Ritsumeikan University, Shiga, Japan

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1CV.3.85 **Electro-Optical Modeling of a ZnO/Cu2O Subcell in a Silicon-Based Tandem Heterojunction Solar Cell**
O. Nordseth, S.E. Foss & H. Haug
Institute for Energy Technology, Kjeller, Norway
L. Fara, C. Dumitru, V.-F. Muscurel, F. Dragan, D. Craciunescu & P. Sterian
University Politehnica of Bucharest, Romania
R. Kumar, K. Bergum, E. Monakhov & B.G. Svensson
University of Oslo, Norway
I. Chilibon, C. Vasiliu, L. Baschir & D. Savastru
INOE-2000, Magurele, Romania

1CV.3.87 **Electrically Conductive Adhesives for Photovoltaic (PV) Applications**
P. Feng, J. Mo, M. Mu, B. Xiang, D. Ju & L Wu
DuPont, Shanghai, China
B.J. Laughlin
DuPont, Wilmington, United States

1CV.3.88 **Extended Optical Response of Two-Step Photoexcitation in InAs/GaAs Quantum-dot Superlattice Intermediate Band Solar Cells**
K. Hirao, S. Asahi, T. Kaizu & T. Kita
Kobe University, Japan

1CV.3.89 **Photon Up-Converted Photocurrent in a Single Junction Solar Cell with a Hetero-Interface**
K. Kusaki, S. Asahi, T. Kaizu & T. Kita
Kobe University, Japan

1CV.3.90 **Cell-to-Module Conversion Loss Simulation for Shingled-Cell Concept**
J. Rabanal-Arabach, D. Rudolph, A. Halm, I. Ullmann & A. Schneider
ISC Konstanz, Germany
T. Fischer
Teamtechnik, Freiberg, Germany

1CV.3.91 **Correlation of Peel and Shear Forces with Temperature Cycle Test for Electrical Conductive Adhesive Interconnections**
S. Hoffmann, T. Geipel, M. Meinert & A. Kraft
Fraunhofer ISE, Freiburg, Germany

1CV.3.92 **Polymeric Microlenses for Photovoltaic Microconcentrator Applications: Prototype Characterization and Simulation**
F. Loffredo, F. Villani, G. Nenna, R. Miscioscia, C. Minarini & F. Roca
ENEA, Portici, Italy

1CV.3.93 **>32% Efficient III-V/Si Multi-Junction Solar Cells**
S. Essig & C. Ballif
EPFL, Neuchâtel, Switzerland
C. Allebé, L. Barraud, A. Descoeudres & M. Despeisse
CSEM, Neuchâtel, Switzerland
J.F. Geisz, T. Remo, M. Steiner, J.S. Ward, M. Schnabel, K. Horowitz, D.L. Young, P. Woodhouse & A. Tamboli
NREL, Golden, United States

1CV.3.95 **Analysis for Different Materials Used as Up Converters When Incorporated in Bifacial Silicon Solar Cells Using the Program PC1-D**
A.C. Pan, L.S. Grassi Cardoso & F. Soares dos Reis
PUCRS, Porto Alegre, Brazil

1CV.3.97 **Hard and Transparent DLC Coating as a Protective Layer for Solar Cells**
A. Dehbi-Alaoui
USMBA, Fez, Morocco

1CV.3.98 **Stress-Free Fabrication of Photovoltaic Modules Using Room Temperature Interconnection**
H.W. Chung, E.H. Park & D.-Y. Shin
Pukyong National University, Busan, Korea South
H. Song & J.I. Lee
KIER, Daejeon, Korea South

1CV.3.99 **Multi-Property Optimization Framework for Solar Cell Device Using Drift-Diffusion Approach**
A.A.B. Baloch, M.I. Hossain, N. Tabet & H. Al Hajri
Hamad bin Khalifa University, Doha, Qatar
H. Al-Salman
KACST, Riyadh, Saudi Arabia

1CV.3.100 **A Study of Interface Materials in Perovskite-Silicon 4-Terminal Tandem Solar Cells**
T. Rahman & S.A. Boden
University of Southampton, United Kingdom

VISUAL PRESENTATIONS 4CV.4

17:00 - 18:30 III-V-Based Devices for Terrestrial and Space Applications

4CV.4.1 **Fabrication of GaInP/GaAs on InGaAs Solar Cells by Wire Bonding and Mechanical Stacking Technology**
R.-H. Horng
NCTU, Hsinchu, Taiwan
Y.-C. Kao, C.-H. Tien & Y.-H. Fu
National Chung Hsing University, Taichung, Taiwan

4CV.4.2 **Detailed Investigation of a GaInP/GaAs/Ge Up-Conversion System: Efficiency Loss Analysis and Possible Route to Improvement**
D. Lan & M.A. Green
UNSW Australia, Sydney, Australia

4CV.4.3 **Comparison of Novel Optimization Techniques with Application in Maximizing Tandem Solar Cells Performances**
S. Michael & M. Tsutagawa
Naval Postgraduate School, Monterey, United States

4CV.4.4 **Temperature-Dependent Properties of an Inverted Metamorphic Four-Junction (IMM-4J) Solar Cell**
H. Zhang, L. Wang, R. Liu, Q. Sun, Z. Xiao, Q. Zhang, P. Peng, C. Xue, M. Jiang, L. Shi, Y. Tang, L. Yao & H. Wang
Tianjin Institute of Power Sources, China

4CV.4.5 **III-V Multi-Junction Solar Cells Utilising Group IV SiGeSn Alloys as a 1.0eV Component Sub-Cell**
P. Pearce, T. Wilson & N.J. Ekins-Daukes
Imperial College London, United Kingdom
A.D. Johnson
IQE, Cardiff, United Kingdom

4CV.4.6 **Development of GaSb Solar Cells on GaAs via Interface Misfit Technique**
G.T. Nelson, M.A. Slocum, Z.S. Bittner & S.M. Hubbard
Rochester Institute of Technology, United States
B.-C. Juang, R.B. Lagumavarapu & D. Huffaker
UCLA, Los Angeles, United States
S.W. Johnson
NREL, Golden, United States

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4CV.4.7 **Pseudomorphic and Metamorphic (Al)GaAsSb/(Al)InGaAs Tunnel Junctions for GaAs Based Multi-Junction Solar Cells**
K. Louarn, A. Arnoult, C. Fontaine, J. Colin, C. Cornille & G. Almuneau
LAAS CNRS, Toulouse, France
Y. Claveau & N. Cavassilas
CNRS, Marseille, France
F. Piquemal
LNE, Trappes, France
A. Bounouh
CEA, Gif sur Yvette, France

4CV.4.8 **High-Quality GaAs (100) Thin Films on Silicon (100) Using Epitaxial Germanium (100) Buffer for Low-Cost III-V Solar Cells**
S. Chaurasia, S. Raghavan, S. Avasthi & A.S. Chouhan
Indian Institute of Science, Bangalore, India
J. Lohani & R. Tyagi
Solid State Physics Laboratory, New Delhi, India

4CV.4.9 **Internal-Stress-Assisted Epitaxial Lift-off Process for Thin Film Gallium Arsenide Solar Cells on Metal Foil**
Y. Kim, S.H. Jung, K. Kim, C.Z. Kim, H.-B. Shin, K.H. Park, W.-K. Park & H.K. Kang
KANC, Suwon, Korea South

4CV.4.10 **Rapidly Deposited GaAs Epitaxial Thin Films by MOCVD for Solar Cells**
S.-T. Hwang, J. Kim, T. Kwon, D.J. You & H.-M. Lee
LG Electronics, Seoul, Korea South

4CV.4.11 **The Effects of Short-Range Alloy Disorder on the Potential Voltage Performance in GaAsBi Based Solar Cells**
T. Wilson, A. Mellor, N.P. Hylton & N.J. Ekins-Daukes
Imperial College London, United Kingdom

4CV.4.12 **Passivation of GaInP and AlInP Surfaces for III-V Solar Cells**
M. Raappana, V. Polojärvi, T. Aho, A. Aho, R. Isoaho, A. Tukiainen & M. Guina
Tampere University of Technology, Finland

4CV.4.13 **A Full Transparent Electrode Application in III-V Compound Solar Cell**
P. Dai, M. Tan, J. Lu, L. Ji, L. Bian, S. Lu & H. Yang
CAS, Suzhou, China

4CV.4.14 **Design of Broadband and Omnidirectional Antireflection Coatings for III-V Concentrating Multijunction Solar Cells**
L.C. Andreani, M. Liscidini, M. Passoni & M. Patrini
University of Pavia, Italy
G. Timò & F. Trespidi
RSE, Piacenza, Italy

4CV.4.15 **Enhanced Photon Utilization in Ultrathin 1.0eV GaInAs Sub-Cell by SiO2/Au Reflector**
L. Yao, L. Liu, Q. Zhang, H. Wang, H. Zhang, P. Peng & Q. Sun
Tianjin Institute of Power Sources, China

4CV.4.16 **Counteracting Photovoltaic Effect in Multi-Junction Solar Cells**
M.A. Mintairov, V.V. Evstropov, S.A. Mintairov, M.Z. Shvarts, S.A. Kozhukhovskaia & N.A. Kalyuzhnyy
RAS/ Ioffe, St. Petersburg, Russia

4CV.4.17 **Optical Characterization of a Red Dye Luminescent Solar Concentrator**
P. Bernardoni, M. Tonezzer, D. Vincenzi, S. Fugattini, M. Boschetti & V. Guidi
University of Ferrara, Italy

4CV.4.18 **Overview of Different Characterization Techniques Used in Studying the Radiation Effect of Multijunction Solar Cells**
B.R. Uma, M. Ravindra, M. Sankaran & N. Raghu
ISRO Satellite Centre, Bangalore, India
S. Krishnan
Shreedevi Institute of Technology, Mangalore, India
R. Campesato
CESI, Milan, Italy

4CV.4.20 **Simulation of InGaN Solar Cell**
N. Hanan & B. Smail
University of Bejaia, Algeria

4CV.4.22 **Performance Assessment of Dense Array CPV Receiver Cooled by a Matrix of Microfluidic Cells under Non-Uniform Radiation**
G. Laguna, M. Vilarrubi, J. Barrau, J.I. Rosell, Y. Betancourt, A. Fernandez, G. Sisó, M. Ibañez, J. Illa & F. Badia
UDL, Lleida, Spain
L. Fréchette
University of Sherbrooke, Canada

4CV.4.23 **Transmittance and Reflectance Maps in 3D-CPCs**
A. Parretta & E. Cavallari
University of Ferrara, Italy
M. Tucci
ENEA, S. Maria di Galeria, Italy

4CV.4.24 **Soiling Effects on HCPV Energy Productivity in Morocco**
A. Barhdadi, M.A. Sebbar, W. Anana, F. Chaouki, B. Laarabi & D. Dahlioui
University Mohammed V, Rabat, Morocco
V. Gilioli & D. Verdilio
Becar, Bologna, Italy

4CV.4.25 **High-Perfomance Photovoltaic Receiver of Laser Radiation for Wireless Power Transfer System**
A. Razuvaev, V. Tugaenko, V. Kapranov & N. Sukhareva
RSC "Energy", Korolev, Russia
V.P. Khvostikov, M.Z. Shvarts, N.A. Kalyuzhnyy & S.A. Mintairov
RAS/ Ioffe, St. Petersburg, Russia
M. Perales & M.-H. Yang
MH GoPower, Kaohsiung, Taiwan

4CV.4.26 **Evaluation of Outdoor Performance and Techno-Financial Analysis of a Stationary High Concentrating PVT System**
C. de Keizer & W. Folkerts
SEAC, Eindhoven, Netherlands
M. van de Zande & P. Penning
SunCycle Technology, Eindhoven, Netherlands

4CV.4.27 **High Temperature Solar Cells for Venus Exploration**
J. Grandidier
NASA, Pasadena, United States
M.L. Osowski
MicroLink Devices, Niles, United States
M.L. Lee
UIUC, Urbana, United States
H.A. Atwater
Caltech, Pasadena, United States

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4CV.4.28 **Novel Epitaxial GaAs Lift-Off Approach via van der Waals Interface in In2Se3 Buffer Layer**
N. Kojima, L. Wang, Y. Ohshita & M. Yamaguchi
TTI, Nagoya, Japan

4CV.4.29 **Numerical Simulation of the Effect of High Energy Electrons on a n+-p-p+ Space Solar Cell**
S. Babaee & S.B. Ghozati
Shahid Beheshti University, Tehran, Iran

4CV.4.30 **DEGRADE-CPV: A New Initiative on the Degradation Analysis of CPV Systems in Spain and Cyprus**
M. Theristis, G. Makrides & G.E. Georghiou
University of Cyprus, Nicosia, Cyprus
E. F. Fernández, J.P. Ferrer Rodríguez, J. Montes-Romero, F. Almonacid & P.J. Pérez-Higueras
University of Jaén, Spain

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VISUAL PRESENTATIONS 7DV.1

13:30 - 15:00 PV Economics and Markets / PV-Related Policies, Strategies and Societal Issues

7DV.1.1 Forecast of Global Long-Term PV Installations – Analysis of 190 Individual Countries
A. Gerlach
Gerlach New Energy Consulting, Ellrich, Germany
C. Werner
Chris Werner Energy Consulting, Dessau, Germany
M. Fischer
Hanwha Q CELLS, Bitterfeld-Wolfen, Germany

7DV.1.3 PV Economics, Markets and Policies
H. Maleeha, M. Reshme & A. Bhuiyan
Innoel Renewable Energy, Narayanganj, Bangladesh
A. Rahman
Dhaka University, Bangladesh
K. Ali & J. Mollick
Innoel Renewable Energy, Dhaka, Bangladesh
K. Alam
NCC Bank, Dhaka, Bangladesh
T.I.M.R. Zadeed
IFIC Bank, Dhaka, Bangladesh

7DV.1.4 Cabriss: Market Analysis and Business Models for a Circular Economy in PV
R. Thomas
CEA, Grenoble, France
D. Pelletier, J.P. Rakotoniaina & L. Federzoni
CEA, Le Bourget du Lac, France
M.-C. Hoffmann
PROJEKTkompetenz, Salzburg, Austria

7DV.1.5 Scenario of Photovoltaics in Power Situation in India
A. Kumar
Georgia Institute of Technology, Atlanta, United States

7DV.1.7 Economic Assessment Study of Photovoltaic Energy Generation under Incentive Polices in Grid Connected Homes within Urban Area in Development Countries: The Brazilian Case
L.C. Ribeiro Galvão, M.E. Morales Udaeta, A.L.V. Veiga Gimenes & B. da Silva Junior
University of São Paulo, Brazil

7DV.1.8 On the Economics of Grid-Tied Residential Solar PV Generation in Pakistan: Policies, Realities and the Way Forward
M. Arsalan
Institute of Business Management, Karachi, Pakistan
F. Shehzad & A. Tahir
NUCES, Karachi, Pakistan

7DV.1.9 Value Added by PV Installations In The Netherlands
C. Olson, F. Lenzmann, L. Beurskens & M. Sonne
ECN, Petten, Netherlands
K. Heinbach, B. Hirsch & S. Salecki
IÖW, Berlin, Germany

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7DV.1.10 Impacts of Solar Energy Integration on Fuel-Mix Strategies
A. Sanfilippo & M. Khraisheh
QEERI, Doha, Qatar
M. Bohra
Imperial College London, United Kingdom
N. El Dehaibi
Stanford University, United States

7DV.1.11 Business Models for Energy Delivery
C.S. Mutubuki-Makuyana
SNV, Harare, Zimbabwe

7DV.1.12 A Systemic Economic Analysis of Residential PV Systems: A Strategic Utilization of Residential Battery Systems to Address Systemic Effects of PV Integration
H.J.J. Yu
CEA, Gif sur Yvette, France

7DV.1.16 A Methodology to Evaluate the Potential of Using PVRO Desalinated Brackish Water in Irrigation on Large Farming Scale: Application to Saline Area in Rhamna Region (Morocco)
Y. Ettayeb, N. Mbodji, T.A.A. Arisily & A. Hajji
Agronomic and Veterinary Institute Hassan II, Rabat, Morocco

7DV.1.17 Photovoltaic System and Components Price Development in the Netherlands
W.G.J.H.M. van Sark
Utrecht University, Netherlands
T. Schoen
New-Energy-Works, Utrecht, Netherlands

7DV.1.18 Innovative Business Model for Photovoltaic Power Plants on Multiple Dwellings in Austria
S. Woess-Gallasch & D. Frieden
JOANNEUM RESEARCH, Graz, Austria
H. Rest-Hinterseer
Arbeitsgemeinschaft Erneuerbare Energie Salzburg, Austria
G. Korpitsch & M. Auer
KW Solartechnik, Graz, Austria
W. Aichinger
EAG, Salzburg, Austria

7DV.1.21 Evaluating the Factors Affecting the Break-Even Cost of On-Site PV Generation at Industrial Units
M. Papapetrou
WIP - Renewable Energies, Munich, Germany
M. Vallés, T. Gómez & P. Frías
Comillas Pontifical University, Madrid, Spain
A. Cipollina & G. Micale
University of Palermo, Italy

7DV.1.23 Comparison and Performance Analysis Strategies of Photovoltaic Technologies: A Systematic Literature Review
H. Sellak & B. Ouhbi
University Moulay Ismail, Meknes, Morocco
B. Frikh
USMBA, Fez, Morocco
A. Bennouna
Cadi Ayyad University, Marrakech, Morocco
Z. Naimi & B. Ikken
IRESEN, Rabat, Morocco

7DV.1.24 **An Overview of Patent Application Data in the Field of Photovoltaics**
A. Visentin & B.E. Sagol
European Patent Office, Berlin, Germany
M. Boero & C. Königstein
European Patent Office, Rijswijk, Netherlands

7DV.1.25 **Current and Future Estimates of the LCOE for a 10-MW Ground-Mount Solar Plant According to Different Technologies and Local Specificities**
J. Cren & R. Thomas
CEA, Grenoble, France

7DV.1.26 **Borneo Eiland Prosumer Community: Towards More Energy Independent Neighbourhoods in Amsterdam**
H. Niesing, C. Varela & A. Van der Giessen
Resourcefully, Amsterdam, Netherlands
T. AlSkaif
Utrecht University, Netherlands

7DV.1.29 **PVSITES Project – Building Integrated Photovoltaic Technologies and Systems for Large-Scale Market Deployment**
M. Machado & R. Alonso
Tecnalia Research & Innovation, San Sebastián, Spain
S. Challet & I. Weiss
WIP - Renewable Energies, Munich, Germany
P. Alamy & V.K. Nguyen
CADCAMation, Onex, Switzerland
J.M. Espeche & F. Noris
R2M Solution, Pavia, Italy
E. Rico
Onyx Solar Energy, Avila, Spain
T. Reijenga
BEAR-iD, Gouda, Netherlands
P. Brassier
Nobatek, Anglet, France
P. Surguy
Film Optics, Watchfield, United Kingdom
V. Francisco
CTCV, Coimbra, Portugal
S. Stutterheim
Filsom, Dübendorf, Switzerland
H. Delgado
CRICURSA, Barcelona, Spain
F. Burgun
CEA, Le Bourget du Lac, France
J.C. Esteban
Acciona Infraestructuras, Alcobendas, Spain
D. Déramaix
Bureau d'Architectes Format D2, Sirault, Belgium
A. Bogucka
Vilogia, Paris, France

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7DV.1.30 **FP7-CHEETAH Knowledge Exchange Platform: Results and their Exploitation**
F. Roca, D. Casaburi, F. Beone, C. Diletto, I. Falcone, A. De Girolamo & R. Miscioscia
ENEA, Portici, Italy
K. Bittkau
Forschungszentrum Jülich, Germany
I. Lauermann & M. Schmid
HZB, Berlin, Germany
S.A. Gevorgyan
DTU, Roskilde, Denmark
I. Gordon & K. Van Nieuwenhuysen
imec, Leuven, Belgium
A. Roesch
SolarPower Europe, Brussels, Belgium
A. Danel
CEA, Le Bourget du Lac, France
P. Sommeling, J. Kroon & S.C. Veenstra
ECN, Petten, Netherlands
S. Binetti
University of Milan, Italy
T. Boeck & F. Ringleb
IKZ Institute for Crystal Growth, Berlin, Germany
F. Brunetti & A. Di Carlo
University of Rome II, Italy
J. Bowers
Loughborough University, United Kingdom
S. Buecheler
EMPA, Dübendorf, Switzerland
J. Cárabe & J.F. Trigo
CIEMAT, Madrid, Spain
C. del Cañizo
UPM, Madrid, Spain
M. Grossberg
Tallinn University of Technology, Estonia
G. Halambalakis
CRES, Athens, Greece
J. Hast
VTT, Oulu, Finland
A. Joyce
INETI, Lisboa, Portugal
R. Kvande
SINTEF, Trondheim, Norway
E. Lotter
ZSW, Stuttgart, Germany
E. Román Medina
Tecnalia, Derio, Spain
R. Turan
METU, Ankara, Turkey
G. Sánchez-Plaza
UPV, Valencia, Spain
N. Wyrsch
EPFL, Neuchâtel, Switzerland
S. Zamini
AIT, Vienna, Austria

7DV.1.31 **Really Building with BIPV - Putting the Foundation in Place for a Successful Dutch BIPV Sector (the 'Werkelijk Bouwen Aan BIPV' Project)**
A. De Vries
Stichting Monitoring Zonnestroom, Utrecht, Netherlands
A. Kahn
4WWWWIE, Ouderkerk aan de Amstel, Netherlands
R. Comuth
Adviesbureau Comuth, Maastricht, Netherlands
A. van Deursen
HD Solar, Someren, Netherlands
M. Arninkhof
Holland Solar, Utrecht, Netherlands
G. Verpaalen
Kameleon Solar Specials, Roosendaal, Netherlands
C. Maas
Chatim, Heerlen, Netherlands
S. Kin
SolarSwing, Delft, Netherlands
P. de Jong
Solinso, Kessel, Netherlands
W. van de Wall
Wallvision, Heeze, Netherlands
Z. Vroon
Zuyd University of Applied Sciences, Heerlen, Netherlands
A. Kuypers
TNO, Delft, Netherlands
J. Kester
ECN, Petten, Netherlands
R.M.E. Valckenborg
SEAC, Eindhoven, Netherlands
W.G.J.H.M. van Sark
Utrecht University, Netherlands
R. Loonen
Eindhoven University of Technology, Netherlands
L. van den Hurk & E. Teunissen
Berenschot, Utrecht, Netherlands

7DV.1.32 **Development of BIPV Courseware for Students and Professionals**
M. Tabakovic & H. Fechner
University of Applied Sciences, Vienna, Austria
W.G.J.H.M. van Sark & A. Louwen
Utrecht University, Netherlands
I. Weiss & S. Arancón
WIP - Renewable Energies, Munich, Germany
G. Georghiou, G. Makrides & M. Hadjipanayi
University of Cyprus, Nicosia, Cyprus
E. Loucaidou & M. Ioannidou
Deloitte, Limassol, Cyprus

7DV.1.35 **The Pilot Tender for PV in Greece within 2016. Results and Conclusions**
D. Papachristou, P. Kapetana & P. Daliouris
RAE, Athens, Greece
T. Petmezas
cosmoONE, Athens, Greece

7DV.1.36 **Photovoltaic Power Production in Greece: History, Current Status and New Policies for Future Deployment**
J.S. Anagnostopoulos
NTUA, Athens, Greece

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7DV.1.38 **Moroccan PV Energy Policy Assessment on Economic Growth and Social Issue**
Z. Zaoui, O. Ghriach & C. Benqlilou
ENIM, Rabat, Morocco

7DV.1.41 **Promoting a Sustainable Diffusion of Solar PV Electricity in Africa: Results of the CODEV Project**
E. Annigoni, A. Virtuani, N. Wyrsch & C. Ballif
EPFL, Neuchâtel, Switzerland
A. Ndiaye, M.L. Ndiaye & C.M.F. Kebe
Polytechnical University of Dakar, Dakar Fann, Senegal

7DV.1.43 **Impacts of Socio-Economic Policies on Temporal Diffusion of PV-Based Communal Grids in a Rural Developing Community**
N. Opiyo
University of Leeds, United Kingdom

7DV.1.44 **Prospects of PV Deployment in Japan under the Revised FIT Law**
I. Kaizuka, H. Matsukawa, H. Yamaya, T. Ohigashi & O. Ikki
RTS, Tokyo, Japan

7DV.1.45 **Policy Statement of Certified PV Module Registration and Management in Taiwan**
C.-C. Chou
ITRI, Hsinchu, Taiwan

7DV.1.46 **Distributed Photovoltaic Generation: Challenges and Solutions for Its Expansion and Integration in the Brazilian Grid with Case Study of the Impact of the White Tariff**
V.O. Silva, D.B. Bernhard, S. Gomes Relva, M.E. Morales Udaeta, A.L. Veiga Gimenes & M.B.C. Salles
University of São Paulo, Brazil

7DV.1.48 **Training the Next Generation of PV Reliability Experts – New Marie-Sklodowska Curie (MSCA) Project SOLAR-TRAIN**
K.-A. Weiß, S. Saile, A. Keiner & L. Pitta Bauermann
Fraunhofer ISE, Freiburg, Germany
G. Oreski
PCCL, Leoben, Austria
R. Gottschalg
Loughborough University, United Kingdom
D. Moser
Eurac Research, Bolzano, Italy
M. Topic
University of Ljubljana, Slovenia
A.R. Lagunas
CENER, Sarriguren, Spain
P. Chiantore
BayWa, Rome, Italy
M. Van Iseghem
EDF R&D, Moret-sur-Loing, France

7DV.1.50 **School Sustainable: Ecological Farming, Solar Energy and Rainwater Capture as Element Educator in County Gravataí / RS - Brazil**
A.C. Pan, A. Machado Golembieski, L.P. Menna de Oliveira, L. Alves Schmitt, A. Antunes De Paulo & R. Souza da Silva
PUCRS, Porto Alegre, Brazil
L.F. Ribeiro Gomes
EEEPM, Gravataí, Brazil

7DV.1.51 **Economic Assessment of Photovoltaic Installations in Multi-Apartment Buildings**
B. Fina, J. Auer, A. Fleischhacker & G. Lettner
Vienna University of Technology, Austria

VISUAL PRESENTATIONS 3DV.2

15:15 - 16:45 CI(G)S, CdTe and Related Thin Film Solar Cells and Modules (II) / Perovskite, Organic and Dye-Sensitised Devices

3DV.2.2 **Structural and Optical Properties of RF-Sputtered ZnS:Cr Thin Films**
O.M. Cheikh & M. Aggour
Ibn Tofail University, Kenitra, Morocco
L. Nkhaili, A. El Kissani, M. Chaik & A. Outzourhit
Cadi Ayyad University, Marrakech, Morocco

3DV.2.4 **Optimization of Monolithic Two-Terminal Hybrid a-Si:H-CIGS Tandem Devices**
A.J. Blanker, Y.H. Liu, P. Berendsen, N. Phung, M. Zeman & A.H.M. Smets
Delft University of Technology, Netherlands
Z. Vroon
TNO/Solliance, Eindhoven, Netherlands

3DV.2.5 **HPMF Process of Al-Doped Zinc Oxide Films from Rotatable Targets**
V. Sittinger, S. Jung, C. Britze, H. Gerdes & G. Bräuer
Fraunhofer IST, Braunschweig, Germany
D. Schorn
MAGPULS, Sinzheim, Germany
T. Wallendorf
IBW Technologieberatung, Berlin, Germany

3DV.2.6 **High Speed Curing of AR Coatings on Thin-Film Modules by Laser Irradiation: An End-of-Line Approach for Improved Power Outputs**
D. Hawelka & J. Stollenwerk
Fraunhofer ILT, Aachen, Germany
R. Cauchois, Y. Li & H. Schoot
DSM, Geleen, Netherlands

3DV.2.8 **Structural, Morphological and Raman Scattering Studies of Carbon Doped ZnO Nanoparticles Fabricated by PSP Technique**
R. Taziwa & E. Meyer
University of Fort Hare, Alice, South Africa

3DV.2.9 **First Principles Calculations on Incorporation of Point Defects in Beta-In2S3**
E. Ghorbani & K. Albe
Technical University of Darmstadt, Germany

3DV.2.10 **Reverse Bias JV Characteristics of CIGS Devices**
B.E. Pieters
Forschungszentrum Jülich, Germany

3DV.2.12 **Rear-Side Contacted, Laser-Structured CIGSe Cells: A Proof of Concept**
G. Farías Basulto, M.D. Heinemann, C.A. Kaufmann, B. Rau & R. Schlatmann
HZB, Berlin, Germany
C. Schultz & B. Stegemann
Berlin University of Applied Sciences, Germany

3DV.2.13 **Properties of Co-Sputtered CdSxTe1-x Thin Films for Compositional Optimization in High Performance CdS/CdTe Solar Cells**
M.A. Islam, K.S. Rahman, F.M. Tahzib Enam, K. Sobayel, I. Kamaruzzaman, M. Akhtaruzzaman & N. Amin
National University of Malaysia, Bangi, Malaysia

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3DV.2.14 **A Growth Model to Predict the Composition of Cadmium Telluride Films**
X. Tan, A. Saraf, G. Liu, A.E. Delahoy & K.K. Chin
NJIT, Newark, United States
S. Peng & S. Xia
Bengbu Design & Research Institute for Glass Industry, China
J. Pan
CNBM Chengdu Optoelectronic Materials, China
V. Krishnakumar & B. Siepchen
CTF Solar, Dresden, Germany

3DV.2.15 **Densification of Solution-Based Processed Kesterite Cu2ZnSnS4 Thin Films by Thermal Annealing**
R.A. Wibowo, F. Berzsenyi & N. Bansal
AIT, Vienna, Austria

3DV.2.17 **Analytical and Empirical Modeling of CZTSSe Solar Cells with Incomplete Gamma Function of Quantum Efficiency under Voltage and Light Biases**
S. Lee & K.J. Price
Morehead State University, United States
E. Saucedo & S. Giraldo
IREC, Barcelona, Spain

3DV.2.18 **Optical Optimization of CIGS Solar Cells Based on Rear Dual-Layer Dielectric Spacer and Point-Contact Scheme**
N. Rezaei, O. Isabella & M. Zeman
Delft University of Technology, Netherlands
Z. Vroon
TNO, Geleen, Netherlands

3DV.2.19 **Physical Model of Defect Formation in Non-Stoichiometric Cadmium Telluride**
X. Tan, A. Saraf, A.E. Delahoy & K.K. Chin
NJIT, Newark, United States
S. Peng & S. Xia
CTIEC, Bengbu, China
J. Pan
CNBM, Chengdu, China
V. Krishnakumar & B. Siepchen
CTF Solar, Dresden, Germany

3DV.2.20 **Investigation of KF-PDT Induced Surface Modification of Cu(In,Ga)Se2 Absorbers and Its Correlation with Device Performance**
I. Majumdar, V. Parvan, D. Greiner, R. Schlatmann & I. Lauermann
HZB, Berlin, Germany
M.C. Lux-Steiner
Free University of Berlin, Germany

3DV.2.21 **Layer-Selective Laser-Lift off and Removal Mechanism in a TCO/Si and TCO/CdTe Thin Film System by Nano- to Femtosecond Pulses**
S. Krause, P. Miclea, K. Kaufmann & C. Hagendorf
Fraunhofer CSP, Halle, Germany

3DV.2.22 **Properties of Cu2ZnSn(SxSe1-X)4 Thin Films Obtained by an Electrodeposition-Annealing Process**
E.P. Zaretskaya & V.F. Gremenok
NASB, Minsk, Belarus
K.A. Urazov & M.B. Dergacheva
National Academy of Sciences, Almaty, Kazakhstan
S. Özcelik
University of Gazi, Ankara, Turkey

3DV.2.23 **Low Resistivity of ZnMgO Films Grown by Spin-Coated Method**
H. Tominaga & K. Yoshino
University of Miyazaki, Japan

3DV.2.24 **Growth of Photovoltaic Compound Single Crystals**
A. Nagaoka & Y. Nose
Kyoto University, Japan
M.A. Scarpulla
University of Utah, Salt Lake City, United States
K. Yoshino
University of Miyazaki, Japan

3DV.2.26 **Comparative Study of CuSbS2 Thin Film Solar Cells Prepared by Two Different Hybrid Inks**
S. Banu & A. Cho
KIER, Daejeon, Korea South

3DV.2.27 **Influence of Mo Microstructural Properties on the Formation of MoS2 Thin Film by Sulphurization Process**
P. Chelvanathan, S.A. Shahahmadi, Z. Zakaria, Y. Yusoff, M.T. Ferdaous, M.M.I. Sepali, K. Sopian & N. Amin
National University of Malaysia, Bangi, Malaysia

3DV.2.28 **Photovoltaic Properties of CdSeTe Alloys**
A. Los
First Solar, Perrysburg, United States

3DV.2.31 **Identification of Trap States in Hybrid Organic/Inorganic Perovskites**
G. Gordillo, C.A. Otálora, E.R. Romero & A.A. Ramírez
National University of Colombia, Bogotá, Colombia

3DV.2.32 **Comparison of Simulation Models for Perovskite Solar Cells**
S. Silvestre & J. Puigdollers González
UPC, Barcelona, Spain
E. Mas-Marzá, F. Fabregat-Santiago & V.G. Alfonso
UJI, Castellón, Spain

3DV.2.34 **Challenges and Solutions in the R2R Manufacturing of Perovskite Solar Cells**
M. Busch, T. Kolbusch, K. Crone & N. Meyer
Coatema, Dormagen, Germany

3DV.2.37 **Long Term Thermal Stability Tests for Air Processed Inkjet Infiltrated Carbon Based Printed Perovskite Solar Cells**
S.G. Hashmi, A. Rimppi & P.D. Lund
Aalto University, Espoo, Finland

3DV.2.38 **A Study on the Degradation Mechanism of Flexible Oraganic Photovoltaic Modules under Damp-Heat Test**
S.H. Kim & H.J. Son
KETI, Gyeonggi-do, Korea South

3DV.2.40 **Reduced Graphene Oxide Nano Sheet Modified Dye-Sensitized Solar Cell for Future Energy Challenge**
M.Z.H. Khan & M.R. Hasan
Jessore University of Science and Technology, Bangladesh

3DV.2.41 **Eliminating Irregular Hysteresis Behavior in Perovskite Solar Cells**
O. Bhandakkar
University of Massachusetts, Lowell, United States

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3DV.2.43 **Emergence of Flexible Perovskite Photovoltaic Solar Cells**
S. Uddin & I. Rehman Ansari
Aligarh Muslim University, India

3DV.2.45 **Stability Issues of Perovskite Photovoltaic Cells**
D. Strachala, J. Hylsky, J. Vanek, M. Kadlec & J. Mucha
Brno University of Technology, Czech Republic

3DV.2.47 **Machine Learning for Stability Research of Dye-Sensitised and Perovskite Solar Cells**
A. Tiihonen, K. Miettunen & P.D. Lund
Aalto University, Espoo, Finland

3DV.2.49 **Optical and Recombination Losses in Hybrid Perovskite Solar Cells**
M. Tamakoshi, T. Fujiseki, S. Fujimoto & H. Fujiwara
Gifu University, Japan
T. Miyadera, T. Murakami, T. Sugita & M. Chikamatsu
AIST, Tsukuba, Japan

3DV.2.50 **Fabrication of CH3NH3PbI3 Perovskite Solar Cells with MAI-PbI2-MAI Structure via Sandwich Evaporation Technique**
P.-T. Kuo, S.-P. Lin, C.-S. Lin & C.-F. Lin
NTU, Taipei, Taiwan

3DV.2.51 **Molecular Strategies towards Efficient Organic Solar Cells**
C. Zhan
CAS, Beijing, China

3DV.2.53 **Solution-Processed Inverted Organic Solar Cells: Towards Fully Spray-Coated Devices**
R. López Vicente, C. Toledo Arias, J. Padilla, A. Urbina & J. Abad
UPCT, Cartagena, Spain

3DV.2.55 **Perovskite Solar Cell via Ultrasonic Spray Assisted Two-Step Deposition Method**
S. Wang, G. Chai & H. Zhou
PKUSZ, Shenzhen, China
P. Hiralal
Zinergy, Shenzhen, China
T. Meng
University of Delaware, Newark, United States

3DV.2.56 **Conductive Inks with Epoxy Resin Based Vehicles for Perovskite Screen Printing Metallization as a Viable and Low-Cost Alternative to Thermal Evaporation**
C. Montes, L. Ocaña, C. Quinto, M. Friend & M. Cendagorta
ITER, Granadilla de Abona, Spain
S. González-Pérez, B. González-Diaz & R. Guerrero-Lemus
ULL, La Laguna, Spain

3DV.2.57 **Performance Enhancement of Naturally Synthesized Dye-Sensitized Solar Cells (DSSCs) by Using Mono- and Bimetallic Nanoparticles Additives**
K. Ranabhat, K.S. Skripkin, E.A. Sofronova & A.I. Pylinin
RUDN University, Moscow, Russia
A.A. Revina
Russian Academy of Sciencies, Moscow, Russia
L.N. Patrikeev & V.A. Lapshinsky
MEPhI, Moscow, Russia

3DV.2.58 **Structural, Optical and Electrical Properties of ZnO/Perovskite/CuO/ Al Solar Cells**
H. Ait Dads, L. Nkhaili, A. El Kissani, H. El Aakib, S. Laalioui, M. Ait Ali & A. Outzourhit
Cadi Ayyad University, Marrakech, Morocco

3DV.2.59 **Synthesis and Characterization of (2-(4-Chlorophenyldiazenyl)-Ethyl2-(2-Amino-7-Hydroxypyrazolo[1,5-a]Pyrimidin-5-yl) Acetate as Hole-Transporting Layer for Perovskite Solar Cells**
E. El-Menyawy
National Research Center, Cairo, Egypt

3DV.2.61 **Investigation of the Effect of Interfacial Transport Layer on Perovskite Solar Cells by Optoelectronic Approach**
D.B. Khadka, Y. Shirai, M. Yanagida & K. Miyano
NIMS, Tsukuba, Japan

3DV.2.62 **Perovskite-Based Solar Devices: Towards 2-Terminal Silicon Heterojunction Tandem Cells**
R. Benrabbah, M. Manceau, D. Muñoz, C. Roux & S. Berson
CEA, Le Bourget du Lac, France

3DV.2.63 **Tunneling Assisted Trapping as a Possible Origin of the Hysteresis in Perovskite Solar Cells, a Study with the Simulation Software SILVACO ATLAS**
S. Almosni, L. Cojocaru, S. Uchida, T. Kubo & H. Segawa
University of Tokyo, Japan
D. Li
Silvaco Japan, Yokohama, Japan

3DV.2.64 **Enhancement of Efficiency for Mixed Metal Sn/Pb Perovskite Solar Cells with 16% Efficiency from the View Point of Crystal and Hetero-Interface Architecture**
Y. Ogomi, K. Hamada, D. Yamasuso, D. Hirotani, A. Yonaha, E. Yamaguchi & S. Hayase
Institute of Technology, Kitakyushu, Japan
S. Shen & T. Toyoda
University of Electro-Communication, Chofu, Japan
K. Yoshino
University of Miyazaki, Japan
T. Minemoto
Ritsumeikan University, Kusatsu, Japan

3DV.2.65 **Laser Patterning of Perovskite Solar Cells: Process Development and Determination of the Heat-Affected Zone**
C. Schultz, F. Schneider & B. Stegemann
Berlin University of Applied Sciences, Germany
C. Ferber, L. Kegelmann, S. Meyer, B. Rech, R. Schlatmann & S. Albrecht
HZB, Berlin, Germany

3DV.2.66 **Designing Highly Efficient Perovskite Solar Cells**
B.M.W. Wilkinson, M.A. Green & A.W.Y. Ho-Baillie
UNSW Australia, Sydney, Australia

3DV.2.68 **One-Step Fabrication of Two Dimensional Copper Based Perovskite Thin Film**
N. Bansal, P. Santos Oritz, R. Wibowo & T. Dimopoulos
AIT, Vienna, Austria

3DV.2.69 **On Cost Effectiveness of Perovskite/c-Si Tandem Modules**
B. Geerligs
ECN, Petten, Netherlands

3DV.2.70 **Investigation of Industrial Crystalline Silicon Cell Architectures as Bottom Cell in Perovskite/c-Si Hybrid Tandems**
S.L. Luxembourg, Y. Wu & L.J. Geerligs
ECN, Petten, Netherlands
D. Zhang, W. Verhees & S.C. Veenstra
ECN, Eindhoven, Netherlands

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3DV.2.71 **A One-Step Deposition Method Assisted with Non Polar Washing Solvent Treatment for Producing Uniform Thin Layers of Perovskite Validated through Ellipsometry**
C. Montes, L. Ocaña, C. Quinto, M. Friend & M. Cendagorta
ITER, Granadilla de Abona, Spain
S. González-Pérez, B. González-Diaz, C. Hernandez-Rodriguez & R. Guerrero-Lemus
ULL, La Laguna, Spain

3DV.2.72 **Design Guidelines for Highly Efficient Perovskite/Si Tandem Solar Cells**
M.H. Futscher & B. Ehrler
AMOLF, Amsterdam, Netherlands

3DV.2.73 **Maximization of Short Circuit Current in Perovskite Solar Cells by Optical Engineering**
M. Koç, D. Turkay, W. Soltanpoor & S. Yerci
METU, Ankara, Turkey

3DV.2.74 **Comparison of the Aluminium Back Contact Deposited by Sputtering, E-Beam, or Thermal Evaporation for Inverted Perovskite Solar Cells**
J. Hanisch, T. Wahl & E. Ahlswede
ZSW, Stuttgart, Germany

3DV.2.75 **CH3NH3PbI3-xBrx Films with Tunable Optoelectronic Properties by Thermal Co-Evaporation**
W. Soltanpoor, O. Yilmaz, M. Cem Sahiner & S. Yerci
METU, Ankara, Turkey

3DV.2.76 **Unencapsulated CH3NH3PbI3 Solar Cells under Different Relative Humidity**
A. De Maria, V. La Ferrara, L.V. Mercaldo, A. Bruno, G. Rametta & P. Delli Veneri
ENEA, Portici, Italy
F. Matteocci & A. Di Carlo
University of Rome "Tor Vergata", Italy

3DV.2.77 **ITO-ZnO Perovskite Solar Cell Using Hexagonal Array Nano Cone Patterned Substrate for Improving Efficiency**
M. Byun, K.S. Oh, Y.D. Kim, J.-Y. Choi, D. Huh, K. Kim & H. Lee
Korea University, Seoul, Korea South
D.S. Kim
KIER, Ulsan, Korea South

3DV.2.78 **Nordic Outdoor Aging Test for Dye-Sensitised Solar Cells**
S. Lepikko, K. Miettunen, A. Poskela, A. Tiihonen & P.D. Lund
Aalto University, Espoo, Finland

3DV.2.79 **The Potential of Perovskite Solar Cell in Morocco**
S. Laalioui, K. Belrhiti Alaoui, A. Chachdi & B. Ikken
IRESEN, Rabat, Morocco
H. Ait Dads, K. El Assali & A. Outzourhit
Cadi Ayyad University, Marrakech, Morocco
B. Rahmouni
Université Hassan Premier, Settat, Morocco

3DV.2.80 **A Fast and Easy Perovskite Solar Cell Simulation Tool Featuring Ion Migration**
A. Fell & S.W. Glunz
Fraunhofer ISE, Freiburg, Germany
D. Walter
ANU, Canberra, Australia

3DV.2.81 **Raman Spectroscopy and Imaging of Titanium Dioxide Nanotubes**
R. Taziwa & E.L. Meyer
University of Fort Hare, Alice, South Africa

3DV.2.82 **Spatial Atomic Layer Deposition: A Potential Up-Scalable Route for Selective Contacts in Perovskite Solar Cells**
V. Zardetto, F. Di Giacomo, F. van den Bruele, H. Lifka, R.A.J.M. Andriessen, P. Poodt & A. Illiberi
TNO/Solliance, Eindhoven, Netherlands
A. Hadipour
imec, Leuven, Belgium
S.C. Veenstra
ECN, Eindhoven, Netherlands

3DV.2.84 **Light Management Films for Enhanced Harvesting in Printable Photovoltaics**
J. Mayer, T. Offermans, B. Gallinet, I. Zhurminsky & R. Ferrini
CSEM, Muttenz, Switzerland

3DV.2.85 **Perovskite Stability Investigated by Combined Surface and Bulk Analysis Techniques**
E. Pellereau, D. Aureau, M. Bouttemy, M. Frégnaux, A.-M. Goncalves, N. Steunou, J. Vigneron & A. Etcheberry
UVSQ, Versailles, France
J.-E. Bouree, C. Dindault, B. Geffroy, H. Lee, A. Marronnier, D. Tondelier & Y. Bonnassieux
CNRS, Palaiseau, France
T. Bourgeteau
NAIST, Ikoma, Japan
G. Roma
CEA, Gif Sur Yvette, France

3DV.2.87 **Parallel Tandem Solar Cell Based on Transparent Singlet Fission Solar Cell**
J. Lee, M.H. Futscher & B. Ehrler
AMOLF, Amsterdam, Netherlands
L. Pazos-Outón
University of California, Berkeley, United States

3DV.2.88 **Influence of Pd-Doped TiOx on Inverted Organic Solar Cells Performance**
J.G. Sánchez López, A. Viterisi, J. Ferré-Borrull, L.F. Marsal Garví & J. Pallarès Marzal
URV, Tarragona, Spain
V.S. Balderrama Vazquez & M. Estrada del Cueto
CINVESTAV, Mexico City, Mexico

3DV.2.89 **Solar Cell Efficiency as a Function of Blocking Layer Thicknesses and Exciton Fluorescence Quantum Yield**
B. Godefroid & G. Kozyreff
Free University of Brussels, Belgium

3DV.2.90 **Raising the Technology Readiness for Highly Efficient, Stable Perovskite-Based Photovoltaic Modules**
T. Aernouts, W. Qiu & R. Gehlhaar
imec, Leuven, Belgium
F. Di Giacomo & R.A.J.M. Andriessen
TNO, Eindhoven, Netherlands
Y. Galagan & S.C. Veenstra
ECN, Eindhoven, Netherlands

3DV.2.91 **Characterisation of a Multidimensional Nonlinear Solar Cell**
T. Fey, I. Kröger & S. Winter
PTB, Braunschweig, Germany

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3DV.2.92 **Effect of Single-Chirality Single-Walled Carbon Nanotubes in Dye Sensitized Solar Cells Photoanodes**
F. Gaspari & S. Quaranta
University of Ontario, Oshawa, Canada
V.L. Davis
University of Freiburg, Germany
A. Latini & C. Cavallo
University of Rome, Italy

3DV.2.96 **Large Perovskite Single Crystals for Integrated Circuits**
S. Liu
CAS, Dalian, China
Y. Liu & Z. Yang
Shaanxi Normal University, Xi'an, China

3DV.2.97 **Hydromolecular-Resist and Dipole Effects of Metal-Acetylacetonate Series in Interface Engineering for Full Low Temperature Processed, High Performance and Stable Inverted Planar Perovskite Solar Cells**
Z. He & W. Chen
SUSTech, Shenzhen, China

3DV.2.98 **Loss Analysis for Meso-Structured Perovskite Solar Cells**
H. Xue, E. Birgersson & R. Stangl
NUS, Singapore, Singapore
K. Fu
NTU, Singapore, Singapore

3DV.2.99 **Enhancing the Efficiency of Perovskite Solar Cell Using Selective TiO2 Nanorod Patterned Substrate**
D. Huh, H.-J. Choi, J.-Y. Choi, M. Byun & H. Lee
Korea University, Seoul, Korea South
M. Kim & D.S. Kim
KIER, Ulsan, Korea South

3DV.2.100 **Cu Based Hole Transport Materials for Perovskite Solar Cells**
V. Erkkara Madhavan, M. Buffière & A. Belaidi
QEERI, Doha, Qatar
I. Zimmermann, C. Roldán-Carmona, G. Grancini & M.K. Nazeeruddin
EPFL, Lausanne, Switzerland

3DV.2.101 **Scalable Synthesis of Carbon Materials for Highly Efficient Charge Transfer Perovskite Solar Cells**
A.R. bin Mohd Yusoff & J. Jang
Kyung Hee University, Seoul, Korea South
M.K. Nazeeruddin
EPFL, Lausanne, Switzerland

3DV.2.102 **Charge Carrier Lifetime in CH3NH3PbI3 Thin Film: Role of Humidity**
A.S. Chouhan, N. Prathibha Jasti & S. Avasthi
Indian Institute of Science, Bangalore, India

3DV.2.103 **Structural and Raman Spectroscopic Characterization of c-TiO2 Nanotubes Synthesized by Template Assisted Sol-Gel Technique**
N. Takata, E.L. Meyer & R.T. Taziwa
University of Fort Hare, Alice, South Africa

3DV.2.104 **Low Temperature Growth of ZnMgO Thin Films for Perovskite Based Solar Cell**
H. Tominaga & K. Yoshino
University of Miyazaki, Japan
Y. Ogomi & S. Hayase
Kyushu Institute of Technology, Kitakyushu, Japan
Q. Shen & T. Toyoda
University of Electro-Communication, Chofu, Japan
T. Minemoto
Ritsumeikan University, Shiga, Japan

3DV.2.105 **Translucent, Color-Neutral and Efficient Perovskite Modules**
L. Rakocevic, R. Gehlhaar, M. Jaysankar & J. Poortmans
imec, Leuven, Belgium
H. Fledderus
TNO, Eindhoven, Netherlands

3DV.2.107 **Characterization of Lead Halide Perovskites by Modulated Surface Photovoltage**
C.A. Omondi, T. Dittrich, E. Unger, L. Kegelmann, S. Albrecht & B. Rech
HZB, Berlin, Germany

3DV.2.108 **Role of the Fabrication Technique in the Stability of CH3NH3PbI3 Perovskite Film**
M. Habibi & M. Eslamian
Shanghai Jiao Tong University, China

3DV.2.109 **Comparison of Outdoor Performance of Large Scale DSSC Module**
K.-W. Ko, C.-H. Han & S. Hong
KIER, Daejeon, Korea South

3DV.2.111 **Development of Polymer Gel Electrolytes Containing Cobalt Complexes for Efficient and Durable Dye-Sensitized Solar Cells**
S.-E. Kim, D.-H. Kim & M.-S. Kang
Sangmyung University, Cheonan, Korea South

3DV.2.112 **Performance Enhancement of Perokskite Solar Cells with TiO2 Scaffold Modified by Block Copolymer Templating Method**
D.-H. Kim, H.-R. Kim, S.-E. Kim & M.-S. Kang
Sangmyung University, Cheonan, Korea South

3DV.2.113 **Peroprint-Printing Perovskite Solar Cells**
A. Verma, J. Heier & F. Nüesch
EMPA, Dübendorf, Switzerland
D. Martineau & T. Meyer
Solaronix, Aubonne, Switzerland

3DV.2.115 **Efficient Polymer Solar Cells with Solution-Processed Gold Chloride/Polyacrylonitrile as an Anode Interfacial Bilayer**
J.-H. Jeong, S.-W. Kim, Y.-J. Noh, S.-N. Kwon & S.-I. Na
Chonbuk National University, Jeonju, Korea South

3DV.2.116 **Analytical Modeling for Large-Scale Perovskite Solar Cell Modules**
S.H. Lee, K.-S. Lee & M.G. Kang
ETRI, Daejeon, Korea South

3DV.2.117 **Preliminary Guidelines for Accurate I-V Measurements on Perovskite Solar Cells**
R.B. Dunbar, T.W. Jones, K.F. Anderson, B.C. Duck, C.J. Fell & G.J. Wilson
CSIRO Energy Technology, Mayfield West, Australia

3DV.2.118 **SnS/CdS Thin Film Solar Cells by Ionized Jet Deposition**
D. Menossi, S. Di Mare, E. Artegiani, F. Piccinelli & A. Romeo
University of Verona, Italy
G. Tedeschi
Noivion, Rovereto, Italy

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3DV.2.119 **Highly Efficient Polymer Solar Cells Based on Photo-Cross-Linked Perylene Diimide Derivative Materials**
Y.-J. Noh, J.-H. Jeong, S.-N. Kwon, K.-U. Jeong & S.-I. Na
Chonbuk National University, Jeonju, Korea South

3DV.2.120 **Multi-Layer Strategy to Enhance the Grain Size of CIGS Thin Film Fabricating by Single Quaternary CIGS Target**
X. Peng, M. Zhao & D.-M. Zhuang
Tsinghua University, Beijing, China

VISUAL PRESENTATIONS 5DV.3

17:00 - 18:30 **PV Module Performance and Reliability (II) / Inverters and Balance of System Components / Sustainability and Recycling**

5DV.3.1 **Advanced PV Module Hot Spot Characterisation**
S. Wendlandt, L. Süthoff, S. Berendes, J. Teubner, L. Podlowski, J. Berghold, S. Krauter & P. Grunow
PI Berlin, Germany

5DV.3.2 **Shading and Hot Spot Performance of Shingled Cell Array Module**
H. Zhou
Flextronics International, Shanghai, China
L. Zhou
Flextronics International, San Jose, United States

5DV.3.4 **Tape Interconnection for Silicon Solar Cells with Extended Long Term Stability**
J. Buddgård, T. Lagerstedt & A. Machirant
JB EcoTech, Lidingö, Sweden

5DV.3.5 **Indium-Free Coating and Advanced Metallization for SmartWire Connection Technology**
A. Faes, M. Despeisse, J. Champliaud, H.-Y. Li, J. Levrat, A. Lachowicz, N. Badel, J. Geissbühler, L. Curvat, J. Escarré, F. Debrot, J. Horzel, L.-E. Perret-Aebi & C. Ballif
CSEM, Neuchâtel, Switzerland
T. Söderström, Y. Yao, S. Beyer & B. Bonnet-Eymard
Meyer Burger, Gwatt, Switzerland
P. Papet & B. Strahm
Meyer Burger Research, Hauterive, Switzerland

5DV.3.6 **Reliability Analysis of Photovoltaic Modules by Contact States between Interconnector Ribbonand Ag Electrode**
I.-A. Kim, Y.-K. Min, C.-H. Kim, J.-H. Chio, E.-J. Lee, S. Ryu & D.-S. Kim
Shinsung Solar Energy, Eumseong-gun, Korea South

5DV.3.7 **Assessing the Impact of Broken and Defective Interconnection Ribbons on the Electrical Performance of Crystalline Silicon Photovoltaic Modules**
E. Annigoni, A. Virtuani, F. Sculati-Meillaud & C. Ballif
EPFL, Neuchâtel, Switzerland

5DV.3.8 **Advances in the Development of a Novel Module Design Based on Electrical Conductive Adhesive Glue for Contacting Highly Efficient n-Type Solar Cells with PVD Al Back Contact**
E. Cabrera, A. Schneider, T. Buck, Z.-W. Peng & R. Kopecek
ISC Konstanz, Germany
T. Fischer
Teamtechnik Maschinen und Anlagen, Freiberg, Germany

5DV.3.9 **Advances in the Development of a Novel Module Concept Based on Conductive Structures in the Encapsulation Material for Contacting Highly Efficient n-Type Back-Contact Solar Cells**
E. Cabrera, A. Schneider, D. Thaller, L.J. Koduvelikulathu & A. Halm
ISC Konstanz, Germany
B. Pérez & R. Merino
STRE, Llanera, Spain
B. Puerto, P. Sánchez-Friera & R. Camblor
Fundación PRODINTEC, Gijón, Spain
R. Pittson, D. Greenhill & T. Brown
Gwent Electronic Materials, Pontypool, United Kingdom

5DV.3.10 **EVA and Backsheet Inspection for Solar Module**
H.-H. Hsieh, Y.-H. Lee, Y.-T. Li, E.-Y. Wang & H.-S. Wu
ITRI, Hsinchu, Taiwan

5DV.3.11 **Verification of the Hydrolysis Resistance of Polyester Based Backsheets on the Market**
B. Ottersböck & G. Oreski
PCCL, Leoben, Austria
M. Kühne
Hanwha Q CELLS, Bitterfeld-Wolfen, Germany
G. Pinter
University of Leoben, Austria

5DV.3.12 **Development of an Electrically-Conductive Backsheet for Back-Contact Based PV-Modules**
R.H.C. Janssen, F. van Duijnhoven, I.J. Bennett & J.J. Xu
DSM, Geleen, Netherlands

5DV.3.13 **Improved Accelerated Durability Testing and Comparison to Field Degradation**
W.J. Gambogi, T. Felder, S. MacMaster, K. Roy-Choudhury, A. Bradley, B.-L. Yu, K.M. Stika & J. Trout
DuPont, Wilmington, United States
Y. Heta
DuPont, Utsunomiya, Japan
L. Garreau-Iles
DuPont, Geneva, Switzerland
H. Hu
DuPont, Shanghai, China

5DV.3.14 **Benchmarking of New, Promising Polyolefin Encapsulation Material under Extreme Weathering Conditions**
D. Philipp, L. Pitta Bauermann & I. Dürr
Fraunhofer ISE, Freiburg, Germany
B. Broeders, S. Hellström, G. Galgali & F. Costa
Borealis, Vienna, Austria

5DV.3.16 **Investigation of Effects due to Encapsulation Thickness Reduction in Light Weight Modules**
G. Oreski
PCCL, Leoben, Austria
A. Halm
ISC Konstanz, Germany
V. Schenk & W. Krumlacher
ISOVOLTAIC, Lebring, Austria
H. Nussbaumer
ZHAW, Winterthur, Switzerland

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5DV.3.17 **Concept of Optimized Encapsulant Composition for PV Module Reliability under Different Climatic Conditions**
A. Mihaljevic & G. Oreski
PCCL, Leoben, Austria
G. Eder & Y. Voronko
OFI, Vienna, Austria
W. Mühleisen, L. Neumaier & C. Hirschl
CTR, Villach, Austria
R. Ebner
AIT, Vienna, Austria
G. Pinter
University of Leoben, Austria

5DV.3.18 **Influence of Acetic Acid Retention in PV Module Degradation**
G. Oreski & A. Mihaljevic
PCCL, Leoben, Austria
G.C. Eder & Y. Voronko
OFI, Vienna, Austria
L. Neumaier & C. Hirschl
CTR, Villach, Austria
R. Ebner
AIT, Vienna, Austria
M. Edler & W. Krumlacher
ISOVOLTAIC, Lebring, Austria

5DV.3.19 **Long Term Stability Test and Analysis of Amorphous Silicon Glass-Glass Mini-Modules**
U. Banik, N. Reininghaus, M. Vehse & C. Agert
NEXT ENERGY, Oldenburg, Germany

5DV.3.20 **Modeling and Simulation of Non-Uniform Encapsulant Discoloration Effect in Crystalline-Silicon Photovoltaic Modules**
H. Mohammed Niyaz, A. Sinha & R. Gupta
IIT Bombay, Mumbai, India

5DV.3.21 **Correlation of Degree of EVA Crosslinking with Formation and Discharge of Acetic Acid in PV Modules**
J. Zhu, D. Montiel-Chicharro, T.R. Betts & R. Gottschalg
Loughborough University, United Kingdom

5DV.3.22 **Effect of the Frame Sealing on the Functionality of a Photovoltaic Module**
J. Vanek, K. Jandová, M. Sturm, J. Hylsky & D. Strachala
Brno University of Technology, Czech Republic

5DV.3.23 **Analyses of Photovoltaic Modules Influenced by Volcanic Ashes at Kagoshima in Japan**
Y. Chiba, R. Sato & A. Masuda
AIST, Tosu, Japan
T. Hirayama & S. Kawabata
Kagoshima University, Japan
Y. Yoshimura
KIT, Kirishima, Japan

5DV.3.24 **Annual Evaluation and Changes of Thirty Types of PV Modules in Outdoor Exposure for Two Years**
Y. Nakamura, K. Otani & J. Hashimoto
AIST, Koriyama, Japan

5DV.3.25 **Determination of Degradation Rates for PV Modules and PV Generators Applying Various Methods**
D. Stellbogen & P. Lechner
ZSW, Stuttgart, Germany

5DV.3.27 **Indoor and Outdoor Soiling Experiments: Comparison of Different Glass Coatings**
K. Ilse, L. Schönleber, M.Z. Khan, V. Naumann & C. Hagendorf
Fraunhofer CSP, Halle, Germany
J. Rabanal-Arabach
ISC Konstanz, Germany
J. Bagdahn
Anhalt University of Applied Sciences, Köthen, Germany

5DV.3.28 **Soiling Effect on PV Modules Performance in Arid Environment**
F.G. Alzubi & A.T. Alasfour
KISR, Safat, Kuwait

5DV.3.31 **Advanced Method for Determining Soiling Losses on PV Modules in Desert Climate**
D. Daßler, S. Malik, J. Fröbel & M. Ebert
Fraunhofer CSP, Halle (Saale), Germany
A. Benazzouz, Z. Naimi & B. Ikken
IRESEN, Rabat, Morocco

5DV.3.32 **Advanced Coating for Solar Cell Module Protection**
G.K. Zhavnerko, V.Y. Shiripov, E.A. Khokhlov & V.A. Savich
Izovac Technologies, Minsk, Belarus
O.V. Sergeev
NEXT ENERGY, Oldenburg, Germany

5DV.3.34 **Energy Yield Losses due to Soiling and Assessment of Different Cleaning Strategies for PV Modules Installed in a Semi-Arid Area in South Africa**
M.B. Øgaard, J.H. Krogh Selj, J.A. Tsanakas, E.S. Marstein & S.E. Foss
Institute for Energy Technology, Kjeller, Norway

5DV.3.35 **Investigation of Soiling Impact on Photovoltaic Modules Performance Installed in Rabat- Morocco**
D. Dahlioui, B. Laarabi, A. Sebbar & A. Barhdadi
University Mohammed V, Rabat, Morocco
J. Boardman, E. Menard & G. Dambrine
HeliosLite, Le Bourget du Lac, France

5DV.3.36 **Sol-Gel Based Antireflecting Coatings with Tunable Wettability for Solar Glass Covers**
D. Adak, R. Bhattacharyya, S. Ghosh, H. Saha & A. Mondal
IIEST Shibpur, Howrah, India
P. Chakraborty
IIT Kharagpur, India

5DV.3.37 **Classification of Photovoltaic Defectives through Type of Characterizing Methods and Faults Discriminations**
G. Vannier, V. Soulima, A. Grobon, F. Al Shakarchi & H. Colin
CEA, Le Bourget du Lac, France

5DV.3.38 **Investigating Hotspots Performance of PV Module Using Halved Multi-Crystalline Silicon Cells**
J. Jiang, J. Ni, D. Rong, Y. Li, G. Li, Y. He, C. Ma, J. Shi & D. Song
Yingli Green Energy, Baoding, China

5DV.3.39 **Energy Performance Improvement and Thermal Operation of Crystalline Silicon Photovoltaic Modules Designed with Innovative Packaging Components**
G. Makrides & G.E. Georghiou
University of Cyprus, Nicosia, Cyprus
J. Bratcher & J. Pratt
Honeywell, Morris Plains, United States

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5DV.3.40 **The New Method of the Silicon Photovoltaic Panels Fault Detection Using Impedance Spectroscopy**
J.K. Symonowicz, N. Riedel, S. Thorsteinsson & P.B. Poulsen
Technical University of Denmark, Roskilde, Denmark

5DV.3.43 **Inverter Testing and Evaluation - Brazilian Standards Application and Compliance**
J.C. de Souza Almeida Neto, R. Zilles & A.R. Mocelin
University of São Paulo, Brazil
J. Tavares Pinho
University of São Paulo, Belém, Brazil

5DV.3.44 **Long-Term Performance of PV Micro-Inverters**
S. Krauter & J. Bendfeld
University of Paderborn, Germany

5DV.3.45 **Development of a Controller-Hardware-in-the-Loop (CHIL) Toolbox Applied for Pre-Certification Services for Grid-Connected PV Inverters According to the State-of-the-Art BDEW RL Guideline and FGW TR3 Standard**
G. Lauss, F. Leimgruber, Z. Miletic & R. Bründlinger
AIT, Vienna, Austria
D. Majstorovic, N. Fischer Celanovic, I. Morar & D. Medjo
Typhoon HIL, Novi Sad, Serbia

5DV.3.46 **DLMS Smart Meter Reading Application for PV-Micro-Grids**
M. Ait Benali & A. Outzourhit
Cadi Ayyad University, Marrakech, Morocco

5DV.3.50 **Introduction of an Advanced Method for Testing of Battery Charge Controllers for Off-Grid PV Systems**
A. Khatibi, J. Bendfeld, W. Bermpohl & S. Krauter
University of Paderborn, Germany

5DV.3.51 **Testing and Analysis of Battery Charge Controllers for Off-Grid PV Systems**
A. Khatibi, J. Bendfeld, W. Bermpohl & S. Krauter
University of Paderborn, Germany

5DV.3.53 **Photovoltaic System Test Platform with Integrated Battery Energy Storage Emulator**
S.V. Spataru, D. Sera & D. Stroe
Aalborg University, Denmark

5DV.3.54 **DC-Coupled Buck-Boost Battery Charge Controller for Utility Scale Photovoltaic Plants**
P. Burski & R. Merz
University of Applied Sciences Karlsruhe, Germany

5DV.3.56 **A Scalable Wireless System for Monitoring of PV Modules on a Substring Level**
M. Jankovec, D. Morelj, G. Matic, K. Brecl, M. Bokalic & M. Topic
University of Ljubljana, Slovenia

5DV.3.57 **Approach to Determine the Impact of Cosmic Rays on PV Systems**
M. Halwachs & M. Schwark
AIT, Vienna, Austria

5DV.3.62 **Pursuing a Product Stewardship Approach to Energy Storage in the PV Sector in Australia**
L. Chaplin
Australian Battery Recycling Initiative, Melbourne, Australia
N. Florin & E. Dominish
University of Technology, Sydney, Australia

5DV.3.63 **Evaluation of EoL Treatment Strategies from a Holistic and Long-Term Perspective Considering the Shift towards More Circular Economies: A Case Study for Photovoltaic (PV) Panels**
E. Bracquené, J. Peeters, W. Dewulf & J. Duflou
KU Leuven, Belgium

5DV.3.64 **Implementation of a Circular Economy Based on Recycled, Reused and Recovered Indium, Silicon and Silver Materials for Photovoltaic and Other Applications**
W. Palitzsch
Loser Chemie, Zwickau, Germany

5DV.3.65 **Building a Dynamic Photovoltaic Waste Management Model: Current Results and Future Potentials**
A. Han & S. Rotter
Berlin University of Technology, Germany
A. Castillo
Imperial College London, United Kingdom

5DV.3.66 **Eco-Solar Factory: Establishment of Pan Industrial Material Re-Use Opportunities**
K. Wambach & I. Fechner
bifa Environmental Institute, Augsburg, Germany
M.P. Bellmann
SINTEF, Trondheim, Norway
G.S. Park
NorSun, Oslo, Norway
J. Denafas
Soli Tek R&D, Vilnius, Lithuania
F. Buchholz
ISC Konstanz, Germany
R. Einhaus
Apollon Solar, Lyon, France
G. Noja
Garbo, Cerano, Italy
B. Ehlen
Boukje.com Consulting, Bleiswijk, Germany
R. Roligheten
Steuler Solar Technology, Porsgrunn, Norway
P. Romero
AIMEN, Porrino, Spain
A. Bollar
INGESEA, Elgoibar, Spain

5DV.3.67 **Comminution and Separation of End-of-Life Photovoltaic Materials**
P. Bogust & Y.R. Smith
University of Utah, Salt Lake City, United States

5DV.3.68 **Sustainable Recycling of Wafer-Silicon Solar Modules**
M. Tao, W.-H. Huang & J. Schichtel
Arizona State University, Tempe, United States

5DV.3.69 **A Study on the Morphology of Silver Particles Electrochemically Recovered from c-Si Solar Cell with Variation of Current Density**
J.-K. Lee, J.-S. Lee, Y.-S. Ahn & G.-H. Kang
KIER, Daejeon, Korea South

5DV.3.70 **Circular Economy - with PV Recycling**
W. Palitzsch & U. Loser
Loser Chemie, Zwickau, Germany

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5DV.3.71 **Remelting and Production of PV-Wafers Using Purified Si-Kerf**
M. Syvertsen & A. Nordmark
SINTEF, Trondheim, Norway
T. Halvorsen
Resitec, Kristiansand, Norway
T. Kaden
Fraunhofer THM, Freiberg, Germany
A. Ulyashin
SINTEF, Oslo, Norway

5DV.3.72 **Electrodynamic Fragmentation (EDF) for Photovoltaic Module Recycling: A Feasibility Study**
F. Lenzmann, A. van Zomeren, I. Velzeboer & P. Blokker
ECN, Petten, Netherlands
D. Hoellen
University of Leoben, Austria
S. Seifert
Fraunhofer IBP, Valley, Germany

5DV.3.73 **Laboratory Scale Optimization of the Different Layers Separation of a Photovoltaic Panel by Supercritical CO2 Treatment**
M. Chaillou, J. Ducamp & C. Sanvoisin
Innoveox, Paris, France
C. Slostowski & C. Aymonier
CNRS, Pessac, France

5DV.3.75 **Assess the Possibility to Recycle Heavy Metals from E Scrap Using Solar Energy**
B. Bhardwaj & N. Bhardwaj
Maclec Technical Project Laboratory, New Delhi, India

5DV.3.77 **Ecodesign of an Innovative Building Integrated Photovoltaic System: The PHOSTER Project**
R. Turconi, A.-L. Hettinger & R. Vignal
Arcelor Mittal, Maizières-lès-Metz, France
L. Samain & L. Fourdrinier
CRM Group, Liège, Belgium

5DV.3.78 **A Comparative Life Cycle Assessment of CIGS/Si, CZTS/Si and AZTS/Si Tandem Solar Cells**
M.M. Lunardi, R.P. Corkish, S. Moore, J.P. Alvarez-Gaitan, C. Yan & X. Hao
UNSW Australia, Sydney, Australia

5DV.3.79 **An Assessment of a Photovoltaic System in Tehran (Iran): Life-Cycle Approach**
A. Bakhtiari, S. Eslami & H. Akhbari
Shahid Beheshti University, Tehran, Iran
I. Kazemi
Islamic Azad University, Damavand, Iran

5DV.3.81 **Physical Delamination of PV-Modules in Less Than One Second**
M. Heuschkel & H. Gross
FLAXRES, Dresden, Germany