EU PVSEC 2015

31st European Photovoltaic Solar Energy Conference and Exhibition

The Innovation Platform for the global PV Solar Sector

Conference Programme
Exhibition Catalogue

CCH - Congress Center Hamburg
Hamburg, Germany

Conference 14 - 18 September 2015
Exhibition 15 - 17 September 2015

www.photovoltaic-conference.com
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INSTITUTIONAL SUPPORT

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WCRE – World Council for Renewable Energy

COORDINATION OF THE TECHNICAL PROGRAMME

JOINT RESEARCH CENTRE

INSTITUTIONAL PV INDUSTRY COOPERATION

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SolarPower Europe

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The content represents the status as of 25 August 2015.

CHAIRMAN'S MESSAGE

Dear Member of the Global PV Community,

It is my great pleasure to welcome you in Hamburg, Germany, to the 31th EU PVSEC. The EU PVSEC 2015 will be again the platform for global Photovoltaic (PV) industry and international R & D specialists to discuss the latest developments and innovations. I am happy to chair the 31th EU PVSEC 2015 where the Conference programme of the highest scientific calibre was prepared by EU PVSEC's International Scientific Committee, made up of more than 200 leading experts from the global PV community, under the guidance of the EU PVSEC Technical Programme Chairman, Dr. Nigel Taylor, European Commission, Joint Research Centre.

There will be 1,300 keynote, plenary, oral and visual presentations, with 40% of these presentations being contributed by international specialists from outside Europe. The comprehensive conference programme will provide a full range of PV knowledge and technologies and promises a week of excellence. With these presentations and oral sessions, EU PVSEC 2015 underlines its worldwide importance and once again sets the benchmark for this year's global PV events. It offers you the opportunity to join the world's top-ranking scientists, engineers and industry leaders to present and discuss future PV technologies and applications. The exhibition will again be the showroom of the international PV community and for you the occasion to network and check out products, equipment and new materials.

According to Energy Trend's gold member data research, global PV installations will reach 52 GW in 2015, of which China, Japan and the US account for about 63%. Based on Energy Trend's statistics, global PV installations surpassed 12 GW in the first quarter of 2015 and the full-year goal can be achieved.

In Europe the good news is that we've now already passed the 88 GW the Member States originally committed to do by 2020. So the question is: how much more can we bring into the system, looking not just at 2020 but beyond to 2030? We need to take PV to the next level in terms of cost-effective, integrated electricity supply solutions. Evolutionary improvement in cell concepts like PERC (PERL/PERT), bifacial devices, n-type material, IBC and heterojunction cells as

well as high efficiency thin films like CIGS will drive the future of solar systems further. Europe has cutting-edge R&D and we can leverage this with industry to achieve a significant future market share in PV products.

At the same time we can't hide our concern regarding Europe's future market share in PV products. In photovoltaic research and development Europe has still a leading role. In the industrial implementation Europe must take action to achieve this position again.

Here the timing of the 31th EU PVSEC coincides with a year where the European Commission plans new growth initiatives in key energy technologies. Innovation will always be at the heart of efficient and competitive manufacturing. I hope we all can provide ideas and solutions on this, as well on the whole range of factors that determine PV's future share of the energy supply system.

I welcome you in Hamburg!

Dr.-Ing. Stefan Rinck
Conference General Chairman
CEO SINGULUS TECHNOLOGIES,
Member of Main Executive Board VDMA and
Chairman Committee for Research and Innovation

MESSAGE FROM THE TECHNICAL PROGRAMME CHAIR

A very warm welcome to EUPVSEC 2015! Again this year we've had a great response from the PV research community, with well over 1300 abstracts, involving 6000 authors and co-authors from 87 countries. Thanks to you all, and also to my colleagues in the Scientific Committee who have dedicated considerable time and effort as paper reviewers and as topic organisers to arrive at a really stimulating programme for the week.

It goes without saying that photovoltaic solar energy is a critical technology sector for realising a clean and sustainable energy system in the future. Globally the sector continues its impressive development: over 50 GW of annual installations, a steady flow of device efficiency improvements, GW-scale manufacturing facilities, 25 year+ performance guarantees and systems that already covering over 10% of annual electricity demand in some countries.

However all of us working in the field are aware that there are big challenges, ranging from the physics and materials science needed for the next generation of innovative devices, to creating and improving cost efficient manufacturing process, to optimising system reliability and performance, to interfacing with complementary technologies (in particular storage) and to the overall energy market design.

The common factor is that tomorrow's solutions will be based on today's research, and this is where EUPVSEC comes in. The conference programme aims to address exactly these challenges, with a format targeting both scientific specialists as well as the broader community. Together I sincerely hope we can send a clear message to the UN Climate Change COP-21 meeting being to be held in Paris, December 2015, that PV is delivering and on track to exploit its potential for communities across the planet.

Dr. Nigel Taylor
EU PVSEC Technical Programme Chair
European Commission Joint Research Centre

CONFERENCE PROGRAMME

Plenary, Oral and Visual Sessions

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, 14 September 2015

CONFERENCE OPENING

08:00 - 08:30 Welcome Coffee

08:30 - 10:00 Scientific Opening

PLENARY SESSION 1AP.1

08:30 - 10:00 The Only Way Is Up !

Chairpersons:

Jozef (Jef) Poortmans
imec, Belgium

Antonio Martí Vega
UPM, Spain

1AP.1.1 Keynote Presentation: Future Generation Solar Photon Conversion to Photovoltaics and Solar Fuels Based on Nanoscience and Size Quantization
A.J. Nozik
NREL, Golden, USA

1AP.1.2 Keynote presentation: Improvements in Sunlight to Electricity Conversion Efficiency: above 40% for Direct Sunlight with over 30% Targeted for Global
M.A. Green & M.J. Keevers
UNSW, Sydney, Australia

1AP.1.3 Keynote presentation: Towards Ultra-High Efficient Photovoltaics with Perovskite/crystalline Silicon Tandem Devices
C. Ballif, J. Werner, P. Löper, A. Walter, C.-H. Weng, M. Morales Masis, S. De Wolf & B. Niesen
EPFL, Neuchâtel, Switzerland
M. Filipic & M. Topic
University of Ljubljana, Slovenia
S.-J. Moon, J.-H. Yum, S. Nicolay & J. Bailat
CSEM, Neuchâtel, Switzerland
R. Peibst & R. Brendel
ISFH, Emmerthal, Germany

10:00 - 11:00 Opening Addresses/ Political Opening

- Stefan Rinck, Conference General Chairman, CEO SINGULUS TECHNOLOGIES, Member of Main Executive Board VDMA and Chairman Committee for Research and Innovation
- Andreea Strachinescu, European Commission DG Energy, New Energy technologies, innovation and clean coal
- Harry Lehmann, General Director Division I, German Federal Environment Agency (UBA)
- Eicke Weber, Director, Fraunhofer ISE, Germany

11:00 Moderated Opening Panel

Topic:

- Europe's role to take PV to the next level – Focusing on cost effective integrated supply solutions

Moderator

- Paolo Frankl, IEA International Energy Agency, Head of the Renewable Energy Division, France

Panelists:

- Giovanni De Santi, Director, European Commission, Joint Research Centre, Institute for Energy and Transport
- Carsten Agert, Managing Director – EWE Research Centre Next Energy, Germany
- Pierre Bernard, CEO and Chairman of the Board, Friends of the Supergrid, Belgium
- Milan Nitzschke, Solarworld, Germany

12:10 Becquerel Prize Ceremony

For the latest programme details please check www.photovoltaic-conference.com or your Personal Programme Planner www.eupvsec-planner.com.

Conference Programme
MONDAY, 14 SEPTEMBER 2015

PROGRAMME

ORAL PRESENTATIONS 1AO.1

13:30 - 15:00 From Fundamentals to Performance

Chairpersons:

John Van Roosmalen
ECN, Netherlands

invited

1AO.1.1 Special Introductory Presentation: Perovskite Based PV Modules for Stand-Alone and Mechanically Stacked Applications
T. Aernouts, R. Gehlhaar & D. Cheyns
imec, Leuven, Belgium

1AO.1.2 Injection Kinetics and Electronic Structure at the N719/TiO2 Interface Studied by Means of Ultrafast XUV Photoemission Spectroscopy
M. Borgwardt, M. Wilke, K.M. Lange,
I.Y. Kiyan & E.F. Aziz
HZB, Berlin, Germany
T. Kampen & S. Mähl
SPECS, Berlin, Germany
W. Xiang & L. Spiccia
Monash University, Clayton, Australia

1AO.1.3 Towards 10% Solar-to-Hydrogen Efficiencies Using Earth-Abundant Materials
P. Perez Rodriguez, I. Digdaya, L. Han, H. Tan,
R. Vasudevan, W. Smith, M. Zeman & A.H.M. Smets
Delft University of Technology, Netherlands

1AO.1.4 Pathways Towards Advanced PID Resistance of 1500V
S.C. Pop & R. Schulze
Yingli Green Energy Americas, San Francisco,
United States
X. Wang, H. Wang & B. Yuan
Yingli Green Energy, Baoding, China
D. Inns, A. Meisel & H. Antoniadis
DuPont, Sunnyvale, United States

1AO.1.5 Assessment of the Inter-Annual Variability of the Global Horizontal Irradiance in the Atacama Desert of Chile
J. Baudry & P. Darez
Mainstream Renewable Power, Santiago de Chile, Chile
C. Darr
350 renewables, Santiago de Chile, Chile

ORAL PRESENTATIONS 3AO.4

13:30 - 15:00 Industrial Processes

Chairpersons:

Roland Scheer
Martin Luther University, Germany

Ayodhya Nath
EMPA, Switzerland

3AO.4.1 Influence of the Alkali Post-Deposition Treatment on Optical and Electrical Properties of CIGS Solar Cells
O. Kiowski, P. Jackson, A. Bauer, T. Magorian-Friedlmeier,
R. Würz, R. Menner & M. Powalla
ZSW, Stuttgart, Germany

3AO.4.2 Up-Scaling of Production Process for Producing Flexible CZTS Photovoltaic Modules
G. Peharz & V. Satzinger
JOANNEUM RESEARCH, Weiz, Austria
A. Neisser & C. Waldauf
Crystalsol, Vienna, Austria
R. Hüttenbrenner & A. Grader
Forster FF, Waidhofen, Austria
S. Edinger & T. Dimopoulos
AIT, Vienna, Austria
E.J. List-Kratochvil
Graz University of Technology, Austria
S. Sax
NanoTecCenter, Weiz, Austria
G. Oreski & S. Pötz
PCCL, Leoben, Austria

3AO.4.3 Absorber Optimization for Thin Film Solar Modules Beyond 17% Efficiency
R. Verma, R. Lechner, T. Dalibor, M. Fürfanger,
P. Eraerds & J. Palm
AVANCIS, Munich, Germany

3AO.4.4 Printing Cu(in,Ga)(Se,S)2 Thin Film Solar Cell on Stainless Steel Foils with 13.98% Mini-Module Efficiency
C.-M. Chang, C.-C. Chiang, S.-W. Chan, C.-C. Li, W.-S. Lin,
L.-P. Wang & S.Y. Tsai
ITRI, Hsinchu, Taiwan
Y.-F. Chen
ITRI, Chutung, Taiwan

3AO.4.5 Non-Vacuum Solution Processed High Efficiency CIGS PV Devices
S. Whitelegg, P. Kirkham, C. Allen, S. Stubbs, Z. Liu, O. Masala & C. Newman
Nanoco Technologies, Manchester, United Kingdom

3AO.4.6 All Sputtered Flexible CIGS Cells at High Speed
E. Niemi, J. Sterner, P. Carlsson, J. Oliv, E. Jaremalm & S. Lindström
Midsummer, Järfälla, Sweden

ORAL PRESENTATIONS 5AO.7

13:30 - 15:00 Meteorology

Chairpersons:

Thomas Huld
European Commission DG JRC, Italy

Stathis Tselepis
CRES, Greece

5AO.7.1 Modelling and Simulation of PV Power Fluctuations of Large PV Plants from one Single Irradiance Sensor
J. Marcos, I. de la Parra, M. Muñoz & L. Marroyo
Public University of Navarre (UPNa), Pamplona, Spain

5AO.7.2 PV Energy Yield Nowcasting Combining Sky Imaging with Simulation Models
D.G. Anagnostos
NTUA, Piraeus, Greece
T. Schmidt & J. Kalisch
University of Oldenburg, Germany
H. Goverde & F. Catthoor
imec, Leuven, Belgium
D. Soudris
NTUA, Athens, Greece

5AO.7.3 Model Requirements for Accurate Short Term Energy Yield Predictions during Fast-Varying Weather Conditions
H. Goverde, J. Govaerts, F. Catthoor & J. Poortmans
imec, Leuven, Belgium
D. Anagnostos
NTUA, Piraeus, Greece
B. Herteleer
KU Leuven, Gent, Belgium
K. Baert & J. Driesen
KU Leuven, Heverlee, Belgium

5AO.7.4 Simulating Dispersed Photovoltaic Power Generation Using a Bimodal Mixture Model of the Clear-Sky Index
J. Munkhammar, J. Rydén, J. Widén & D. Lingfors
Uppsala University, Sweden

5AO.7.5 Recognition of Shading Events Caused by Moving Clouds and Determination of Shadow Velocity from Solar Radiation Measurements
K. Lappalainen & S. Valkealahti
Tampere University of Technology, Finland

5AO.7.6 Short-Term Clearness Index Forecasting Based on a Network of PV Systems
B. Elsinga & W.G.J.H.M. van Sark
Utrecht University, Netherlands

VISUAL PRESENTATIONS 2AV.1

13:30 - 15:00 Silicon Feedstock, Crystallisation and Wafering

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

VISUAL PRESENTATIONS 6AV.4

13:30 - 15:00 PV Supporting Electrical and Thermal Energy Systems

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

NOTES

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ORAL PRESENTATIONS 1AO.2

15:15 - 16:45 Advanced Characterisation of PV Materials

Chairpersons:

Nicholas J. Ekins-Daukes
Imperial College London, United Kingdom

Bernd Rech
HZB, Germany

1AO.2.1 Special Introductory Presentation: EMIL: the Energy Materials in-Situ Laboratory Berlin – a Novel Characterization Facility for Photovoltaic and Energy Materials
K. Lips, T.F. Schultze, D.E. Starr, M. Bär, R.G. Wilks, F. Fenske, F. Ruske, M. Reiche, R. van de Krol, S. Raoux, G. Reichardt, F. Schäfers, S. Hendel, R. Follath, J. Bahrdt, M. Hävecker & B. Rech
HZB, Berlin, Germany
S. Peredkov
MPI CEC, Mülheim, Germany
S. DeBeer
MPI CEC, Mühlheim, Germany
A. Knop-Gericke & R. Schlögl
FHI, Berlin, Germany

1AO.2.2 Probing Carrier Transport by Surface Excitation of GaNAs/GaAs Quantum Structure Embedded Solar Cells with Zero Valance Band Offset
M. Elborg, T. Noda & Y. Sakuma
NIMS, Tsukuba, Japan

1AO.2.3 Fast Current Mapping of Photovoltaic Devices Using Compressive Sampling
G. Koutsourakis, X. Wu, M. Bliss, T.R. Betts & R. Gottschalg
Loughborough University, United Kingdom
M. Cashmore & S.R. Hall
National Physics Laboratory, London, United Kingdom

1AO.2.4 Two-Dimensional Carrier Distribution in Phosphorus Implanted Emitter Observed by Scanning Capacitance Microscopy
K. Tanahashi, M. Moriya, Y. Kida, N. Suzuki, T. Fukuda, K. Shirasawa & H. Takato
AIST, Koriyama, Japan

1AO.2.5 Photoluminescence Measurement System for Thin Film Modules
R. Ebner, B. Kubicek, G. Újvári & M. Halwachs
AIT, Vienna, Austria

ORAL PRESENTATIONS 3AO.5

15:15 - 16:45 Performance and Quality Control

Chairpersons:

Iver Lauermann
HZB, Germany

Alessandro Romeo
University of Verona, Italy

3AO.5.1 Optimization of GGI Profiles Based on Models for World Record CIGSe Cells
A. Bauer & P. Jackson
ZSW, Stuttgart, Germany

3AO.5.2 On the Interpretation of Admittance and IV(T) Measurements of CIGS Thin Film Solar Cells
T. Ott & T. Walter
Ulm University of Applied Sciences, Germany
R. Schäffler
Manz CIGS Technology, Schwäbisch Hall, Germany

3AO.5.3 Low-Irradiance Performance of Cu(In,Ga)Se2 Thin Film Solar Cells
F. Pianezzi, B. Bissig, S. Nishiwaki, P. Reinhard, S. Buecheler & A.N. Tiwari
EMPA, Dübendorf, Switzerland

3AO.5.4 10.1% Efficiency Cu2ZnSnSe4 Solar Cells through a Novel Absorber Engineering with Ge Optimizing the Open Circuit Voltage
S. Giraldo, M. Neuschitzer, S. López-Marino, Y. Sánchez, M. Colina, M. Placidi, P. Pistor, V. Izquierdo-Roca, A. Perez-Rodriguez & E. Saucedo
IREC, Barcelona, Spain

3AO.5.5 Towards Quality Control for Photovoltaic Thin Films: Time-Resolved Photoluminescence in Experiment and Simulation
M. Maiberg, C. Spindler, T. Hölscher, E. Jarzembowski, S. Hartnauer & R. Scheer
Martin Luther University, Halle, Germany

3AO.5.6 On the Performance Stability of CdTe Solar Cells
C. Gretener, L. Kranz, J. Perrenoud, S. Buecheler & A.N. Tiwari
EMPA, Dübendorf, Switzerland

ORAL PRESENTATIONS 5AO.8

15:15 - 16:45 Operational Experience and Economics

Chairpersons:

Andreas Wade
First Solar, Germany

Claas Helmke
Management Consultancy Research, Germany

5AO.8.1 Monitoring 30,000 PV Systems in Europe: Performance, Faults, and State of the Art
J. Leloux, R. Moreton Villagrá & L. Narvarte
UPM, Madrid, Spain
J. Taylor
University of Sheffield, United Kingdom
D. Trebosc
BDPV, Toulouse, France
A. Desportes
RTone, Lyon, France

5AO.8.2 Survey of Operation and Maintenance Costs of PV Plants in Switzerland
F.P. Baumgartner, O. Maier, D. Schär & D. Sanchez
ZHAW, Winterthur, Switzerland
P. Toggweiler
Basler & Hofmann, Zurich, Switzerland

5AO.8.3 Operational Performance of Grid-Connected PV Systems in European Countries
P. Moraitis, B.B. Kausika & W.G.J.H.M. van Sark
Utrecht University, Netherlands

5AO.8.4 Yield Modelling for Micro Inverter, Power Optimizer and String Inverter PV Systems under Clear and Partially Shaded Conditions
K. Sinapis, C. Tzikas, G.B.M.A. Litjens,
M.N. van den Donker & W. Folkerts
SEAC, Eindhoven, Netherlands

5AO.8.5 Experience and Outlook on Operational Costs for Small to Medium PV Plants in Switzerland from a Point of View of an Independent Power Producer
T. Vontobel, T. Nordmann & R. Lingel
TNC Consulting, Feldmeilen, Switzerland

5AO.8.6 Assessment of PV System Performance with Incomplete Monitoring Data
E. Koumpli, D. Palmer, P. Rowley, T.R. Betts & R. Gottschalg
Loughborough University, United Kingdom

VISUAL PRESENTATIONS 2AV.2

15:15 - 16:45 Silicon Solar Cell Improvements

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

VISUAL PRESENTATIONS 6AV.5

15:15 - 16:45 Integrating Photovoltaics in our Living Environment: New Solutions from Optimization to Application / PV Applications without a Centralised Grid

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

ORAL PRESENTATIONS 1AO.3

17:00 - 18:30 Nanostructures

Chairpersons:

invited

Igor Konovalov
University of Applied Sciences Jena, Germany

1AO.3.1 Quantum Wire-on-Well (WoW) Cell with Long Carrier Lifetime for Efficient Carrier Transport
H. Fujii, T. Kato, K. Toprasertpong, H. Sodabanlu,
K. Watanabe, M. Sugiyama & Y. Nakano
University of Tokyo, Japan
D. Alonso-Álvarez, M. Yoshida, N. Hylton &
N. Ekins-Daukes
Imperial College London, United Kingdom

1AO.3.2 Type-II Hybrid InAs QD/GaAsSb QW Solar Cells with GaAs Interlayer
S. Hatch, D. Kim, P. Jurczak, J. Wu & H. Liu
University College London, United Kingdom
K. Sablon
U.S. Army Research Laboratory, Adelphi, United States

1AO.3.3 Influence of the Host Pin Diode Material in Multi-Quantum Well Solar Cells
A. Delamarre & J.F. Guillemoles
CNRS, Chatou, France
Y. Wang, Y. Nakano & M. Sugiyama
University of Tokyo, Japan

1AO.3.4 An InP Nanowire Solar Cell with 19.6%-Efficiency
Y. Cui, R.P.J. van Veldhoven, M.A. Verheijen, E.P.A.M. Bakkers & J.E.M. Haverkort
Eindhoven University of Technology, Netherlands

1AO.3.5 Embedding GaAs NW Forest in PDMS for Solar Cell Applications
D. Mikulik, F. Matteini, J. Vukajlovic Plestina, G. Tutuncuoglu, H. Potts, E. Alarcon Llado & A. Fontcuberta i Morral
EPFL, Lausanne, Switzerland

1AO.3.6 Efficient Application of a Silicon Nanocrystal Down-converter to a c-Si Solar Cell
S.L. Luxembourg, A.R. Burgers & A.W. Weeber
ECN, Petten, Netherlands
R. Limpens & T. Gregorkiewicz
University of Amsterdam, Netherlands

ORAL PRESENTATIONS 3AO.6

17:00 - 18:30 Alkali Treatment

Chairpersons:

Yukiko Kamikawa-Shimizu
AIST, Japan

Wolfram Witte
ZSW, Germany

3AO.6.1 Special Introductory Presentation: Review on the Role of Alkali Elements in CIGS Thin Film Solar Cells
S. Bücheler
EMPA, Dübendorf, Switzerland

3AO.6.2 The Influence of Alkali Post-Deposition Treatments on the Electronic Surface Structure of Cu(in,Ga)Se2 Absorbers
E. Handick, J.-H. Alsmeier, L. Köhler, S. Krause, M. Gorgoi, R.G. Wilks & M. Bär
HZB, Berlin, Germany

P. Reinhard, F. Pianezzi, S. Buecheler & A.N. Tiwari
EMPA, Dübendorf, Switzerland
E. Ikenaga
SPring-8, Hyogo, Japan
N. Koch
HU Berlin, Germany

3AO.6.3 On the Role of Sodium in the Morphology and Device Properties of Inkjet-Printed Cu2ZnSn(S,Se)4 Absorbers
X. Lin, A. Ennaoui, J. Kavalakkatt, R. Klenk & M.C. Lux-Steiner
HZB, Berlin, Germany

3AO.6.4 Effect of Na-Presence during CuInSe2 Growth on Stacking Fault Density and Electronic Properties
H. Stange
Technical University of Berlin, Germany
S. Brunken, H. Hempel, H. Rodríguez-Alvarez, N. Schäfer, D. Greiner, A. Scheu, J. Lauche, C.A. Kaufmann, T. Unold, D. Abou-Ras & R. Mainz
HZB, Berlin, Germany

3AO.6.5 On the Role of Vapour Phase Alkali Species for Efficient Cu(In,Ga)Se2 Solar Cells
U. Berner, D. Colombara, T. Bertram, J.C. Malaquias, H. Meadows & P.J. Dale
University of Luxembourg, Belvaux, Luxembourg
N. Valle
CRP Lippmann, Belvaux, Luxembourg

ORAL PRESENTATIONS 5AO.9

17:00 - 18:30 Maximising Power Output

Chairpersons:

Giorgio Graditi
ENEA, Italy

Roland Bründlinger
AIT, Austria

5AO.9.1 Prediction of Harvesting Effects of DMPPT System in a Mismatched PV String
D.H. Kim, J. Kim, K. Cho & D.H. Yeom
RTS Energy, Seoul, Korea South

5AO.9.2 **Appearance of a Drift Problem in Variable-Step Perturbative MPPT Algorithms**
J. Kivimäki & T. Suntio
Tampere University of Technology, Finland

5AO.9.3 **Direct Determination of Maximum Power Point and Its Application to Variable Step-Size MPPT**
N. Voyer & N. Chapalain
Mitsubishi Electric, Rennes, France
Y. Hiroshi & N. Shuichi
Mitsubishi Electric, Amagasaki, Japan

5AO.9.4 **An Efficient MPPT Algorithm for Partially Shaded PV Strings**
E. Batzelis & S. Papathanassiou
NTUA, Athens, Greece

5AO.9.5 **Micro-Inverters: Comparison of Costs, Performance and Yield**
S. Krauter & J. Bendfeld
University of Paderborn, Germany

5AO.9.6 **Side-by-Side Test of Tigo Power Optimizers in Catania Lab to Evaluate their Benefits on a Thin Film PV Plant**
A.G.F. Di Stefano, G. Leotta, P.M. Pugliatti,
F. Aleo & F. Bizzarri
ENEL, Catania, Italy
C. Carraro & F. Siri
Tigo Energy, Genoa, Italy

VISUAL PRESENTATIONS 2AV.3

17:00 - 18:30 Silicon Solar Cell Improvements

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

VISUAL PRESENTATIONS 5AV.6

17:00 - 18:30 PV Modules

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

TUESDAY, 15 September 2015

ORAL PRESENTATIONS 2BO.1

08:30 - 10:00 Silicon Feedstock and Direct Wafers

Chairpersons:

Donald Wood
Hemlock Semiconductor, United States

Kai Petter
Hanwha Q Cells, Germany

2BO.1.1 **Increasing the Capacity of a Granular Fluid Bed Reactor to Reduce Polysilicon Production Costs**
C. Fero, J. Gum & K. Papp
GT Advanced Technologies, Missoula, United States

2BO.1.2 **Low Cost and High Quality Polysilicon Production by Upscaled Centrifuge CVD Reactor with Hot Harvest**
W.O. Filtvedt & H. Klette
Institute for Energy Technology, Kjeller, Norway
S. Sørensen & J. Filtvedt
Dynatec Engineering, Askim, Norway

2BO.1.3 **A Novel Silicon Crushing Method by High Voltage Pulses**
J. Käppeler, J. Kolly & M. Morach
Selfrag, Kerzers, Switzerland

2BO.1.4 **A Tool for In-Line Quantitative Chemical Analysis of Molten Metallurgical and Solar Grade Silicon**
L. Patatut, M. Serasset, M. Benmansour & D. Pelletier
CEA, Le Bourget du Lac, France

2BO.1.5 **n-Type and p-Type Si Foils Fabricated in a Quasi-Inline Epi Reactor with Bulk Lifetimes Exceeding 500 ?µs**
S. Janz, N. Milenkovic, M. Drießen & S. Reber
Fraunhofer ISE, Freiburg, Germany

2BO.1.6 **Crystallization in the SDS Process: Tests on Single Crystalline Silicon Wafers**
J.M. Pó, D.M. Pera, I. Costa, P.M. Sousa, K. Lobato,
J. Maia Alves, J.M. Serra & A.M. Vallêra
University of Lisbon, Portugal

ORAL PRESENTATIONS 3BO.5

08:30 - 10:00 Thin-Film Si Cells and Modules

Chairpersons:

Ivan Gordon
imec, Belgium

Carlos Molpeceres
UPM, Spain

3BO.5.1 Hydrogenated Amorphous Silicon: Nanostructure and Defects
J. Melskens, S.W.H. Eijt, H. Schut, E. Brück, M. Zeman & A. Smets
Delft University of Technology, Netherlands

3BO.5.2 High Efficiency High Rate Microcrystalline Silicon Thin Film Solar Cells
C. Strobel, S. Leszczynski, U. Merkel, D.D. Fischer, M. Albert & J.W. Bartha
Technical University of Dresden, Germany
J. Kuske
FAP, Dresden, Germany

3BO.5.3 Modification of the Buffer Layers on the Performance of Superstrate Hydrogenated Microcrystalline Silicon Solar Cells
L. Bai, B. Liu, J. Fang, Q. Huang, B. Li, D.K. Zhang, C. Wei, J. Sun, Y. Zhao & X. Zhang
Nankai University, Tianjin, China

3BO.5.4 Optimization of a-Si Top Cell in Triple Junction Structure Solar Cell
H. Zhao, X. Ru, X. Zhou, C. Hong, C. Lian, M. Du, J. Huang, J. Zhang, Y. Li & X. Xu
Hanergy Advanced Systems Group, Chengdu, China
H. Yan
Beijing University of Technology, China

3BO.5.5 Application of Thin-Film Silicon Solar Cells in 4-Terminal Hybrid Tandem Solar Modules
D. Zhang, M. Dörenkämper, W.J. Soppe & R.E.I. Schropp
ECN, Eindhoven, Netherlands
A. Lambertz & M. Meier
Forschungszentrum Jülich, Germany

3BO.5.6 FP7 Project Fast Track: Highlights and Achievements in the European Thin-Film Silicon Community
M. Meier, A. Gordijn, M. Ghosh & S. Michard
Forschungszentrum Jülich, Germany

F.-J. Haug, J.W. Schüttauf, M. Boccard, M. Stuckelberger, S. Hänni & E. Moulin
EPFL, Neuchâtel, Switzerland
W. Soppe
ECN, Eindhoven, Netherlands
J. Holovsky, N. Neykova, A. Poruba & M. Vanecek
ASCR, Prague, Czech Republic
A. Campa & M. Topic
University of Ljubljana, Slovenia
D.Y. Kim & R. van Swaaij
Delft University of Technology, Netherlands
C. Strobel
Technical University of Dresden, Freital, Germany
L.V. Mercaldo, I. Usatii & P. Delli Veneri
ENEA, Portici, Italy
P. Roca i Cabarrocas, E.-V. Johnson, P. Bulkin & S. Abolmasov
CNRS, Palaiseau, France
E. Hamers
HyET Solar, Arnhem, Netherlands
A. Battaglia
3Sun, Aci Castello, Italy
B. Tinkham
Solayer, Kesselsdorf, Germany
O. Steinke
FAP, Dresden, Germany
K. Du Mong
DSM Advanced Surfaces, Urmond, Netherlands
P. Evans & D. Sheel
University of Salford, United Kingdom
B. Wattenberg
Singulus Stangl Solar, Fürstenfeldbruck, Germany
R. van Erven
Morphotonics BV, Veldhoven, Netherlands
A. Molinari
Uniresearch, Delft, Netherlands

NOTES

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ORAL PRESENTATIONS 5BO.9

08:30 - 10:00 Improving System Integration

Chairpersons:

David Rosewater
Sandia National Laboratories, United States

Marion Perrin
CEA, France

5BO.9.1 Management of Voltage on LV Distribution Networks with Pre-Existing High Levels of Uncontrolled PV Systems & Inverters
E. Franklin & J. Singh
ANU, Canberra, Australia

5BO.9.2 Realistic Snowload Testing for Extreme Alpine Conditions
A. Bohren
HSR, Rapperswil, Switzerland
T. Friesen
SUPSI, Canobbio, Switzerland

5BO.9.3 Tool to Determine Economic Capacity Dimensioning in PV Battery Systems Considering Various Design Parameters
J. Moshövel, D. Magnor, D.U. Sauer & D.U. Sauer
RWTH Aachen University, Germany

5BO.9.4 New P/Q Control Functions of Grid-Connected PV Inverters: Do They Have an Impact on the Anti-Islanding Detection Behaviour in European Grids?
G. Lauss, R. Bründlinger, B. Bletterie & A. Zegers
AIT, Vienna, Austria

5BO.9.5 Characterization and Efficiency Test of a Li-Ion Energy Storage System for PV Systems
A. Makibar & L. Narvarte
UPM, Madrid, Spain

5BO.9.6 Application of MV/LV Transformers with OLTC for Increasing the PV Hosting Capacity of LV Grids
S. Hashemi & J. Østergaard
Technical University of Denmark, Lyngby, Denmark
W. Heckmann, D. Geibel & T. Degner
Fraunhofer IWES, Kassel, Germany

VISUAL PRESENTATIONS 5BV.1

08:30 - 10:00 Meteorology, Online Monitoring, IR Imaging

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

VISUAL PRESENTATIONS 3BV.5

08:30 - 10:00 Perovskites, Organic PV and Hybrid Devices

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

PLENARY SESSION 2BP.1

10:30 - 12:10 High Efficiency Silicon Technology

Chairpersons:

Giso Hahn
University of Konstanz, Germany

Francesca Ferrazza
Eni, Italy

2BP.1.1 Keynote Presentation: The Irresistible Charm of a Simple Current Flow Pattern – Approaching 25% with a Solar Cell Featuring a Full-Area Back Contact
S.W. Glunz, F. Feldmann, A. Richter, M. Bivour, C. Reichel, J. Benick & M. Hermle
Fraunhofer ISE, Freiburg, Germany

2BP.1.2 Breakdown of the Efficiency Gap to 29% Based on Experimental Input Data and Modelling
R. Brendel, T. Dullweber, R. Peibst, C. Kranz & A. Merkle
ISFH, Emmerthal, Germany
D. Walter
ANU, Canberra, Australia

2BP.1.3 3 Years of High Quality mc-Si PERC Production Experience – Approaches for Efficient Cell and Module Development
S. Engelhart, B. Klöter, P. Kowalzik, T. Rudolph, M. Hofmann, M. Heimann, C. Baer, A. Schwabedissen, H.-C. Ploigt, K. Beiner, I. Jarosch, S. Geissler, S. Krtschil, E. Stegemann, P. Engelhart, L. Brockob & K. Wachsmuth
Hanwha Q CELLS, Bitterfeld-Wolfen, Germany

2BP.1.4 Recent Progress of CEA-INES Heterojunction Solar Cell Pilot Line

A. Danel, C. Roux, K. Aumaille, A.-S. Ozanne,
M. Vandenbossche, F. Medlege, B. Novel, B. Commault,
P. Lefillastre, D. Heslinga & P.J. Ribeyron
CEA, Le Bourget du Lac, France
S. Harrison
CEA, Le Bourget du lac Cedex, France

ORAL PRESENTATIONS 2BO.2

13:30 - 15:00 Silicon Crystallisation

Chairpersons:

Anis Jouini
CEA, France

Christian Martin
Vesuvius, France

2BO.2.1 Development of Multicrystalline Silicon for 20 % Efficient n-Type Solar Cells

S. Riepe, P. Krenckel, J. Benick & F. Schindler
Fraunhofer ISE, Freiburg, Germany

2BO.2.2 The Influence of Melting Interface on the Performance of Seed-Assisted Multi-Crystalline Silicon in Directional Solidification

S. Qiao, L. Zhang, X. Niu, Q. Wang, M. Pan, Y. Zhang,
W. Gao, Z. Hu & J. Xiong
Yingli Green Energy, Baoding, China

2BO.2.3 Two Methods for High Performance Mc-Si Ingot Growth

Z. Zhang, Z. Xiong, H. Ye, S. Fu, Z. Feng & P.J. Verlinden
Trina Solar, Changzhou, China

2BO.2.4 Silicon Crystallization by Kyropoulos Process for Photovoltaic applications

L. Lhomond, A. Nouri, G. Chichignoud,
Y. Delannoy & K. Zaidat
SIMAP, Saint-Martin d'Hères, France
F. Lissalde
Cyberstar, Echirolles, France
M. Albaric
CEA, Le Bourget-du-Lac, France

2BO.2.5 Development of an Industrial Applicable Crucible Coating Based on High Pure Silzot Solar Si3N4-Powder

V. Schneider, C. Reimann & J. Friedrich
Fraunhofer IISB, Erlangen, Germany
M. Kuczynski, J. Sans & W. Gross
AlzChem, Trostberg, Germany

2BO.2.6 The Impact of Czochralski Silicon Crystals Grown from the Melt in „Liquinert" Quartz Cucible on Their Lifetime

T. Fukuda, N. Suzuki, M. Moriya, K. Tanahashi, S. Simayi,
K. Shirasawa & H. Takato
AIST, Koriyama, Japan
Y. Horioka
FTB Research Institute, Chiba, Japan

ORAL PRESENTATIONS 3BO.6

13:30 - 15:00 Thin Film for Silicon Heterojunction and Other Devices

Chairpersons:

Julio Cárabe
CIEMAT, Spain

Miro Zeman
Delft University of Technology, Netherlands

3BO.6.1 Kelvin Probe Force Microscopy Study of Electric Field Homogeneity in Epitaxial Silicon Solar Cells Cross-Section under Illumination and Voltage Bias

P. Narchi & P. Prod'homme
TOTAL, Paris, France
G. Picardi, R. Cariou, M. Foldyna & P. Roca i Cabarrocas
CNRS, Palaiseau, France

3BO.6.2 Structural Engineering for Optical and Electronic Properties of a-Si:H/c-Si

J. Mitchell
AIST, Koriyama, Japan

3BO.6.3 Density Determination and Gas Absorption Measurements in Ambient Nitrogen of Silicon Thin Films Deposited by Crucible-Free Electron Beam Evaporation

S. Saager, T. Mauersberger, C. Metzner & D. Temmler
Fraunhofer FEP, Dresden, Germany

3BO.6.4 Crystalline Silicon on Glass: Interface Passivation and Its Impact on the Absorber Material Quality

O. Gabriel, T. Frijnts, D. Amkreutz, S. Ring, S. Calnan,
B. Stannowski, B. Rech & R. Schlatmann
HZB, Berlin, Germany

3BO.6.5 Silicon Specification for High Efficiency HJT
D.L. Bätzner, R. Kramer, L. Andreetta, D. Lachenal, W. Frammelsberger, B. Legradic, J. Meixenberger, P. Papet, B. Strahm & G. Wahli
Meyer Burger, Hauterive, Switzerland

3BO.6.6 Feasibility Study on the Use of Gen5 Kai PECVD Reactors for Manufacturing of High-Efficiency Silicon Heterojunction Solar Cells
S. Abolmasov, A. Abramov, D. Andronikov, K. Emtsev, G. Ivanov, I. Nyapshaev, A. Semenov, G. Shelopin, E. Terukov & D. Orekhov
RAS/ Ioffe, St. Petersburg, Russia
B. Strahm
Roth&Rau, Hauterive, Switzerland
G. Wahli & P. Papet
Meyer Burger, Hauterive, Switzerland
T. Söderström & Y. Yao
Meyer Burger, Gwatt, Switzerland
T. Hengst
Meyer Burger, Hohenstein-Ernstthal, Germany
G. Kekelidze
Moscow Technological Institute, Russia

ORAL PRESENTATIONS 4BO.10

13:30 - 15:00 Multi-Junction Solar Cells for Concentrator and Space Applications

Chairpersons:

Trinidad J. Gomez Rodríguez
INTA, Spain

Gianluca Timò
RSE, Italy

4BO.10.1 The Effect of Fast-Atom-Beam Ion Species in the Surface Activated Bonding Process for Multi-Junction Solar Cells
D. Yamashita
University of Tokyo, Japan
G. Kono, T. Hoshii, K. Watanabe, M. Sugiyama, T. Suga, Y. Okada & Y. Nakano
University of Tokyo, Japan

4BO.10.2 Towards III-V/Si Photovoltaics-In Situ Controlled Growth and Preparation of Single-Domain Heterointerfaces in MOCVD Ambient
O. Supplie, M.M. May, S. Brückner, A. Nägelein, P. Kleinschmidt & T. Hannappel
Ilmenau University of Technology, Germany

4BO.10.3 Use of Double Band Anti-Crossing to Control Optical Absorption of GaAsSbN for Multi-Junction Solar Cells
T. Thomas, M. Führer, N. Hylton & N.J. Ekins-Daukes
Imperial College London, United Kingdom
K.H. Tan, D. Li, S. Wicaksono, W.K. Loke & S.F. Yoon
Nanyang Technological University, Singapore
A. Johnson
IQE, Cardiff, United Kingdom

4BO.10.4 High Efficiency InGaP/GaAs/Ge Triple Junction Solar Cells Monolithically Integrated on Deeply Patterned Silicon Substrates
A. Scaccabarozzi, S. Binetti, M. Acciarri & L. Miglio
University of Milan, Italy
G. Isella
Polytechnic University of Milan, Italy
R. Campesato, G. Gori & M.C. Casale
CESI, Milan, Italy
F. Mancarella
CNR, Bologna, Italy
H. von Känel
ETH Zurich, Switzerland

4BO.10.5 Photoluminescent and Electroluminescent Coupling in III-V Multijunction Solar Cells
D. Lan & M.A. Green
UNSW, Sydney, Australia

4BO.10.6 Simulated and Experimental Performance of High Efficiency GaInNAsSb Solar Cells
A. Aho, A. Tukiainen, V. Polojärvi, T. Aho, M. Raappana, R. Isoaho & M. Guina
Tampere University of Technology, Finland

VISUAL PRESENTATIONS 5BV.2

13:30 - 15:00 Experience, Grid Integration, and Shading

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

VISUAL PRESENTATIONS 1BV.6

13:30 - 15:00 Fundamental Material, Studies and Modelling / New Materials and Concepts for Modules

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

ORAL PRESENTATIONS 2BO.3

15:15 - 16:45 Silicon Wafering and Characterisation

Chairpersons:

Daniel Macdonald
ANU, Australia

Armin Froitzheim
SolarWorld Industries, Germany

2BO.3.1 Progress in Abrasive Electrochemical Multi-Wire Sawing of Silicon Ingot into Solar Wafers
W. Wang, G. Bao, Z. Zhou & Z. Liu
NUAA, Nanjing, China

2BO.3.2 Mechanical Strength of Diamond Wire and Slurry Sawn Wafers from Wafer to Cell and Module
F. Kaule, S. Dietrich & S. Schönfelder
Fraunhofer CSP, Saale, Germany
S. Thormann, R. Lantzsch & K. Petter
Hanwha Q CELLS, Bitterfeld-Wolfen, Germany

2BO.3.3 High Quality Thermal Donor Doped Czochralski Silicon Ingot for Industrial Heterojunction Solar Cells
F. Jay, M. Martel, M. Tomassini, R. Peyronnet-Dremière, J. Stadler, J. Veirman, D. Muñoz, C. Roux & A. Jouini
CEA, Le Bourget du Lac, France
X. Brun
AET-Technologies, Meylan, France

2BO.3.4 The Effect of n-Pasha Processing on Bulk Wafer Quality
P.C.P. Bronsveld, P. Manshanden, A. Gutjahr, M. Koppes & I.G. Romijn
ECN, Petten, Netherlands

2BO.3.5 Impact of Grain Boundary Character in Multicrystalline Silicon on Phosphorus External and Internal Gettering of Impurities for Solar Cell
S. Joonwichien
AIST, Fukushima, Japan
I. Takahashi & N. Usami
Nagoya University, Japan

2BO.3.6 Impact of Phosphorous Gettering and Hydrogenation on the Surface Recombination Velocity of Grain Boundaries in Multicrystalline Silicon
H. Sio, S.P. Phang, H.T. Nguyen & D. Macdonald
ANU, Canberra, Australia
T. Trupke
UNSW, Kensington, Australia

ORAL PRESENTATIONS 3BO.7

15:15 - 16:45 Contacts, Buffers and Interfaces

Chairpersons:

Yaroslav E. Romanyuk
EMPA, Switzerland

Thomas Walter
Ulm University of Applied Sciences, Germany

3BO.7.1 Nanostructured Back Mirror for Ultra-Thin CIGS Solar Cell
J. Goffard, A. Cattoni, C. Colin & S. Collin
CNRS, Marcoussis, France
F. Mollica, M. Jubault, J.F. Guillemoles, D. Lincot & N. Naghavi
CNRS, Chatou, France

3BO.7.2 Improvement of Cu-Rich Cu(in,Ga)Se2 Solar Cells by in and Ga Surface Treatments
L. Choubrac, T. Bertram, D. Regesch, C. Spindler & S. Siebentritt
University of Luxembourg, Belvaux, Luxembourg

3BO.7.3 Reducing the Necessity of Light Soaking by Controlled Incorporation of Indium into Chemically Deposited Zn(O,S) Buffer Layers for Cu(In,Ga)(S,Se)2 Solar Cells
C. Hönes, A. Fuchs & S. Zweigart
Robert Bosch, Stuttgart, Germany
S. Siebentritt
University of Luxembourg, Belvaux, Luxembourg

3BO.7.4 Highly Transparent and Conductive Sputtered Indium Zinc Oxide Films for Application in Cu(In,Ga)Se2 Solar Cells
R. Menner, C. Tschamber, M. Cemernjak, W. Witte, T.M. Magorian-Friedlmeier & W. Wischmann
ZSW, Stuttgart, Germany

3BO.7.5 Electrodeposition of ZnO Films: a Low Cost and Powerful Method to Produce CIGS Solar Cell Front Contact

F. Tsin, T. Hildebrandt, M. Paire & J. Rousset
EDF R&D - IRDEP, Chatou, France
A. Vénérosy, L. Lombez, S. Borensztajn,
N. Naghavi & D. Lincot
CNRS, Chatou, France
S. Collin
CNRS, Marcoussis, France
C. Broussillou, S. Jaime & P.P. Grand
NEXCIS, Rousset, France
D. Hariskos
ZSW, Stuttgart, Germany

3BO.7.6 Influence of Transparent Conductive Oxide on the Degradation of CdTe Solar Cell Performance

E. Artegiani, D. Menossi, A. Bosio & N. Romeo
University of Parma, Italy
A. Salavei & A. Romeo
University of Verona, Italy
I. Rimmaudo
CINVESTAV, Merida, Italy

ORAL PRESENTATIONS 4BO.11

15:15 - 16:45 Terrestrial Concentrator Systems

Chairpersons:

Yaroslav E. Romanyuk
EMPA, Switzerland

Thomas Walter
Ulm University of Applied Sciences, Germany

4BO.11.1 Fundmental Study for the Power Tower's HCPV/T Combined Thermal Receiver

A.O.M. Hagfarah & M. Nazarinia
Heriot Watt University, Dubai, United Arab Emirates

4BO.11.2 Trackless Holographic Concentrator for MW-Scale PV Plants

H.-J. Rodríguez San Segundo, A.M. Villamarín Villegas,
F.J. Pérez López & A. Calo López
Instituto Holográfico, El Puerto de Santa Maria, Spain

4BO.11.3 Indoor Measurement of Cell-to-Ambient Thermal Resistance in Solar CPV Modules

V.D. Rumyantsev, A.V. Chekalin & N.A. Sadchikov
RAS/ Ioffe, St. Petersburg, Russia
N.Yu. Davidyuk
St. Petersburg Academic University, Russia
A. Luque
UPM, Madrid, Spain

4BO.11.4 Invited

4BO.11.5 A Highly Efficient, Angle-Insensitive Solar Quantum Concentrator Based on Microstructured Plastic Optical Fiber.

O. Besida, O. Gobert, M. Comte, G. Mennerat,
F. Rondeaux, C. Jeanney, P. Starzynski, C. Fajolles,
P. Guenoun, D. Doizi & J. De Lamare
CEA, Gif-Sur-Yvette, France

4BO.11.6 Competitive Stationary Low Concentrating Solar Module of Novel Design

M.C. Ubaldi, A. Colombo, A. Righetti & G. Grasso
CIFE, Milan, Italy
A.J. Galdikas, J. Ulbikas & V. Cyras
Modernios E-Technologijos, Vilnius, Lithuania
M. Della Pirriera
Leitat Technological Center, Barcelona, Spain

VISUAL PRESENTATIONS 5BV.3

15:15 - 16:45 Power Conversion, Storage and Testing

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

VISUAL PRESENTATIONS 1BV.7

15:15 - 16:45 New Materials and Concepts for Cells

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

ORAL PRESENTATIONS 2BO.4

17:00 - 18:30 PERC Structures, Bulk and Surface Passivation

Chairpersons:

Radovan Kopecek
ISC Konstanz, Germany

Sébastien Dubois
CEA, France

2BO.4.1 The PERC Cell: From Conception to Mainstream Production
M.A. Green
UNSW, Sydney, Australia

2BO.4.2 21.40% Efficient Large Area Screen Printed Industrial PERC Solar Cell
D. Chen, W. Deng, J. Dong, F. Ye, H. Zhu, H. Li, Y. Jiang, B. Gao, M. Zhong, Y. Cui, Y. Chen, Y. Yang, Z. Feng & P.J. Verlinden
Trina Solar Energy, Changzhou, China

2BO.4.3 21%-Efficient Industrial Bifacial PERC Solar Cells
T. Dullweber, R. Peibst, U. Baumann, C. Kranz & H. Hannebauer
ISFH, Emmerthal, Germany

2BO.4.4 Contact Formation on Boron Doped Silicon Substrates from Passivating PECV-Deposited Dielectric Doping Layers with Anti-Reflective Properties by Screen-Printing Ag Pastes for High-Efficiency N-Type Silicon Solar Cells
J. Engelhardt, A. Frey, S. Fritz, G. Micard, S. Riegel, G. Hahn & B. Terheiden
University of Konstanz, Germany

2BO.4.5 Bifacial Multicrystalline Solar Cells with Efficiencies above 18% Prepared in an Industrial Production Environment
A. Teppe, C. Gong, O. Voigt, I. Melnyk, S. Keller, M. Klenk & P. Fath
RCT-Solutions, Konstanz, Germany

2BO.4.6 Comparison of Light Induced (LiP) and Electrically Induced Passivation (EiP) of Bor-Oxygen-Comlpexes by Means of the Charge State Control of Hydrogen
M. Gläser & D. Lausch
Fraunhofer CSP, Halle, Germany
J. Hirsch
Anhalt University of Applied Sciences, Köthen, Germany

ORAL PRESENTATIONS 3BO.8

17:00 - 18:30 Alternative Processing and Materials

Chairpersons:

Alexander Meeder
Flisom, Switzerland

Phillip Dale
University of Luxembourg, Luxembourg

3BO.8.1 Low Bandgap Cu(In,Ga)Se2 Solar Cells Applied in Tandem Devices with a Perovskite Top Cell
T. Feurer, P. Reinhard, F. Fu, L. Kranz, B. Bissig, S. Nishiwaki, S. Buecheler & A.N. Tiwari
EMPA, Dübendorf, Switzerland

3BO.8.2 Cu(In,Ga)Se2 Solar Cells on Flexible Ultra-Thin Glass Substrates
A. Gerthoffer, F. Roux, F. Emieux, P. Faucherand, H. Fournier, L. Grenet & S. Perraud
CEA, Grenoble, France

3BO.8.3 Fabrication of Cu(In,Ga)Se Solar Cells on Stainless Steel Foils with Sol-Gel Barrier Layer
Y. Kamikawa-Shimizu & H. Shibata
AIST, Tsukuba, Japan
N. Yamada, Y. Yamamoto & S. Yamaguchi
Nippon Steel & Sumitomo Metal, Futtsu, Japan

3BO.8.4 Light Trapping in Thin Cu(In,Ga)Se2 Solar Cells on Textured Polyimide Substrate
N. Bednar, N. Severino & N. Adamovic
Vienna University of Technology, Austria

3BO.8.5 Advanced Characterization and Defect Analysis of High Efficient Solution Deposited Cu2ZnSn(S,Se)4 Solar Cells
S. Haaß, Y.E. Romanyuk, M. Werner, M. Diethelm & A.N. Tiwari
EMPA, Dübendorf, Switzerland

3BO.8.6 Tin Sulfide for PV: a Reconfirmation of Potential
T.J. Whittles, W.M. Linhart, D. Hesp, T.D. Veal & V.R. Dhanak
University of Liverpool, United Kingdom
L.A. Burton & A. Walsh
University of Bath, United Kingdom

ORAL PRESENTATIONS 5BO.12

17:00 - 18:30 Monitoring and Performance

Chairpersons:

Christos Protogeropoulos
Phoenix Solar, Greece

Juergen Sutterlueti
Gantner Instruments, Austria

5BO.12.1 Tools for the High Penetration of PV Systems in the EU Electrical Networks: Results of PVCROPS Project
L. Narvarte
UPM, Madrid, Spain
L. Marroyo
UPNa, Pamplona, Spain
M. Collares-Pereira
University of Évora, Portugal
N. Tyutyuyndzhiev
Bulgarian Academy of Sciences, Sofia, Bulgaria
M.F. Conlon
Dublin Institute of Technology, Ireland
N.E. Bouzzan
ONEE, Casablanca, Morocco
E. Guelbenzu
Acciona energía, Sarriguren, Spain
R. González
Ingeteam, Sarriguren, Spain
A. Desportes
RTone, Lyon, France
G. Simmonds
REDT, Dublin, Ireland
B. Wilkin
APERe, Brussels, Belgium

5BO.12.2 Monitoring and Fault Detection in Photovoltaic Systems Based On Inverter Measured String I-V Curves
S. Spataru, D. Sera, T. Kerekes & R. Teodorescu
Aalborg University, Denmark

5BO.12.3 Experiences with a Performance Package for Multi-MW PV Plants Based on Computations on Top of Monitoring
G. Mütter
Alternative Energy Solutions, Vienna, Austria
Y. Voronko
Vienna University of Technology, Austria
B. Kubicek, T. Krametz & P. Steirer
AIT, Vienna, Austria

5BO.12.4 A New Generation of PV Monitoring System with High-Grade Remote Diagnostics Based on Module Level Monitoring and Integrated Yield Simulation
T. Kilper, C. Feser, U. Kirstein, D. Peters & K. von Maydell
NEXT ENERGY, Oldenburg, Germany
I. Kruse & S. Yilmaz
STORM Energy, Nuremberg, Germany

5BO.12.5 Uncertainties in PV Modelling and Monitoring
M. Richter, K. de Brabandere & A. Woyte
3E, Brussels, Belgium

5BO.12.6 Defect Analysis of Installed PV-Modules - IR-Thermography and in-String Power Measurement
C. Buerhop-Lutz & H. Scheuerpflug
ZAE Bayern, Erlangen, Germany

VISUAL PRESENTATIONS 5BV.4

17:00 - 18:30 Manufacturing Quality, Recycling and Sustainability.

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

VISUAL PRESENTATIONS 2BV.8

17:00 - 18:30 Silicon Solar Cell Characterization and Modelling / Industrial Aspects of c-Si Solar Cells

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

EU PVSEC Welcome Reception

WEDNESDAY, 16 September 2015

ORAL PRESENTATIONS 2CO.1

08:30 - 09:30 Silicon Heterojunction Solar Cells

Chairpersons:

Oliver Anspach *(i)*
PV Crystalox, Germany

Barbara Terheiden
University of Konstanz, Germany

2CO.1.1 Efficient Heterojunction Solar Cells on N-Type Epitaxial Kerfless Silicon Wafers
E. Kobayashi & Y. Watabe
Choshu Industry, Sanyo Onoda, Japan
R. Hao & T.S. Ravi
Crystal Solar, Santa Clara, United States

2CO.1.2 Analysis of Different Front and Back TCO on Heterojunction Solar Cells
D. Muñoz, F. Ozanne, P. Carroy,
A. Valla & P. García-Linares
CEA, Le Bourget du Lac, France
G. Rodriguez
CEA, Grenoble, France

2CO.1.3 Efficient Electrodes for Back-Contacted Silicon Heterojunction Solar Cells
A. Tomasi, B. Paviet-Salomon, A. Tajalli, J.P. Seif,
J. Geissbühler, S.M. de Nicolas, N. Holm,
S. De Wolf & C. Ballif
EPFL, Neuchâtel, Switzerland
S. Nicolay & M. Despeisse
CSEM, Neuchâtel, Switzerland
D. Lachenal
Meyer Burger, Hauterive, Switzerland
B. Strahm
Roth&Rau, Hauterive, Switzerland

2CO.1.4 Process Development for Heterojunction IBC Cells on Thin Silicon Foils Bonded to Glass
T. Bearda, H. Sivaramakrishnan Radhakrishnan,
E. Dönerçark, V. Depauw, C. Trompoukis,
K. Van Nieuwenhuysen, P. Choulat, L. Tous,
I. Sharlandzhiev, M. Xu, J. Govaerts, I. Gordon,
J. Poortmans & J. Szlufcik
imec, Leuven, Belgium
S.N. Granata
Total, Leuven, Belgium

ORAL PRESENTATIONS 5CO.5

08:30 - 09:30 Solar Radiation

Chairpersons:

Wilfried van Sark
Utrech University, Netherlands

Christer Nyman
Soleco, Finland

5CO.5.1 Weather Sensitivity Analyses in Layout Planning
M. Bischoff & M. Dehler
Siemens, Munich, Germany
J. Leitner, K. Plociennik, K.-H. Kuefer & T. Fleuren
Fraunhofer ITWM, Kaiserslautern, Germany

5CO.5.2 Methodology for the Determination of Spectral Characteristics of Solar Radiation on Earth's Surface through Satellites and Radiative Transfer Model
R. Haag & A. Krenzinger
UFRGS, Porto Alegre, Brazil

5CO.5.3 Indoor and Outdoor Evaluation of Global Irradiance Sensors
A. Driesse
PV Performance Labs, Freiburg, Germany
W. Zaaiman
European Solar Test Installation, Ispra, Italy
J.S. Stein
Sandia National Laboratories, Albuquerque, United States

5CO.5.4 Validation of the Next-Generation National Solar Radiation Database for the US
M. Sengupta, A. Weekley, A. Habte & A. Lopez
NREL, Golden, United States
C. Molling
University of Wisconsin, Madison, United States
A. Heidinger
NOAA, Madison, United States

ORAL PRESENTATIONS 1CO.9

08:30 - 09:30 Photonics

Chairpersons:

Yoshitaka Okada
University of Tokyo, Japan

M. Ángeles Fernández-Fenollosa *(i)*
UPV, Spain

1CO.9.1 Silicon Based Thin Film Tandem Solar Cells with Ultrathin Resonant-Cavity-Enhanced a-Ge:H Bottom Cell Absorbers
V. Steenhoff, M. Vehse & C. Agert
NEXT ENERGY, Oldenburg, Germany

1CO.9.2 Photovoltaic Characteristics of Ultra-Thin Silicon Solar Cells below 10 Nm
R. Miyazawa, T. Shoji, K. Kakushima, Y. Kataoka, A. Nishiyama, N. Sugii, H. Wakabayashi, K. Tsutsui, K. Natori, H. Iwai & H. Ohashi
Tokyo Institute of Technology, Yokohama, Japan

1CO.9.3 Multi-Resonant Light-Trapping: New Limits for Solar Cells
S. Collin, J. Goffard, A. Cattoni & C. Colin
CNRS, Marcoussis, France
C. Sauvan
CNRS, Palaiseau, France
P. Lalanne
University of Bordeaux, Talence, France
J.F. Guillemoles
CNRS, Chatou, France

1CO.9.4 Platinum and Iridium Metamaterials for Thermophotovoltaic Selective Emitters
N. Pfiester, N. Naka & T.E. Vandervelde
Tufts University, Medford, United States

ORAL PRESENTATIONS 5CO.13

08:30 - 09:30 PV Module Characterisation Techniques

Chairpersons:

Ana Rosa Lagunas
CENER, Spain

Johanes Meier *(i)*
TEL Solar, Switzerland

5CO.13.1 Investigation on Snail Track Formation, Degradation Mechanisms and Raman Spectroscopic Examination of the Corrosion Products
J. Bierbaum, D. Philipp, S. Stecklum, I. Dürr & K.-A. Weiß
Fraunhofer ISE, Freiburg, Germany

5CO.13.2 Innovative Approach for the Failure Analysis of Damaged PV-Modules: Non-Destructive Module Characterisation Combined with in Depth Material Analysis
G.C. Eder & R. Vizcaya
OFI, Vienna, Austria
R. Ebner, B. Kubicek & K.A. Berger
AIT, Vienna, Austria
H. Sonnleitner
ENcome Energy Performance, Villach, Austria
A. Angerer
InfraTec, Kapfenberg, Germany

5CO.13.3 Monitoring Inhomogeneities Through Initial Operation of Thin-Film Photovoltaic Modules
M. Bokalic, R. Kimovec, B. Kirn, K. Brecl & M. Topic
University of Ljubljana, Slovenia

5CO.13.4 Evaluation of Uncertainty in Electroluminescence Imaging of PV Devices due to Optical and Perspective Distortions
K. Bedrich, M. Bliss, T.R. Betts & R. Gottschalg
Loughborough University, United Kingdom

VISUAL PRESENTATIONS 3CV.1

08:30 - 09:30 Thin Film Si Cells and Modules

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

PLENARY SESSION 3CP.1

09:50 - 11:10 Thin-Film Cells and Modules

Chairpersons:

Susanne Siebentritt
University of Luxembourg, Luxembourg

3CP.1.1 Progress & Challenges in Thin-Film Silicon Photovoltaics: Heterojunctions & Multijunctions
K. Yamamoto, Osaka, Japan

3CP.1.2 Progress in High-Efficiency Cu(In,Ga)Se2 Cells and Modules on Glass and Flexible Substrates
M. Powalla, W. Witte, P. Jackson, D. Hariskos, S. Paetel, E. Lotter, R. Würz, F. Kessler, W. Hempel, R. Menner, T.M. Magorian-Friedlmeier, O. Kiowski, A. Bauer, S. Spiering & W. Wischmann
ZSW, Stuttgart, Germany

3CP.1.3 Unlocking High Performance Potential of CdTe Based Thin Film Solar Devices
Z. Zhao & M. Gloeckler
First Solar, Perrysburg, United States

3CP.1.4 Atomic Layer Deposition of TiO2 Compact Layers for Flexible Mesostructured Perovskite Cells and Modules on Plastics
V. Zardetto, W.M.M. Kessels & M. Creatore
University of Technology, Eindhoven, Netherlands
F. di Giacomo, A. d'Epifanio, S. Licoccia, A. di Carlo & T.M. Brown
University of Rome II, Italy

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ORAL PRESENTATIONS 4CP.2

11:10 - 12:10 Terrestrial Concentrator Systems and Space Solar Generators

Chairpersons:

Andreas W. Bett
Fraunhofer ISE, Germany

4CP.2.1 Keynote Presentation: NGCPV: a New Generation of Concentrator Photovoltaic Cells, Modules and Systems (a Final Review)
A. Datas, A.B. Cristóbal, G. Sala, I. Anton Hernandez, J.C. Miñano, P. Benítez, A. Martí Vega & A. Luque
UPM, Madrid, Spain
A.W. Bett & G. Siefer
Fraunhofer ISE, Freiburg, Germany
N.J. Ekins-Daukes
Imperial College London, United Kingdom
F. Roca & C. Cancro
ENEA, Portici, Italy
I. Luque-Heredia
BSQ Solar, Madrid, Spain
W. Warmuth
PSE, Freiburg, Germany
M. Baudrit
CEA, Le Bourget du Lac, France
Y. Okada & M. Sugiyama
University of Tokyo, Japan
Y. Hishikawa
AIST, Tsukuba, Japan
T. Takamoto
SHARP, Nara, Japan
K. Araki
Daido Steel, Nagoya, Japan
A. Fukuyama, K. Nishioka & H. Suzuki
University of Miyazaki, Japan
N. Kuze & Y. Moriyasu
Asahi Kasei, Shizuoka, Japan
T. Kita
Kobe University, Japan
A. Kotagiri
Takano, Tokyo, Japan
N. Kojima & M. Yamaguchi
TTI, Nagoya, Japan

4CP.2.2 Invited Plenary Presentation
C. Signorini
ESA-ESTEC, Noordwijk, Netherlands

ORAL PRESENTATIONS 2CO.2

13:30 - 15:15 Metallization

Chairpersons:

Richard Russell
imec, Belgium

Jörg Müller
Hanwha Q CELLS, Germany

2CO.2.1 Progress on Industrial Solar Cell Front Side Metallization by Parallel Dispensing Technology
M. Pospischil, M. Kuchler, M. Klawitter, R. Efinger, A. Padilla, H. Gentischer, F. Clement, D. Biro, R. Preu & C. Rodriguez
Fraunhofer ISE, Freiburg, Germany
M. König & M. Hörteis
Heraeus, Hanau, Germany
L. Wende
ASYS, Dornstadt, Germany
A. Mette
Hanwha Q CELLS, Bitterfeld-Wolfen, Germany

2CO.2.2 Cu Based Solar Cell Contacts Formed by High Throughput Inline Plating Technology
J. Horzel, N. Bay & H. Kühnlein
RENA, Freiburg, Germany
Y. Yuan & P.J. Verlinden
Trina Solar Energy, Changzhou, China

2CO.2.3 Development and Implementation of a Plated and Solderable Metallization on 15.6x15.6 cm2 IBC Cells
S. Singh, B. O'Sullivan, L. Tous, R. Russell, M. Debucquoy, J. Szlufcik & J. Poortmans
imec, Leuven, Belgium
M. Kyuzo
Kyocera, Higashiomi, Japan

2CO.2.4 Overcoming Issues with Copper Plated Contacts for Large-Scale Manufacturing
A. Wenham, C.M. Chong, S. Wang, J. Ji, Z. Shi, L. Mai, A. Sugianto, S.R. Wenham, A. Barnett & M.A. Green
UNSW, Sydney, Australia

2CO.2.5 Solar Cells with Diverse Metallization Schemes Enabled by SmartWire Connection Technology for Module Integration
Y. Yao, T. Söderström, D. Habermann & A. Richter
Meyer Burger, Gwatt, Switzerland
P. Papet
Meyer Burger Research, Hauterive, Switzerland
J. Hermans
Roth & Rau, Eindhoven, Netherlands

2CO.2.6 Foil Metallization Process for PERC Solar Cells towards Industrial Feasibility
M. Graf, D. Eberlein, H. Nagel, J. Nekarda & R. Preu
Fraunhofer ISE, Freiburg, Germany
R. Böhme
InnoLas Systems, Krailling, Germany
A. Streek
Laser Institute, Mittweida, Germany

ORAL PRESENTATIONS 3CO.6

13:30 - 15:15 Advanced Analysis Methods

Chairpersons:

Bernhard Dimmler
Manz, Germany

Edgardo Saucedo
IREC, Spain

3CO.6.1 Dependence of Photovoltage on Incident Light Wavelength Investigated by Photo-Assisted Kelvin Probe Force Microscopy on Cu(In,Ga)Se2 Solar Cells
H. Yong & T. Takahashi
University of Tokyo, Japan
T. Minemoto
Ritsumeikan University, Shiga, Japan

3CO.6.2 Photocurrent Collection Efficiency Mapping of CIGS Solar Modules by a Differential Luminescence Imaging Technique
V. Huhn, A. Gerber, B.E. Pieters, Y. Augarten & U. Rau
Forschungszentrum Jülich, Germany

3CO.6.3 Origins of Shunt Signals of Cu(in,Ga)Se2 Solar Cells Investigated by Two-Dimensional Simulations
M. Richter, F.-S. Babbe, S.J. Heise, J. Ohland & I. Riedel
University of Oldenburg, Germany
A. Vetter
ZAE Bayern, Erlangen, Germany

3CO.6.4 Advanced Characterization of Cu(In,Ga)(Se,S)2 Thin Film Modules Based on Imaging and Mapping Techniques
T. Lavrenko, K. Marzinzig & T. Walter
Ulm University of Applied Sciences, Germany
B. Plesz
Budapest University of Technology and Economics, Hungary

3CO.6.5 Electroluminescence Study of Cu2ZnSn(S,Se)4 and Cu(in,Ga)Se2 Thin Film Solar Cells
M.A. Halim, M.M. Islam, X. Luo, T. Sakurai & K. Akimoto
University of Tsukuba, Japan
N. Sakai, T. Kato & H. Sugimoto
Solar Frontier, Tokyo, Japan
H. Tampo, H. Shibata & S. Niki
AIST, Tsukuba, Japan

3CO.6.6 Comparison of Surface Composition, Electronic Properties, and Solar Cell Performance of UHV-Transferred and Air Exposed CIGSe Thin Film Solar Cell Absorbers
W. Calvet, B. Ümsür, A. Steigert, I. Lauermann, B. Chacko, V. Parvan, T. Olar, K. Prietzel, H. Allaf Navirian, S. Brunken, C.A. Kaufmann, D. Greiner, T. Unold & M.C. Lux-Steiner
HZB, Berlin, Germany

ORAL PRESENTATIONS 1CO.10

13:30 - 15:15 New Concepts

Chairpersons:

Masakazu Sugiyama
University of Tokyo, Japan

Marin Rusu
HZB, Germany

1CO.10.1 Prototype of a double-heterojunction hot carrier solar cell
I. Konovalov & V. Emelianov
University of Applied Sciences Jena, Germany

1CO.10.2 Can Resonant Tunneling Diodes Be Used for Hot-Carrier Solar Cells?
Y. Takeda
Toyota Central R&D Labs, Nagakute, Japan
A. Ichiki, Y. Kusano & T. Motohiro
Nagoya University, Japan
N. Sugimoto
Toyota Central, Nagakute, Japan

1CO.10.3 Performance Improving Study of Crystalline Silicon Solar Cell Depending on the Locations of Luminescent Down-Shifting and Optical Reflectance Using Eu-Doped Phosphor Particles Coated on the Antireflective TiO2 Layer
W.-J. Ho, G.-C. Yang, Y.-T. Shen, C.-H. Hu & Y.-J. Deng
NTUT, Taipei, Taiwan

1CO.10.4 Investigation of Tunnel Junction Architectures for III-V/Si Tandem Solar Cells
G. Hamon
TOTAL, Paris la Defense, France
R. Cariou, W. Chen & P. Roca i Cabarrocas
CNRS, Palaiseau, France
R. Lachaume, J. Alvarez & J.-P. Kleider
CNRS, Gif-sur-Yvette, France
J. Decobert & K. Louarn
CNRS, Marcoussis, France

1CO.10.5 Quantitative Optical Spectroscopy of QDs Intermediate Band Solar Cells
P. Rale, B. Behaghel, D. Ory, L. Lombez & J.F. Guillemoles
CNRS, Chatou, France
A. Delamarre
CNRS, Tokyo, Japan
N. Vandamme & S. Collin
CNRS, Marcoussis, France
R. Tamaki, Y. Shoji & Y. Okada
University of Tokyo, Japan

1CO.10.6 All-Silicon Energy Storage (ASES)
A. Datas, A. Martí Vega, C. del Cañizo & A. Luque
UPM, Madrid, Spain

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ORAL PRESENTATIONS 5CO.14

13:30 - 15:15 Bifaciality, Soiling, Shading

Chairpersons:

Kristian Peter
ISC Konstanz, Germany

Khalid Radouane
EDF EN, France

5CO.14.1 A Study of Several Thin-Film Technologies Performance under Desert Environmental Conditions in Qatar
D. Martinez, B. Figgis & A. Abdallah
Qatar Foundation, Doha, Qatar
T. Mirza
Green-Gulf, Doha, Qatar

5CO.14.2 Detection of Roof Shading for PV Based on Lidar Data Using a Multi-Modal Approach
D. Palmer, B. Goss, I. Cole, T. Betts & R. Gottschalg
Loughborough University, United Kingdom

5CO.14.3 Determining Direct Irradiation on Surfaces in a Complex Urban Environment for BIPV Installation
R. Bheemireddy, R.A.C.M.M. van Swaaij & M. Zeman
Delft University of Technology, Netherlands

5CO.14.4 Key Elements in the Design of Bifacial PV Power Plants
A. Lindsay, P. Dupeyrat & B. Binesti
EDF R&D, Moret-sur-Loing, France
E. Lutun
EDF EN, Colombiers, France
K. Radouane
EDF EN, Paris, France

5CO.14.5 Spatiotemporal Model Comparing Dust Mitigation Technologies for Solar Photovoltaics with Applications in Saudi Arabia
S. Alqatari, A. Alfaris & A. Alhassan
CCES, Cambridge, United States
O. L. de Weck
MIT, Cambridge, United States

5CO.14.6 Realistic Yield Expectations for Bifacial PV Systems – an Assessment of Announced, Predicted and Observed Benefits
C. Reise & D. Dirnberger
Fraunhofer ISE, Freiburg, Germany

VISUAL PRESENTATIONS 5CV.2

13:30 - 15:15 PV Modules

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

ORAL PRESENTATIONS 2CO.3

15:15 - 16:45 n-Type Silicon Solar Cells

Chairpersons:

Arthur W. Weeber
ECN, Netherlands

Joachim John
imec, Belgium

2CO.3.1 Industrial n-Type PERL Cells with Screen Printed Front Side Electrodes Approaching 21% Efficiency
U. Jäger, B. Steinhauser, J. Benick,
J.-F. Nekarda & M. Hermle
Fraunhofer ISE, Freiburg, Germany
S.Y. Chong, J. Lam, R. Steeman & J. Rostan
REC Solar, Singapore, Singapore

2CO.3.2 Boron Emitter Optimization of n-Type Back Junction PERT Solar Cells with Atmospheric Pressure Chemical Vapor Deposition
T. Kim, Y.S. Choi, J. Cho, H.N.R. Shin, J. Lee, J. Lee, H. Oh, M.-I. Hwang & E.-C. Cho
Hyundai Heavy Industries, Yongin-si, Korea South

2CO.3.3 Comparison of Bifacial and Monofacial Large-Area n-Type Si Solar Cells from 100 µm Thin Wire-Sawn Wafers
Y. Schiele, G. Hahn & B. Terheiden
University of Konstanz, Germany

2CO.3.4 Modeling and Mass Production High Efficiency N-Type Solar Cells with Selective Back Surface Field
J. Wang, C. Wu, W. Yang, F. Lang, W. Zhang,
Z. Hu & J. Xiong
Yingli Green Energy, Baoding, China
Y. Gao, J. Yang & J. Li
Applied Materials, Shanghai, China
J. Graff, C.E. Dubé & Q. Zhai
Applied Materials, Gloucester, United States

2CO.3.5 **One-Step Selective n++/n+ Diffusion and BSF Formation for n-Type Front-Junction Solar Cells**
Y. Sheng, J. Sheng, Y. Yuan, W. Cai, W. Wang, C. Zhang, Z. Feng & P.J. Verlinden
Trina Solar Energy, Changzhou, China

2CO.3.6 **Beyond 22% Large Area n-Type Silicon Solar Cells with Front Laser Doping and a Rear Emitter**
A. Uruena de Castro, M. Aleman, E. Cornagliotti, A. Sharma, J. Deckers, M. Haslinger, L. Tous, R. Russell, J. John, F. Duerinckx & J. Szlufcik
imec, Leuven, Belgium
Y. Yao & T. Söderström
Meyer Burger, Gwatt, Switzerland

ORAL PRESENTATIONS 3CO.7

15:15 - 16:45 Perovskite Solar Cells

Chairpersons:

Ricardo Pò
Eni spa, Italy

Christophe Ballif
CSEM, Switzerland

3CO.7.1 **Challenges and Opportunities for Organic-Inorganic Halide Perovskite Solar Cells**
L. Tinker
U.S. Dept. of Energy, Washington, United States

3CO.7.2 **Overcoming Instability and I-V Hysteresis to Achieve Accurate Efficiency Measurements of Perovskite Solar Cells at Standard Test Conditions**
R. Dunbar, K.F. Anderson, T.W. Jones, G.J. Wilson & C. Fell
CSIRO Energy Flagship, Mayfield West, Australia

3CO.7.3 **Real-Time XRD Monitoring of Phases Formed during Growth of Co-Evaporated Perovskite Thin Films**
J. Borchert, H. Boht, P. Pistor, W. Fränzel, R. Scheer & R. Csuk
Martin Luther University, Halle, Germany
T. Brenner
University of Potsdam, Germany

3CO.7.4 **Organometallic Halide Perovskite Solar Modules by Laser Scribing Patterning Technology**
L. Löfgren, S.-J. Moon, J.-H. Yum, L. Sansonnens, M. Benkhaira, D. Sacchetto, S. Nicolay & J. Bailat
CSEM, Neuchâtel, Switzerland
A. Walter & C. Ballif
EPFL, Neuchâtel, Switzerland

3CO.7.5 **Towards a Roll-to-Roll Up-Scaling of Perovskite Solar Cell Manufacturing by Slot Die Coating: a Study on the Crystallization and Stability of the Perovskite Layer**
F. di Giacomo & T.M. Brown
University of Rome II, Italy
A. Langen, H. Gorter, H. Akkerman & P. Groen
TNO, Eindhoven, Netherlands

3CO.7.6 **Stability of Polycrystalline CH3NH3PbI3 Perovskites Probed by Optical Absorption and Conductivity**
J. Holovsky, A. Purkrt, Z. Remes, N. Neykova, M. Müller, M. Ledinsky, J. Kocka & T.H. Stuchlikova
ASCR, Prague, Czech Republic
B. Niesen, P. Löper, S. De Wolf & C. Ballif
EPFL, Neuchâtel, Switzerland

ORAL PRESENTATIONS 1CO.11

15:15 - 16:45 Advanced PV Module Materials and Concepts

Chairpersons:

Guy Beaucarne
Dow Corning, Belgium

Harry Wirth
Fraunhofer ISE, Germany

1CO.11.1 **Module Integration of Solar Cells with Diverse Metallization Schemes Enabled by SmartWire Connection Technology**
Y. Yao, T. Söderström, D. Habermann & A. Richter
Meyer Burger, Gwatt, Switzerland
P. Papet
Meyer Burger, Hauterive, Switzerland
J. Hermans
Roth & Rau, Eindhoven, Netherlands

1CO.11.2 **Modelling and Verification of Mechanical Stress Induced by Soldering of Wires for Multi Busbar Interconnection**
L.C. Rendler, J. Walter, T. Geipel & U. Eitner
Fraunhofer ISE, Freiburg, Germany
M. Volk & C. Ebert
Gebr. Schmid, Freudenstadt, Germany

1CO.11.3 Performance and Reliability of Different Anti-Reflective Coated Glass for PV Modules
X. Pan, S. Zhang, J. Xu, Z. Feng & P.J. Verlinden
Trina Solar Energy, Changzhou, China

1CO.11.4 "TPedge": Qualification of a Gas-Filled, Encapsulation Free Glass-Glass Photovoltaic Module Concept
M. Mittag, I. Haedrich, U. Eitner & H. Wirth
Fraunhofer ISE, Freiburg, Germany

1CO.11.5 Light Trapping Film for Bifacial Applications
B.B. Van Aken, J.A.M. Van Roosmalen, L.A.G. Okel, I.G. Romijn & G.J.M. Janssen
ECN, Petten, Netherlands
M. Mrcarica, K. Du Mong, M. Rooijmans & C. Panofen
DSM Advanced Surfaces, Urmond, Netherlands

1CO.11.6 Smart PV Module Topology with a Snake-Like Configuration
M.-I. Baka & D. Soudris
NTUA, Athens, Greece
F. Catthoor
imec, Leuven, Belgium

ORAL PRESENTATIONS 5CO.15

15:15 - 16:45 Infrared Imaging

Chairpersons:

Manfred Bächler
PerVorm, Germany

Matthias Grottke
WIP - Renewable Energies, Germany

5CO.15.1 Standardization of Infrared Imaging of Photovoltaic Plants in Operation
E. Schubert, U. Siegfriedt & R. Haselhuhn
DGS, Berlin, Germany
B. Weinreich & B. Schauer
HaWe Engineering, Gauting-Hausen, Germany

5CO.15.2 Fault Diagnosis and Classification of Large-Scale Photovoltaic Plants through Aerial Orthophoto Thermal Mapping
J.A. Tsanakas, A. Plissonnier G. Vannier,
D.L. Ha & F. Barruel
CEA, Le Bourget-du-Lac, France

5CO.15.3 Characterization of Defects in PV-Modules by Their Temperature Development Using IR-Thermography
C. Buerhop-Lutz & H. Scheuerpflug
ZAE Bayern, Erlangen, Germany

5CO.15.4 Correlation between the Monitoring Data of a Photovoltaic Power Plant and Module Defects Detected by Drone-Mounted Thermography
M. Dalsass
ZAE Bayern, Hof, Germany
H. Scheuerpflug
ZAE Bayern, Erlangen, Germany
M. Maier
IBC Solar, Bad Staffelstein, Germany
C.J. Brabec
University of Erlangen-Nuremberg, Germany

5CO.15.5 Post Processing Technique for Thermo-Graphic Images Provided by Drone Inspections
G. Leotta, P.M. Pugliatti, A.G.F. Di Stefano,
F. Aleo & F. Bizzarri
ENEL, Catania, Italy

5CO.15.6 Infrared (IR) Drone for Quick and Cheap PV Inspection
U. Muntwyler, M. Lanz & E. Schüpbach
BUAS, Burgdorf, Switzerland

VISUAL PRESENTATIONS 4CV.3

15:15 - 16:45 Concentrator and Space Applications for Multi-Junction Solar Cells

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

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ORAL PRESENTATIONS 2CO.4

17:00 - 18:30 Junction Formation

Chairpersons:

Caroline Boulord *(i)*
Dow Corning, Belgium

Paul A. Basore
NREL, United States

2CO.4.1 Status and Perspective of Emitter Formation by POCl3-Diffusion
A. Wolf, A. Kimmerle, S. Werner, S. Maier, U. Belledin, S. Meier, T. Fellmeth & D. Biro
Fraunhofer ISE, Freiburg, Germany

2CO.4.2 Low Pressure Diffusions for High Quality Emitter Formation in Advanced p- and n-Type Solar Cells
A. Piechulla, S. Denzer, T. Zhou & W. Jooß
centrotherm photovoltaics, Blaubeuren, Germany
V.D. Mihailetchi, S. Eisert & R. Harney
ISC Konstanz, Germany

2CO.4.3 Annealing Temperature Reduction for Non-Mass Analyzed Boron Implantation
V. Bhosle, T. Miller, J. Graff & N. Bateman
Applied Materials, Gloucester, United States

2CO.4.4 Implanted and Co-Annealed Bifacial n-type PERT Solar Cells Metallized by Co-Plating – The CoCo Cell
J. Benick, J. Bartsch, U. Jäger, M. Kamp, B. Steinhauser, A. Brand, R. Müller, S. Gutscher, M. Hermle & S.W. Glunz
Fraunhofer ISE, Freiburg, Germany

2CO.4.5 Epitaxially Grown Emitters and Emitters Diffused from the Gas Phase for High Efficiency Solar Cells
S. Lindekugel, T. Rachow, N. Milenkovic, B. Steinhauser, J. Benick, S. Janz & S. Reber
Fraunhofer ISE, Freiburg, Germany

2CO.4.6 Advanced Doping Profiles by Selective Epitaxy in n-Type PERT Cells
M. Récaman-Payo, I. Kuzma Filipek, F. Duerinckx, Y. Li, E. Cornagliotti, A. Uruena de Castro, A. Sharma, L. Tous, R. Russell, J. Szlufcik & J. Poortmans
imec, Leuven, Belgium
A. Hajjiah
Kuwait University, Safat, Kuwait

ORAL PRESENTATIONS 3CO.8

17:00 - 18:30 Organic Solar Cells

Chairpersons:

G. Graditi
ENEA, Portici, Italy

A. Swingler *(i)*
Schneider Electric, Burnaby, Canada

3CO.8.1 Highly Accelerated Life Time Testing via Extreme Illumination at Controlled Temperature for Thin Film Solar Cells
A. Vetter
ZAE Bayern, Erlangen, Germany
K. Burlafinger, M. Woiton & C.J. Brabec
University of Erlangen-Nuremberg, Germany

3CO.8.2 Accelerated Ageing Test of OPV Mini-Modules: Study of the Electrical Performances after Exposure at Different Humidity, Irradiance and Temperature Conditions
G. Bardizza, A. Loi, H. Müllejans, T. Sample & E. Dunlop
European Commission DG JRC, Ispra, Italy

3CO.8.3 ALABO - Advanced Laser Ablation on Barrier Films for Organic and Large Area Electronic Devices
U. Klotzbach & W. Grählert
Fraunhofer IWS, Dresden, Germany
K. Walzer
Heliatek, Dresden, Germany
M. Grimm & B. Keiper
3D-Micromac, Chemnitz, Germany
M. Sentis
CNRS, Marseille, France
J. Kosiec
Sorter, Radom, Poland
R. Mandamparambil
TNO, Eindhoven, Netherlands

3CO.8.4 High Performance PTB7:PC71BM Solar Cells on Flexible Glass
P. Mantilla-Perez, N. Formica, D.S. Ghosh, D. Janner, T.L. Chen, V. Pruneri & J. Martorell
ICFO, Castelldefels, Spain
M. Huang & S. Garner
Corning, United States

3CO.8.5 Organic and Printed Photovoltaics: Process and In-Line Optical Monitoring
S. Logothetidis, A. Laskarakis,
C. Kapnopoulos & E. Mekeridis
Aristotle University of Thessaloniki, Greece

3CO.8.6 Performance Optimization of P3HT:PCBM Solar Cells by Controlling Active Layer Thickness
B. Kadem, A. Hassan & W. Cranton
Sheffield Hallam University, United Kingdom

ORAL PRESENTATIONS 5CO.12

17:00 - 18:30 Grid Interface and Energy Management

Chairpersons:

Jann Binder
ZSW, Germany

Oliver Mayer
GE Global Research, Germany

5CO.12.1 Optimization of the Site for a Carport with a PV System Concept for Electric Vehicles
J. Birtel & H. te Heesen
Environmental Campus Birkenfeld, Germany

5CO.12.2 Solar Eclipse 20th March 2015: Analysis and possible future implications for events of this kind
N. Kreifels, Fraunhofer ISE, Freiburg, Germany

5CO.12.3 Analysis of Voltage Fluctuation and Flicker on Distribution Networks with Significant PV Installations
M.F. Conlon, S. Pukhrem, K. Sunderland & M. Basu
Dublin Institute of Technology, Ireland

5CO.12.4 Grid Feed-in Behavior of Distributed PV Battery Systems
J. Weniger, J. Bergner, T. Tjaden & V. Quaschning
Berlin University of Applied Sciences, Germany

5CO.12.5 Validation of Energy Management Strategies for PV Plants with Li-Ion Batteries
A. Padros & E. Guelbenzu
Acciona Energía, Sarriguren, Spain
J. Marcos & I. de la Parra
Public University of Navarre, Pamplona, Spain

5CO.12.6 Costs of Residential Solar PV Plants in Distribution Grid Networks
S.B. Kjær
Danfoss Solar Inverters, Nordborg, Denmark
G. Yang & J. Østergaard
DTU, Lyngby, Denmark
H.H. Ipsen
Østkraft, Rønne, Denmark
K.H.B. Frederiksen
EnergiMidt, Silkeborg, Denmark

ORAL PRESENTATIONS 5CO.16

17:00 - 18:30 Potential Induced Degradation (PID) and Light Induced Degradation (LID) of PV modules

Chairpersons:

Tom Betts
Loughborough University, United Kingdom

Hartmut Nussbaumer
Zurich University of Applied Sciences, Switzerland

5CO.16.1 Potential-Induced Degradation: Measurement and Modeling of Progression under Actual Field Conditions
C. Taubitz, M. Kröber, M. Schütze, D. Buß & M.B. Köntopp
Hanwha Q CELLS, Bitterfeld-Wolfen, Germany

5CO.16.2 Improvement of a Prediction Model for Potential Induced Degradation by Better Understanding the Regeneration Mechanism
S. Koch, J. Berghold, C. Hinz & P. Grunow
PI Berlin, Germany
S. Krauter
University of Paderborn, Germany

5CO.16.3 Evaluation of Recovery Methods After Potential Induced Degradation of PV Modules
P. Lechner, S. Hummel & J. Schnepf
ZSW, Stuttgart, Germany

5CO.16.4 Quantitative Assessment of the Local Leakage Current in PV Modules for Degradation Prediction
H. Nagel, M. Glatthaar & S.W. Glunz
Fraunhofer ISE, Freiburg, Germany

5CO.16.5 A New Light Induced Volume Degradation Effect of mc-Si Solar Cells

P. Engelhart, F. Kersten, H.-C. Ploigt, F. Stenzel, K. Petter, A. Stekolnikov, T. Lindner, M. Bartzsch, M. Scherff, A. Szpeth & J.W. Müller
Hanwha Q CELLS, Bitterfeld-Wolfen, Germany
J. Heitmann
Freiberg University of Technology, Germany

5CO.16.6 Natural Recovery from LID: Regeneration under Field Conditions

K. Lee, M.-S. Kim, D.-H. Kyeong, J.-K. Lim, J.-H. Ahn, M.-I. Hwang & E.-C. Cho
Hyundai Heavy Industries, Yongin-si, Korea South

VISUAL PRESENTATIONS 2CV.4

17:00 - 18:30 Silicon Solar Cell Improvements

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

EU PVSEC Dinner

PROGRAMME

THURSDAY, 17 September 2015

ORAL PRESENTATIONS 2DO.1

08:30 - 09:30 Luminescence Characterization

Chairpersons:

Martin C. Schubert
Fraunhofer ISE, Germany

Thorsten Trupke
UNSW, Australia

2DO.1.1 Physical Modelling of Luminescence Spectra from Silicon

D. Macdonald, H.T. Nguyen & S.Y. Lim
ANU, Canberra, Australia

2DO.1.2 Luminescence Imaging Analysis of Light Trapping in Crystalline Silicon PV Modules

Z. Liu, Y. S. Khoo, V. Shanmugan, R. Stangl, A.G. Aberle & J. Wong
SERIS, Singapore, Singapore
I.M. Peters
MIT, Cambridge, United States

2DO.1.3 Application of Carrier De-Smearing of PL Images on Silicon Wafers

S.P. Phang, H. Sio & D. Macdonald
ANU, Canberra, Australia

2DO.1.4 Voc Evaluation of Solar Cells and Modules Using Absolute El Images

T. Mochizuki, J. Mitchell & H. Takato
AIST, Koriyama, Japan
C. Kim, Z. Lin, M. Yoshita & H. Akiyama
The University of Tokyo, Kashiwa, Japan
S. Chen
East China Normal University, Shanghai, China
Y. Kanemitsu
Kyoto University, Japan

ORAL PRESENTATIONS 7DO.5

08:30 - 09:30 PV Markets around the World

Chairpersons:

Thomas Nordmann
TNC Consulting, Switzerland

Gaetan Masson
Becquerel Institute, Belgium

7DO.5.1 Trends in Photovoltaic Applications - the Latest Survey Results on PV Markets and Policies from the IEA PVPS Programme
G. Masson
IEA PVPS, Brussels, Belgium
P. Hüsser
Nova Energie, Aarau, Switzerland
V. Salas
UC3M, Leganés, Spain
R. Margolis
NREL, Golden, United States
I. Kaizuka
RTS, Tokyo, Japan

7DO.5.2 Latest Developments in Global Installed Photovoltaic Capacity and Hidden Growth Markets
C. Werner
Hanergy, Berlin, Germany
A. Gerlach
Hanwha Q CELLS, Bitterfeld-Wolfen, Germany
C. Breyer
Lappeenranta University of Technology, Finland

7DO.5.3 PV Market Status in Japan –Challenges and Opportunities
H. Matsukawa, H. Yamaya, T. Ohigashi, I. Kaizuka & O. Ikki
RTS, Tokyo, Japan

7DO.5.4 Solar PV Grid Integration: Challenges in India After Grid Parity
G. Gupta
MNIT, Deoli, India

ORAL PRESENTATIONS 5DO.9

08:30 - 09:30 Long-Term PV Module Performance and Climatic Stress

Chairpersons:

Ralph Gottschalg
Loughborough University, United Kingdom

William Gambogi
DuPont, United States

5DO.9.1 Module Characterisation of a Roof Integrated PV System After a 12-Years Operation in the Swiss Midlands
S. Dittmann, T. Friesen & F. Frontini
SUPSI, Canobbio, Switzerland
U. Wolfer
Swiss Federal Office of Energy, Bern, Switzerland

5DO.9.2 Degradation and Reliability of Fielded c-Si PV Modules over 20 Years in China
X. Dong, H. Wang, Y. Jin, J. Huang & H. Shen
ShunDe SYSU Institute for Solar Energy, Foshan, China

5DO.9.3 Analysis of Crystalline Silicon PV Modules After 30 Years of Outdoor Exposure
J. Lopez, A. Pozza & T. Sample
European Commission, Ispra, Italy

5DO.9.4 Environmental Stress Potentials of Different Climatic Regions
M. Owen-Bellini, J. Zhu, T.R. Betts & R. Gottschalg
Loughborough University, United Kingdom

ORAL PRESENTATIONS 3DO.13

08:30 - 09:30 Light Management

Chairpersons:

Paola Delli Veneri
ENEA, Italy

Marko Topic
University of Ljubljana, Slovenia

3DO.13.1 In2O3:H Transparent Conductive Oxides Prepared by Atomic Layer Deposition for Application in Passivated Contacts

B. Macco, H.C.M. Knoops, M.F. Vos, Y. Kuang,
M.A. Verheijen & W.M.M. Kessels
Eindhoven University of Technology, Netherlands

3DO.13.2 Nano-Imprint Textured Intermediate Reflectors for Advanced Light Management in Multi-Junction Solar Cells

F. Lentz, M. Ghosh & M. Meier
Forschungszentrum, Jülich, Germany
U.-W. Paetzold, A. Hoffmann, M. Smeets,

3DO.13.3 Ultrathin C-Si Solar Cells with Inverted Nanopyramids Array

A. Gaucher, A. Cattoni, I. Massiot, C. Dupuis & S. Collin
CNRS, Marcoussis, France
W. Chen, R. Cariou, M. Foldyna & P. Roca i Cabarrocas
CNRS, Palaiseau, France
L. Lalouat, E. Drouard & C. Seassal
INL, Ecully, France

3DO.13.4 When Nanophotonics Meet Thin Crystalline-Silicon Photovoltaics

V. Depauw, C. Trompoukis, I. Gordon & J. Poortmans
imec, Leuven, Belgium
O. El Daif
Qatar Foundation, Doha, Qatar
L. Lalouat, H. Ding, J. Liu, R. Orobtchouk, F. Mandorlo,
A. Fave, C. Seassal & E. Drouard
Centrale Lyon, Ecully, France
A. Harouri
Centrale Lyon, Palaiseau, France
W. Chen, M. Foldyna & P. Roca i Cabarrocas
CNRS, Palaiseau, France
J. Müller, A. Mayer, A. Herman & O. Deparis
University of Namur, Belgium
K.D. Lee & R. Jiawook
Obducat Technologies, Lund, Sweden
I. Massiot & A. Dmitriev
Chalmers University, Goteborg, Sweden

VISUAL PRESENTATIONS 3DV.1

08:30 - 09:30 CdTe, CIS and Related Thin Film Devices I

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

PLENARY SESSION 5DP.1

09:50 - 11:20 Reliability and Life Cycle Analysis of PV Modules, Irradiance Forecasting and Integration of PV Systems

Chairpersons:

Ulrike Jahn
TÜV Rheinland, Germany

5DP.1.1 Keynote Presentation: PV Module Reliability: How Can We Improve It?

J. Wohlgemuth & S.R. Kurtz
NREL, Golden, United States

5DP.1.2 Review and Status - Life Cycle Analysis of PV Modules

M. de Wild-Scholten
Groet, Netherlands

5DP.1.3 Comparison of Irradiance Forecasts Based on Numerical Weather Prediction and Satellite Data for Central and Northern Europe

E. Lorenz, J. Kühnert & D. Heinemann
University of Oldenburg, Germany
K.P. Nielsen
Danish Meteorological Institute, Copenhagen, Denmark
J. Remund & S.C. Müller
Meteotest, Bern, Switzerland
W. Traunmüller
Blue Sky, Attang, Austria
S. Cros
Reuniwatt, Sainte-Clotilde, Reunion

5DP.1.4 International Development of Energy Storage Interoperability Test Protocols for Photovoltaic Integration

D. Rosewater & J. Johnson
Sandia National Laboratories, Albuquerque, United States
C. Messner, R. Bründlinger & J. Kathan
AIT, Vienna, Austria
M. Verga & R. Lazzari
RSE, Milan, Italy
J. Hashimoto & K. Kenji
AIST, Tsukuba, Japan

PLENARY SESSION 6DP.2

11:20 - 12:10 From Novel Products to Large-Scale Grid Integration

Chairpersons:

Franz P. Baumgartner
Zurich University of Applied Sciences, Switzerland

6DP.2.1 Keynote Presentation: Smart Grid Solar Bavaria Project
C. Brabec
University of Erlangen-Nuremberg, Germany

6DP.2.2 Solar Road Operating Efficiency and Energy Yield – a Case Study
S. Klerks
TNO, Delft, Netherlands
A. Shekhar, V. Prasanth & P. Bauer
Delft University of Technology, Netherlands

ORAL PRESENTATIONS 2DO.2

13:30 - 15:00 Advanced solar cell structures

Chairpersons:

Stefan W. Glunz
Fraunhofer ISE, Germany

Pierre-Jean Ribeyron
CEA/INES, France

2DO.2.1 Macroporous Blind Holes as Surface Texture for High Efficiency Silicon Solar Cells
S. Schäfer, C. Gemmel, S. Kajari-Schröder & R. Brendel
ISFH, Emmerthal, Germany

2DO.2.2 Optimized Metal Free Back Reflectors for High Efficiency Open Rear c-Si Solar Cells
A. Ingenito, O. Isabella & M. Zeman
Delft University of Technology, Netherlands
S. Luxembourg, P. Spinelli & A.W. Weeber
ECN, Petten, Netherlands

2DO.2.3 22.1% Efficient Black Silicon Solar Cells with Interdigitated Back-Contacts
P. Repo, G. von Gastrow & H. Savin
Aalto University, Espoo, Finland
P. Ortega, E. Calle, M. Garin & R. Alcubilla González
UPC, Barcelona, Spain

2DO.2.4 23.6% Efficiency with Laser Processed IBC Solar Cells
E. Hoffmann, M. Dahlinger, K. Carstens & J.H. Werner
Unversity of Stuttgart, Germany

2DO.2.5 Process Implification and Improvement of Rear Side of IBC Cells by Means of PECVD SIOX and Epitaxy
Y. Li, M. Récaman-Payo, B. Zielinski,
M. Debucquoy & J. Poortmans
imec, Leuven, Belgium

2DO.2.6 Concepts and Prospects of Passivated Contacts for Crystalline Silicon Solar Cells
J. Melskens, B. van de Loo, B. Macco, M.F. Vos,
J. Palmans, S. Smit & W.M.M. Kessels
Eindhoven University of Technology, Netherlands

ORAL PRESENTATIONS 6DO.6

13:30 - 15:00 Photovoltaics as a Part of our Living Environment: Design, Strategies, Approaches and Solutions

Chairpersons:

Francesco Frontini
SUPSI, Switzerland

Heinz Ossenbrink
European Commission DG JRC, Italy

6DO.6.1 Parametric Analysis and Systems Design of Dynamic Photovoltaic Shading Modules
J. Hofer, J. Prageeth, Z. Nagy & A. Schlueter
ETH Zurich, Switzerland
A. Groenewolt
University of Stuttgart, Germany

6DO.6.2 Thermal and Electrical Performance of Semi-Transparent PV Windows: Numerical Simulations and Experimental Study
K. Kapsis & A.K. Athienitis
Concordia University, Montreal, Canada

6DO.6.3 G-Value Indoor Characterization of Semi-Transparent Photovoltaic Elements for Building Integration: New Equipment and Methodology
L. Olivieri & E. Caamaño-Martín
UPM, Madrid, Spain
F. Frontini, C.S. Polo López & D. Pahud
SUPSI, Canobbio, Switzerland

6DO.6.4 **A Multifunctional Photovoltaic Shed for Sustainable Mobility**
P. Bernardoni, S. Baricordi, G. Calabrese, V. Guidi, M. Tonezzer & D. Vincenzi
University of Ferrara, Italy

6DO.6.5 **Innovative Photovoltaic Patterns for New Landscape Ecological Performances. Design, Concepts, and Assessment**
A. Scognamiglio
ENEA, Portici, Italy

6DO.6.6 **Building Integrated Photovoltaics with Passive Solar Heating and Cooling**
E.L. Meyer, S. Ziuku, M. Simon & O.K. Overen
University of Fort Hare, Alice, South Africa

ORAL PRESENTATIONS 5DO.10

13:30 - 15:00 **Materials for PV Modules, Backsheets and Encapsulants**

Chairpersons:

Gernot Orenski
PCCL, Austria

Henning Nagel
Fraunhofer ISE, Germany

5DO.10.1 **Special Introductory Presentation: Round Robin Testing of Various Back-Sheets for PV-Modules with Different Ultra-Violet Radiation Sources and Sample Temperatures**
M. Köhl & A. Ballion
Fraunhofer ISE, Freiburg, Germany
Y.-H. Lee & H.-S. Wu
ITRI, Hsinchu, Taiwan
K.P. Scott
Atlas MTT, Chicago, United States
S. Glick & P. Hacke
NREL, Golden, United States
H.J. Koo
FITI Testing & Research Institute, Seoul, Korea South

5DO.10.2 **Silver-Grid Corrosion: Identification of Critical Environmental Stresses, Corrosion Products and Influences of the Back Sheet**
J. Bierbaum, I. Dürr, S. Hoffmann, D. Philipp & K.-A. Weiß
Fraunhofer ISE, Freiburg, Germany

PROGRAMME

5DO.10.3 **Moisture Ingress in PV Modules: Innovative and Versatile In-Situ Monitoring Technique**
M. Jankovec & M. Topic
University of Ljubljana, Slovenia
F. Galliano, H.-Y. Li, F. Sculati-Meillaud, C. Ballif & E. Annigoni
EPFL, Neuchâtel, Switzerland
L.-E. Perret-Aebi
CSEM, Neuchâtel, Switzerland

5DO.10.4 **Permeation of Water Vapour, Oxygen and Acetic Acid through PV-Backsheets: Correlation with Material Properties and Ageing Induced Changes**
G.C. Eder & Y. Voronko
OFI, Vienna, Austria
M. Knausz & G. Oreski
PCCL, Leoben, Austria
T. Koch
Vienna University of Technology, Austria
K.A. Berger
AIT, Vienna, Austria

5DO.10.5 **Holistic View of Interactions in Modules Affecting Durability – Adhesion and Snail Trails**
A. Meisel, T. Dang, C. Alcantara, D. Inns, M. Terry & H. Antoniadis
DuPont, Sunnyvale, United States
Y. Xu, J. Fan & J. Wang
DuPont, Shanghai, China
J. Kapur, B. Hamzavytehrany & W. Gambogi
DuPont, Wilmington, United States

NOTES

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ORAL PRESENTATIONS 7DO.14

13:30 - 15:00 Building Blocks for High PV Penetration in the Markets

Chairpersons:

Christian Breyer
Lappeenranta University of Technology, Finland

Izumi Kaizuka
RTS, Japan

7DO.14.1 Forecast of Long-Term PV Installations – Discussion of Scenarios ranging from IEA to the Solar Economy
A. Gerlach & M. Fischer
Hanwha Q CELLS, Bitterfeld-Wolfen, Germany
C. Breyer
Lappeenranta University of Technology, Finland
C. Werner
Hanergy, Berlin, Germany

7DO.14.2 Case Study of a Low-Voltage Distribution Grid with High PV Penetration in Germany and Simulation Analyses of Cost-Effective Measures
F. Carigiet & F. Baumgartner
Zurich University of Applied Sciences, Winterthur, Switzerland
M. Niedrist & C. Scheuermann
EKS, Schaffhausen, Switzerland

7DO.14.3 Increase of PV Self-Consumption by DSM, EV and Battery Storage
J. Thomsen, V. Jülch, N. Saad Hussein & C. Kost
Fraunhofer ISE, Freiburg, Germany

7DO.14.4 Investigating the Impact of Solar Radiation Variability on Grid Stability with Dispersed PV Generation
P. Rodden, J. Backwell, M. Thwaites & L. Frearson
CAT Projects, Alice Springs, Australia

7DO.14.5 Enhance Interconnection Operation of Japan's Power System to Accommodate PV Penetration in 2030
K. Ogimoto, K. Kataoka & J.G.S. Fonseca Jr.
University of Tokyo, Japan
H. Azuma, A. Isonaga & S. Nonaka
JP Business Service, Tokyo, Japan
T. Oozeki
AIST, Tsukuba, Japan

7DO.14.6 North-East Asian Super Grid for 100% Renewable Energy Power Supply: Distributed Small-Scale and Centralized Large-Scale Solar PV as a Major Energy Source
D. Bogdanov & C. Breyer
Lappeenranta University of Technology, Finland

VISUAL PRESENTATIONS 3DV.2

13:30 - 15:00 Silicon-Heterojunction Devices and Light

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

ORAL PRESENTATIONS 2DO.3

15:15 - 16:45 Characterization and Simulation of PERC Solar Cells

Chairpersons:

Wilhelm Warta
Fraunhofer ISE, Germany

Armin Gerhard Aberle
SERIS, Singapore

2DO.3.1 Efficiency Potential of Cz-Si PERC Solar Cells After Permanent Deactivation of the Boron-Oxygen Defect
D. Walter & J. Schmidt
ISFH, Emmerthal, Germany

2DO.3.2 Regeneration of B-Doped Solar Cell by Carrier Injection and Extra Energy
X. Meng, X.-S. Wang & G. Xing
Canadian Solar, Suzhou, China

2DO.3.3 Incremental Efficiency Improvements of Mass-Produced PERC Cells Up to 24%, Predicted Solely with Continuous Development of Existing Technologies and Wafer Materials
B. Min
ISFH, Emmerthal, Germany
H. Wagner
MIT, Cambridge, United States
M. Müller & D.-H. Neuhaus
SolarWorld Innovations, Freiberg, Germany
P.P. Altermatt
Leibniz University of Hannover, Germany

2DO.3.4 Investigating the Impact of Parameter and Process Variations on Multicrystalline PERC Cell Efficiency
S. Wasmer, J. Greulich, H. Höffler, J. Haunschild,
M. Demant & S. Rein
Fraunhofer ISE, Freiburg, Germany

2DO.3.5 Investigation of Rear Contact Resistance of Line Contacted Industrial PERC Solar Cells
F. Lottspeich, M. Müller, M. Schuchart, G. Fischer & E. Schneiderlöchner
SolarWorld Innovations, Freiberg, Germany
T. Dullweber
ISFH, Emmerthal, Germany

2DO.3.6 A New Tool to Predict the Temperature and the Efficiency of Silicon Solar Cells
R. Couderc, M. Amara & M. Lemiti
INSA Lyon, Lyon, France

ORAL PRESENTATIONS 6DO.7

15:15 - 16:45 PV Supporting the Electrical Energy System

Chairpersons:

Ingrid Weiss
WIP - Renewable Energies, Germany

Sandor Szabó *(i)*
European Commission DG JRC, Italy

6DO.7.1 Optimum Allocation of PV and Wind Power for Green Power Supplier Under Power Retail Deregulation in Japan
N. Sugishita, A. Ogawa & G. Mogi
University of Tokyo, Japan

6DO.7.2 The Role of Solar PV in the Long-Term Sustainability of the Finnish Energy System
M. Child & C. Breyer
Lappeenranta University of Technology, Finland
T. Haukkala
Aalto University, Finland

6DO.7.3 On the Influence of PV System Orientation on Residential Self-Consumption
G.B.M.A. Litjens, P. Moraitis & W.G.J.H.M. van Sark
Utrecht University, Netherlands

6DO.7.4 Optimal Design of a PV Installation with Regards to a House's Electrical Load Curve
A. Lindsay, P. Dupeyrat, E. Vallet & G. Kwiatkowski
EDF, Moret-sur-Loing, France

6DO.7.5 Developing and Investigating a Smart Solar Powered Energy System for Increased PV Self-Consumption
M. Noebels, J. Glatz-Reichenbach, A. Minde & K. Peter
ISC Konstanz, Germany

6DO.7.6 Solar Mobility: Long term Practical Experience Charging Electrified Cars with Solar Energy
J. Merten, N. Martin, H. Guillou, D.L. Ha, O. Wiss & M. Perrin
CEA, Le Bourget du Lac, France

ORAL PRESENTATIONS 5DO.11

15:15 - 16:45 PV Module Characterisation and Energy Rating

Chairpersons:

Tony Sample
European Commission DG JRC, Italy

Yoshihiro Hishikawa
AIST, Japan

5DO.11.1 Current Status and Outlook on the Accuracy of PV Module Calibration
D. Dirnberger, U. Kräling, A. Schmid & F. Neuberger
Fraunhofer ISE, Freiburg, Germany
H. Müllejans & E. Salis
European Commission DG JRC, Ispra, Italy
K. Emery & M. Campanelli
NREL, Golden, United States
Y. Hishikawa
AIST, Tsukuba, Japan

5DO.11.2 Results of the SOPHIA Module Intercomparison Part-2: STC, Low Irradiance Conditions and Temperature Coefficients Measurements of Thin Film Technologies
B. Mihaylov, J.W. Bowers, T.R. Betts & R. Gottschalg
Loughborough University, United Kingdom
T. Krametz, R. Leidl, K.A. Berger & S. Zamini
AIT, Vienna, Austria
N.J.J. Dekker
ECN, Petten, Netherlands
G. Graditi, F. Roca, M. Pellegrino & G. Flaminio
ENEA, Portici, Italy
G. Razongles & J. Merten
CEA, Le Bourget du Lac, France
A. Pozza & R.P. Kenny
European Commission DG JRC, Ispra, Italy

5DO.11.3 Impact of Realistic Illumination on Optical Losses in Si Solar Cell Modules Compared to Standard Testing Conditions

M. Winter, M. Vogt & P.P. Altermatt
Leibniz University of Hannover, Germany
H. Holst
ISFH, Emmerthal, Germany

5DO.11.4 Effect of Glass/EVA/backsheet Encapsulation Package on the Industrial Rating of c-Si PV Modules

C. Monokroussos, J. Lau, L. Xu, D. Etienne,
C. Dreier & R. Struwe
TÜV Rheinland, Shanghai, China
S. Kera & K. Morita
TÜV Rheinland, Yokohama, Japan

5DO.11.5 Energy Rating Label for PV Modules to Improve Energy Yield Prediction in Different Climates

M. Schweiger & W. Herrmann
TÜV Rheinland, Cologne, Germany

5DO.11.6 A Comparison of PV Performance Prediction Model Types for Different Technologies from Outdoor Measurements

S. Ransome
Steve Ransome Consulting, Kingston upon Thames, United Kingdom
J. Sutterlueti
Gantner Instruments, Schruns, Austria

ORAL PRESENTATIONS 7DO.15

15:15 - 16:45 The Role of Adequate Business Models in Shaping PV Development

Chairpersons:

Verónica Bermudez
CNRS, France

Andrew Machirant
Svensk Solenergi, Sweden

7DO.15.1 PV LCOE in Europe 2014-30

E. Vartiainen
Fortum, Espoo, Finland
G. Masson
Becquerel Institute, Brussels, Belgium

7DO.15.2 Deployment Pathways for Photovoltaics in the EU Towards 2020: Comparing Economic Factors with Policies at Municipal Level

N. Taylor, S. Szabó, A. Jäger-Waldau, A. Kona, G. Melica, T. Huld & H. Ossenbrink
European Commission, Ispra, Italy

7DO.15.3 PV Investment Financeability and Attractiveness: Improvement of Business Models through Technical Risk Quantification and Management

C. Tjengdrawira & A. Woyte
3E, Brussels, Belgium
M. Graf von Armansperg
ACCELIOS Solar, Bensheim, Germany
D. Moser
EURAC Research, Bolzano, Italy
I.T. Theologitis
SolarPower Europe, Brussels, Belgium
U. Jahn & M. Herz
TÜV Rheinland, Cologne, Germany

7DO.15.4 Building Integrated Photovoltaics (BIPV) - a Projects and Market Overview to Assess Potential of Innovative Solutions

E. Delponte & F. Marchi
D'Appolonia, Genova, Italy
F. Frontini & C.S. Polo López
SUPSI, Canobbio, Switzerland
K. Fath
Fraunhofer ISE, Freiburg, Germany
M. Batey
Howest, Bruges, Belgium

7DO.15.5 Quantifying System-Wide Financial Costs and Benefits of PV in South Africa

K. Roro & T. Bischof-Niemz
CSIR, Pretoria, South Africa

7DO.15.6 Economics of Global LNG Trading Based on Hybrid PV-Wind Power Plants

M. Fasihi & C. Breyer
Lappeenranta University of Technology, Finland

VISUAL PRESENTATIONS 3DV.3

15:15 - 16:45 CdTe, CIS and Related Thin Film Devices II

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

ORAL PRESENTATIONS 2DO.4

17:00 - 18:30 Advanced Characterization and Simulation

Chairpersons:

Jan Schmidt
ISFH, Germany

Ronald Sinton
Sinton Instruments, United States

2DO.4.1 Fast and Accurate 1D Cell Simulation
K.R. McIntosh & M.D. Abbott
PV Lighthouse, Coledale, Australia

2DO.4.2 Development, Characterization, and Modelling of Doping Profile, Contact Resistance, and Metal Spiking in Diffused and Screen-Printed Boron Emitters
N. Woehrle, E. Lohmüller, S. Werner, J. Greulich & S. Mack
Fraunhofer ISE, Freiburg, Germany

2DO.4.3 Characterization of Selective Emitter Structures Formed by Laser Doping through ALD Al2O3 Layers
A. Sharma, E. Cornagliotti, A. Uruena de Castro, M. Aleman, L. Tous, R. Russell, F. Duerinckx, J. Szlufcik & J. Poortmans
imec, Leuven, Belgium

2DO.4.4 Microscopic Thick Film Contact Formation Mechanism to p(p+) Si and Influence of the Metal Contact on the Sisubstrate - Lessons Learned from the KONSENS Project
S. Riegel, S. Fritz, K. Dressler, A. Herguth & G. Hahn
University of Konstanz, Germany
M. König & M. Hörteis
Heraeus, Hanau, Germany

2DO.4.5 Demonstration of a Novel Inspection System for a Solar Cell Using Terahertz Emission Imaging
H. Nakanishi, A. Ito, M. Mizubata & I. Kawayama
SCREEN, Kyoto, Japan
H. Murakami & M. Tonouchi
Osaka University, Japan

2DO.4.6 Spectrally Shaped Supercontinuum for Advanced Solar Cell Characterization
M. Mundus, M. Kumar Dasa, X. Wang, J. Hohl-Ebinger & W. Warta
Fraunhofer ISE, Freiburg, Germany

ORAL PRESENTATIONS 6DO.8

17:00 - 18:30 PV and Storage Solutions

Chairpersons:

Nicola Pearsall
Northumbria University, United Kingdom *(i)*

6DO.8.1 The Swiss PV Wall System to Maximise Self-Consumption in a Single Building Element
F.P. Baumgartner, R. Knecht, D. Lantschner, T. Baumann & H. Nussbaumer
ZHAW, Winterthur, Switzerland
J. Böhler & U. Brühl
Sto, Stühlingen, Germany

6DO.8.2 PV Battery Systems Tested with Real-Life Consumption Data
R. Rode Mosbæk
LiTHIUM BALANCE, Ishøj, Denmark
I. Katic
Danish Technological Institute, Taastrup, Denmark

6DO.8.3 Lightweight Fuel-Fired Thermophotovoltaic Power Supply
L. Fraas, L. Minkin, J. Avery & H. She
JX Crystals, Issaquah, United States
L. Ferguson
C12Materials, Everett, United States
F. Dogan
Missouri S&T, Rolla, United States

6DO.8.4 Thermal and Electrical Performance of Solar Photovoltaic/Thermal Hybridair Collectors Integrated into Building
Y.B. Assoa, F. Sauzedde & B. Boillot
CEA, Le Bourget du Lac, France

6DO.8.5 Utilisation of Excess Solar PV Generation in the Production of Domestic Hot Water for Residential Applications
J. Harrison & J. Terry
E.ON Technologies, Nottingham, United Kingdom

6DO.8.6 Utilization Concept for Residential PV Storage Systems Based on an Innovative Measurement and Control System
F. Soyck, F. Funck, S. Diekmann, S. Laudahn & B. Engel
TU Braunschweig, Germany

ORAL PRESENTATIONS 5DO.12

17:00 - 18:30 Stress Testing of PV Modules

Chairpersons:

John Wohlgemuth
NREL, United States

Roland Einhaus *(i)*
Apollon Solar, France

5DO.12.1 Analysis of the Influence of Mechanical Loading Events on the Performance of Photovoltaic Modules and Systems
R. Desharnais
Yingli Green Energy, San Francisco, United States
T. Roessler
Yingli Green Energy, Munich, Germany

5DO.12.2 Cocktail Sequential Test for c-Si PV Module: the Correlation Among Accelerated Stress Factors
M. Chang, H. Chen, C. Chen & C.H. Hsueh
AU Optronics, Taichung, Taiwan

5DO.12.3 Safety of Photovoltaic Modules – Focus on Insulation Coordination
A. Roth
VDE Testing and Certification Institut, Offenbach, Germany
G. Volberg & J. Althaus
TÜV Rheinland, Cologne, Germany
B. Jaeckel
UL International, Roitzsch, Germany
P. Seidel
First Solar, Mainz, Germany
M. Beck
SIVApower, San Jose, United States
G. Kleiss
SolarWorld, Bonn, Germany

5DO.12.4 Highly Accelerated Thermal Cycling Test for Short Term Examination of Photovoltaic Module Reliability
M. Fujimori & T. Kohno
Hitachi, Tokyo, Japan
Y. Tsuno & K. Morita
TÜV Rheinland, Yokohama, Japan

5DO.12.5 PV Module Damages Caused by Hail Impact – Field Experience and Lab Tests
G. Mathiak, L. Pohl, J. Sommer, U. Fritzsche, W. Herrmann, F. Reil & J. Althaus
TÜV Rheinland, Cologne, Germany
M. Köntges
ISFH, Emmerthal, Germany

5DO.12.6 Accelerated PV Module Aging by a Two-Axis Solar Tracking Mirror Concentrator System
D. Stellbogen & P. Lechner
ZSW, Stuttgart, Germany

ORAL PRESENTATIONS 2DO.16

17:00 - 18:30 Industrial Aspects of High Performance c-Si Cells

Chairpersons:

Juliane Heiber
Meyer Burger Technology, Switzerland

Peter Wohlfart
SINGULUS TECHNOLOGIES, Germany

2DO.16.1 Investigation of Process-Induced Parasitic Rear Contacts in High Efficiency PERC Pilot Manufacturing
T. Weber, M. Müller, A. Fülle, A. Krause, F. Wolny, G. Fischer, R. Schiepe, A. Oehlke, C. Kusterer & S. Steckemetz
SolarWorld Innovations, Freiberg, Germany

2DO.16.2 Implementation and Optimization of an Industrial mc-Si PERC Process for Mass Production
J. Denafas, L. Petreniene, K. Meskereviciene, M. Pranaitis, A. Stonkus & V. Juzumas
Baltic Solar Solutions, Vilnius, Lithuania
T. Dippell & A. Hain
SINGULUS TECHNOLOGIES, Kahl am Main, Germany

2DO.16.3 Low Cost High Energy Yield Solar Module Lines and Its Applications
T. Söderström, Y. Yao, R. Grischke, M. Gragert, C. Rychen & C. Erban
Meyer Burger, Gwatt, Switzerland
B. Strahm & P. Papet
Meyer Burger, Hauterive, Switzerland
J. Krause
Roth & Rau, Hohenstein-Ernstthal, Germany

2DO.16.4 Rapid Processing of Boron-Oxygen Defects
B. Hallam, P. Hamer, N. Nampalli, M. Abbott, M. Kim, D. Chen, A. Azmi, N. Gorman, H. Li, P.H.D. Lu, S. Wang, A. Wenham, C. Chan & S.R. Wenham
UNSW, Sydney, Australia

2DO.16.5 Novel Silver and Copper Pastes for N-Type Bi-Facial PERT Cell

K. Nakamura
Meiji University, Kawasaki-shi, Japan
T. Takahashi
Namics, Niigita City, Japan
Y. Ohshita
TTI, Nagoya, Japan

2DO.16.6 Inline Quality Rating of High-Performance Multi-Crystalline Wafers Based on Photoluminescence Images

M. Demant, H. Höffler, J. Broisch, T. Strauch,
J. Haunschild & S. Rein
Fraunhofer ISE, Freiburg, Germany
K. Sunder & O. Anspach
PV Crystalox Solar, Erfurt, Germany

VISUAL PRESENTATIONS 7DV.4

17:00 - 18:30 PV in the Electricity Markets / Local and Regional Business Models for PV Development / From R&D to Large Scale Deployment

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

FRIDAY, 18 September 2015

ORAL PRESENTATIONS 5EO.1

08:30 - 10:00 Manufacturing Quality, Recycling and Sustainability of PV Modules

Chairpersons:

Eric Gerritsen
CEA, France

Sylvère Leu
Meyer Burger Technology, Switzerland

5EO.1.1 Product Environmental Footprint of Photovoltaic Electricity Production: a Step towards a Single Market for Green Products

R. Frischknecht, F. Wyss & P. Stolz
Treeze, Zurich, Switzerland
M. de Wild-Scholten
SmartGreenScans, Groet, Netherlands

5EO.1.2 Production of Recyclable PV Modules

M.J.A.A. Goris, V. Rosca & L.J. Geerligs
ECN, Petten, Netherlands

5EO.1.3 50 Years of PV Development: Review, Learning Rates and Outlook for Cost and Environmental Footprint

A. Louwen & W.G.J.H.M. van Sark
Utrecht University, Netherlands
R.E.I. Schropp
ECN, Eindhoven, Netherlands
A.P. Faaij
Groningen University, Netherlands

5EO.1.4 Fast and Non-Destructive Detection on the EVA Gel Content in Photovoltaic Modules by Optical Reflection

H.-Y. Li & C. Ballif
EPFL, Neuchâtel, Switzerland
Y. Luo
Plus MAT, Schüpfen, Switzerland
L.-E. Perret-Aebi
CSEM, Neuchâtel, Switzerland

5EO.1.5 Backsheet Designs Critical to PV Module Performance, Safety and Durability

W. Gambogi, J. Kopchick, T. Felder, S. MacMaster,
A. Bradley, B. Hamzavytehrany, B.-L. Yu,
K.M. Stika & J. Trout
DuPont, Wilmington, United States

Y. Heta
DuPont, Utsunomiya-shi, Japan
L. Garreau-Iles
DuPont, Meyrin, Switzerland
C.F. Wang & H. Hu
DuPont, Shanghai, China

5EO.1.6 Advancements in the Development of "AtaMo": a Solar Module Adapted for the Climate Conditions of the Atacama Desert in Chile

E. Cabrera, A. Schneider, J. Rabanal-Arabach & R. Kopecek
ISC Konstanz, Germany
P. Ferrada
University of Antofagasta, Chile

ORAL PRESENTATIONS 7EO.2

08:30 - 10:00 What Works - What Remains to be Done?

Chairpersons:

Emiliano Perezagua
Consultores de Energía Fotovoltaica, Spain

Paola Mazzucchelli
EUREC, Belgium

7EO.2.1 From off Grid through Grid Connected Applications, the Economic and Behavioral History of the Global Photovoltaic Industry & Its Future Prospects

P. Mints
SPV Market Research, San Jose, United States
B. Newman
Sunfly Consulting, Washington, United States

7EO.2.2 Cost and Benefits of Past and Current Support Schemes for PV in Europe

A. El Gammal, S. Orlandi & G. Masson
Becquerel Institute, Brussels, Belgium

7EO.2.3 Towards a Portfolio of Research Infrastructures to Support the Development of Photovoltaics all along its Value Chain

P. Malbranche
CEA, Le Bourget du Lac, France
F. Roca
ENEA, Portici, Italy
J.M. Kroon
ECN, Petten, Netherlands
G. Arrowsmith
EUREC, Brussels, Belgium

7EO.2.4 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, M. Biedrawa & M. Schulte
Forschungszentrum Jülich, Germany
S. Rabe
CEF-NRW, Düsseldorf, Germany
K. Wikman
TEKES, Helsinki, Finland
Y. Durand
ADEME, Valbonne, France
C. Coulaud
ADEME, Paris, France
J. Herrero
CIEMAT, Madrid, Spain
S. Falcón Morales
MINECO, Madrid, Spain
L. Polain & J. Marlier
Public Service of Wallonia, Jambes, Belgium
E. De Clercq
IWT, Brussels, Belgium
M. Swiderska
NCBR, Warsaw, Poland
K. Karaösz & I. Dogan
TUBITAK, Gebze, Turkey
O. Bernsen
Netherlands Enterprise Agency, Den Haag, Netherlands
S. Tselepis
CRES, Athens, Greece
C. Inglis
InnovateUK, Swindon, United Kingdom
L. Antoniou & D. Petsa
RPF, Lefkosia, Cyprus
L. Antoniou & D. Petsa
RPF, Lefkosia, Northern Cyprus
A. Agrimi
Regione Puglia, Bari, Italy
C. Gadaleta Caldarola
ARTI, Valenzan, Italy
D. Tornabene & F. Montagnino
Regione Sicilia, Palermo, Italy
T. Zillner
Federal Ministry of Transport, Vienna, Austria
E. Lutter & G. Wörther
Klima- und Energiefonds, Vienna, Austria
L. Sjöström & T. Walla
Swedish Energy Agency, Eskilstuna, Sweden

7EO.2.5 **Perspectives on Management of End-of-Life Photovoltaic Modules**
K. Sander
Ökopol, Hamburg, Germany
K. Wambach
bifa Environmental Institute, Augsburg, Germany

7EO.2.6 **A Greenhouse Gas Neutral Society in 2050: More Than 100 % RE**
M. Nowakowski, K. Purr, B. Hain,
K. Müschen & H. Lehmann
Federal Environment Agency of Germany, Dessau-Roßlau, Germany

ORAL PRESENTATIONS 6EO.3

08:30 - 10:00 **Multifunctional Systems Providing Local Technical Services**

Session Chair:

Philippe Malbranche
CEA/INES, France

Badr Ikken
IRESEN, Morocco

6EO.3.1 **PV Powered Products: the Future Is Design and Styling**
A.H.M.E. Reinders & W. Eggink
University of Twente, Enschede, Netherlands

6EO.3.2 **PV-Battery Energy Storage Projects: Lessons Learned in the Field**
N. Munzke & J. Barry
KIT, Eggenstein-Leopoldshafen, Germany

6EO.3.3 **Advanced Systems for Harsh Environment Off-Grid Renewable Generation using Battery Energy Storage**
L. Lanuzza, F. Bizzarri & F. Bonemazzi
ENEL, Rome, Italy
J.P. Justiniano
ENEL, Santiago de Chile, Chile

6EO.3.4 **Micro-Grid Expansion: Usage Patterns, Key Role of Storage, Modeling to Project Demand**
A. Skumanich & S. Reddy
SolarVision, Los Gatos, United States
P. Loka & K. Polsani
Premier Solar, Hyderabad, India
P. Mints
SPV Market Research, San Jose, United States

PROGRAMME

6EO.3.5 **Maximising Sustainability and Transformative Potential via Community Engagement in Mini Grid Deployment Models**
I. Baudish & A. Bruce
UNSW, Sydney, Australia

6EO.3.6 **PV-Hybrid Mini-Grids for Rural Electrification Economics, Profitability and Challenges of the Business Model**
J. Rosenbusch
BSW - Solar, Berlin, Germany

PLENARY SESSION 7EP.1

10:30 - 12:00 **PV Becoming Mainstream**

Chairpersons:

Stefan Nowak
NET Nowak Energy & Technology, Switzerland

Pietro Menna
European Commission DG Energy, Belgium

7EP.1.1 **Keynote Presentation: PV in the Utility World - Today and Tomorrow**
C. Pignoloni
Enel Green Power, Rome, Italy

7EP.1.2 **Keynote Presentation: Quantification, Challenges and Outlook of PV Integration in the Power System: a Review by the European PV Technology Platform**
P.-J. Alet
CSEM, Neuchâtel, Switzerland
F. Baccaro
ENEL GREEN POWER, Rome, Italy
M. De Felice & M. Petitta
ENEA, Rome, Italy
V. Efthymiou
University of Cyprus, Nicosia, Cyprus
C. Mayr
AIT, Vienna, Austria
G. Graditi
ENEA, Portici, Italy
M. Juel
SINTEF, Trondheim, Norway
D. Moser
EURAC, Bolzano, Italy
F. Nemac
ApE, Ljubljana, Slovenia
S. Tselepis
CRES, Pikermi, Greece
G. Yang
DTU, Lyngby, Denmark

7EP.1.3 **Keynote Presentation: Towards a European Union of Photovoltaic Solar Electricity**

H. Ossenbrink, A. Jäger-Waldau, N. Taylor, S. Szabó, T. Huld & E. Dunlop
European Commission DG JRC, Ispra, Italy

12:00 – 13:30 CONFERENCE CLOSING

Chaired by:

Stefan Rinck
Conference General Chairman
CEO SINGULUS TECHNOLOGIES,
Member of Main Executive Board VDMA and
Chairman Committee for Research and Innovation

Key note presentation

The Highlights of the Conference

Ceremony of Poster Awards

Winners of Student Awards

Conclusions and Farewell

At the time of printing the detailed Programme of the Closing Event is under final preparation. Please visit www.photovoltaic-conference.com for all information.

Conference Programme
FRIDAY, 18 SEPTEMBER 2015

PROGRAMME

NOTES

MONDAY, 14 September 2015

VISUAL PRESENTATIONS 2AV.1

13:30 - 15:00 Silicon Feedstock, Crystallisation and Wafering

22AV.1.3 Improved Seeded Directional Solidification Thermal Model for Producing High-Efficiency Multi-Crystalline Silicon Ingots
Q. Wang, L. Zhen, L. Liu, L. Zhang, Y. Zhang, W. Gao, Z. Hu & J. Xiong
Yingli Green Energy, Baoding, China

2AV.1.4 Dedusting of Czochralski Waste Gas and Dust Deactivation - Contributions to Safe and Economic Production
J. Ruth & G. Heser
Pall, Dreieich, Germany
R. Berndt
RBFM Consulting, Dresden, Germany

2AV.1.5 Monocrystalline Upgraded Metallurgical Grade Silicon Obtained through Vacuum Degassing and Czochralski Growth for Solar Cell Application
F.C. Marques, A.D. Soares Côrtes, R.B. Merlo, D. Soares da Silva, G.A. Viana & P.R. Mei
UNICAMP, Campinas, Brazil

2AV.1.6 Manipulation of Zeta Potential on Silicon Particles
T. Luessenhop, M. Bittner, F. Gerling & C. Mühl
Petrofer Chemie H.R. Fischer, Hildesheim, Germany

2AV.1.7 Effects of the Specific Gravity of Coolant in Diamond Wire Slicing on Cutting Ability and Defect of Wafer Edge
C.-F. Yeh & W.-J. Cheng
Motech Industries, Tainan City, Taiwan

2AV.1.8 Mathematical Modeling of Metallurgical-Grade Silicon Plasma-Chemical Purification Process
S.M. Karabanov, D.V. Suvorov, D.Y. Tarabrin, E. Slivkin & G.P. Gololobov
RSREU, Ryazan, Russia
V. Yasevich & A.S. Karabanov
Energy Ryazan, Russia

2AV.1.9 The Study of the Method of Plasma-Chemical Purification of Metallurgical-Grade Silicon
S.M. Karabanov
RSREU, Ryazan, Russia
V. Yasevich, A.S. Karabanov & V.L. Dshkhunyan
Energy Ryazan, Russia
M. Hoshino
Japan S.E.C., Tokyo, Japan

2AV.1.10 Comparison of Defect Formations in Solar Silicon Growth from Small Random and Large Oriented Seeds
C.C. Hsieh, Y. Wu, C.-W. Lan & H.P. Hsu
NTU, Taipei, Taiwan
A. Lan & C. Hsu
SAS, Hsinchu, Taiwan

2AV.1.11 Influence of Argon Gas Flow on the Crystal Quality in the 400mm CZ Silicon with a Magnetic Field
M. Gao, L. Jin & L. Sen
Ningxia University, Yinchuan, China

2AV.1.12 Effect of Total Dopant Concentration on the Effciency of Solar Cells Made of CS-Silicon
V. Hoffmann
Technology Consulting, Berlin, Germany
J. Míguez Novoa, R. Ordás Badia & J. Bullon Camarasa
Silicio FerroSolar, Arteixo, A Coruña, Spain
I. Buchovska, T. Vlasenko & S. Beringov
Pillar Group, Kiev, Ukraine

2AV.1.13 Phosphorus Removal in Batch Silicon Refinement by Electron Beam
Al. Kravtsov & An. Kravtsov
KEPP-EU, Riga, Russia

2AV.1.14 New Steps in the Electron Beam Pulling of Silicon Rods for the FZ Silicon Single Crystals
An. Kravtsov
KEPP-EU, Riga, Latvia

2AV.1.15 Effect of Phosphorus Gettering on Quasi-Single-Crystalline Silicon Wafers
R. Søndenå
Institute for Energy Technology, Kjeller, Norway
K.E. Ekstrøm, L. Arnberg & M. Di Sabatino
NTNU, Trondheim, Norway
G. Stokkan & H. Dalaker
SINTEF, Trondheim, Norway
T. Lehmann
Fraunhofer THM, Freiberg, Germany

2AV.1.16 Interaction of Dislocations in Si Growth by Directional Solidification Based on Crystallographic Orientation: Experiment and Simulation
K. Jiptner, Y. Miyamura & T. Sekiguchi
NIMS, Tsukuba, Japan
B. Gao & K. Kakimoto
Kyushu University, Kasuga, Japan

2AV.1.17 Photovoltaic Performance of Crystalline Silicon Solar Cell Using Electron-Beam Melting-Based Metallurgical Route
J.-K. Lee, J.S. Lee, Y.S. Ahn & G.-H. Kang
KIER, Daejeon, Korea South
C.-H. Cho
Chungnam National University, Daejeon, Korea South

2AV.1.18 Investigation of Relation between Torque Value of Wire Guide Roller and Diamond Wire Saw
T.-C. Wang
Motech Industries, Tainan, Taiwan

2AV.1.19 Formation of Metallic Silicon Formed by Carbothermal Reduction of Silica Fabricated Using Shirasu Volcanic Ash
K. Hatakeyama, K. Sato, K. Maeda, K. Sakai & K. Nishioka
University of Miyazaki, Japan
K. Itaka
Hirosaki University, Aomori, Japan

2AV.1.20 Formation of Silicon Using Solar Furnace
K. Sato, K. Hatakeyama, H. Kaneko & K. Nishioka
University of Miyazaki, Japan

2AV.1.21 Hydrogenation of Striation Rings in n-Type Wafers
P. Manshanden, P. Bronsveld & G. Coletti
ECN, Petten, Netherlands

2AV.1.22 Application of Pellets in the Production of Solar Silicon
H. Bolze, J.-P. Mai & A. Fromm
JPM Silicon, Braunschweig, Germany

2AV.1.23 Inline Photoluminescence Imaging Inspection of Silicon Blocks
B. Mitchell, D. Chung & T. Trupke
UNSW, Sydney, Australia
J.W. Weber
BT Imaging, Sydney, Australia
J. Schön
Fraunhofer ISE, Freiburg, Germany

2AV.1.24 Effects of Superimpose Low and Medium Frequency Magnetic Fields in Induction Direction Solidification System
F. Dughiero, M. Forzan, N. Sempreboni & A. Tolomio
University of Padua, Italy

2AV.1.25 Investigation of the Effect of Varied Sawing Parameter (Feed Rate and Wire Speed) and Varied Coolant Brands on Forces between Silicon and Wire as Well as Wafer Surface Quality
R. Buchwald, S. Würzner, A. Proshkin,
K. Fröhlich & H.J. Möller
Fraunhofer THM, Freiberg, Germany

2AV.1.26 Origin of Periodic Structures on Silicon Wafers Sawn with Diamond Wire
K. Sunder & O. Anspach
PV Crystalox Solar, Erfurt, Germany
R. Buchwald
Fraunhofer THM, Freiberg, Germany

2AV.1.27 Evaluation of the Electrical Properties of Intentionally Al and Fe Contaminated p-Type and n-Type Cz Si Ingots: from Feedstock to Solar Cells
J. Degoulange & R. Einhaus
Apollon Solar, Lyon, France
N. Enjalbert & S. Dubois
CEA, Le Bourget du Lac, France
P. Rivat
FerroPem, Chambery, France
Y. Delannoy
Grenoble University, St Martin d'Heres, France

2AV.1.28 New Kerfless Technology for Thin Film Crystalline Silicon Based PV Cells
C. Metzner, D. Temmler, S. Saager, J.-P. Heinß,
E. Bodenstein & M. Ben Yaala
Fraunhofer FEP, Dresden, Germany

2AV.1.29 Quality Aspects of Siemens-Rods for FZ Crystallization
M. Schley, F. Schaaff & M. Gartenbach
Silicon Products, Bitterfeld-Wolfen, Germany

2AV.1.30 Temperature Dependent Recombination Velocity Analysis on Artificially Induced Grain Boundaries
T. Kojima, T. Tachibana & Y. Ohshita
TTI, Nagoya, Japan
R.R. Prakash & T. Sekiguchi
NIMS, Tsukuba, Japan

2AV.1.31 Influence of Atmospheric Conditions on the Stability of Si3N4-Based Crucible Coatings
C. Reimann, M. Lang, V. Schneider & J. Friedrich
Fraunhofer IISB, Erlangen, Germany

2AV.1.32 Crucible Contribution to Cell Efficiency and Process Yield
J. Laurent, A. Jouini, N. Enjalbert & B. Drevet
CEA, Le Bourget-du-Lac, France
C. Martin
Vesuvius, Feignies, France

2AV.1.33 Capillary Rheometer for the Measurement at Realistic Shear Rates of the Effective Viscosity of Slurries Used for Wire Sawing of Semiconductor Materials
H. Chaves, A. Ams & S. Kriegel
Freiberg University of Technology, Germany

2AV.1.34 Pattern Saw Marks on Diamond Wire Cut Wafers – Investigation from Wafer to Module
M. Lanz & Y. Yao
Meyer Burger, Gwatt, Switzerland
D.L. Bätzner, R. Kramer, L. Andreetta, D. Lachenal, W. Frammelsberger, B. Legradic, J. Meixenberger, P. Papet, B. Strahm & G. Wahli
Meyer Burger, Hauterive, Switzerland

2AV.1.35 Mechanical and Microstructural Analysis of Diamond Wire Sawn Wafers Considering the Wire Wear in Sawing Process
R. Koepge, C. Klute, F. Kaule & S. Schönfelder
Fraunhofer CSP, Halle, Germany
K. Sunder & O. Anspach
PV Crystalox Solar, Erfurt, Germany

2AV.1.36 Analysis of Surface Contamination Levels induced by Maskless Plasma Texturing of Silicon Solar Wafers
D. Lausch, S. Wahl & S. Meyer
Fraunhofer CSP, Halle, Germany
M. Gaudig & J. Hirsch
Anhalt University of Applied Sciences, Köthen, Germany

2AV.1.37 Sprayed Phosphoric Acid as Dopant Source for Silicon Ribbons
J.M. Pereira, J.A. Almeida Silva, I. Costa, D. Pera, M. Brito & J.M. Serra
University of Lisbon, Portugal

2AV.1.38 Analysis of the Impact of Czochralski Growth Parameters on Silicon Grown-in Defects Formation
M. Jomâa & M. M'Hamdi
SINTEF, Oslo, Norway
O. Jensen
Institute for Energy Technology, Kjeller, Norway

2AV.1.39 Neutron Activation Analyses (NAA) Investigation of Transition-Metal Impurities Content in Solar Grade Silicon Feedstock for Directional Solidification of Photovoltaic HEM Silicon Ingot
Y. Chettat, A. Lami & H. Rahab
CRTSE, Algiers, Algeria
L. Hamidatou, M. Salhi & H. Slamene
CRNB, Djelfa, Algeria
A. Benmounah
UR–MPE, Boumerdès, Algeria

2AV.1.40 Hydrogen Passivation of Interstitial Iron in Boron-Doped Silicon by Annealing with Plasma-Enhanced Chemical Vapour Deposited Silicon Nitride
A. Liu, C. Sun & D. Macdonald
ANU, Canberra, Australia

2AV.1.41 Influence of RTP Process on the Carrier Lifetime in Silicon CZ Virgin Wafers
Y. Kouhlane, D. Bouhafs, N. Khelifati, A.E.-G. Boucheham & A. Mokadem
CRTSE, Algiers, Algeria

VISUAL PRESENTATIONS 6AV.4

13:30 - 15:00 PV Supporting Electrical and Thermal Energy Systems

6AV.4.1 Design and Engineering of Modular Cooling Units for Photovoltaic Modules
V.O. Silva, M.E. Morales Udaeta & A.L. Gimenes
University of São Paulo, Brazil
F.C. Costa
HU Berlin, Germany
P.H.D.C. Rigolin & A.L. Linhares
SOLEVEN, London, United Kingdom
W.P. Silvestre
EXER, São Paulo, Brazil
A.C. Abreu Junior & H. Kuratani
CESP, São Paulo, Brazil
M. Dias
Prosolar, Sao Paulo, Brazil

6AV.4.2 The Energy System Defined by PV: Balancing Generation and Load via Adequate Plant Design and Load Adaptation
S. Krauter
University of Paderborn, Germany

6AV.4.4 Use of Solar PV Energy to Replace Nuclear Power in Taiwan
B.-J. Huang, P.C. Hsu, Y.H. Wang, J.H. Tsai, L. Chen, K. Li & K.Y. Lee
NTU, Taipei, Taiwan

6AV.4.7 PRONTAS: Remotely Piloted Solar Plane Prototype
E. Friend, M. Cendagorta, G. Galván, M. Huebra, J. Martín & M. Torres
ITER, Granadilla de Abona / Santa Cruz Tenerife, Spain
M. González, A. Jarzabek & A. Moreno
UPM, Madrid, Spain
F. Martín de la Escalera
Aernnova Engineering Solutions, Madrid, Spain

6AV.4.8 Lessons in Community Owned PV from Swedish Multi-Family Housing Cooperatives
N. Sommerfeldt & H. Muyingo
KTH Royal Institute of Technology, Stockholm, Sweden

6AV.4.9 Demand Side Management for Enhanced Integration of Photovoltaics into Grid
N. Wyrsch, Y. Riesen, R. Tschui, C. Boillat & C. Ballif
EPFL, Neuchâtel, Switzerland

6AV.4.10 Optimisation of Experimental Model Parameter Identification for Lead Acid Storage Batteries Used in Photovoltaic Systems
N. Achaibou
USTHB, Algiers, Algeria
A. Harikenchikh
CDER, Bouzareah-Algiers, Algeria

6AV.4.11 Analysis for the Integration of a PV System in the Energy Concept at a German Airport
V. Becker & H. te Heesen
Environmental Campus Birkenfeld, Germany
A. Lichius & B. Schulitz
DBS Ingenieure, Mülheim/Ruhr, Germany

6AV.4.12 Theoretical Study of a PV/TH Air System with a Parabolic Concentrator
T. Kerbache
University Constantine 1, Algeria
L. Maifi
Polytechnic Military Academy, Algiers, Algeria
O. Hioual
University of Khenchela, Algeria
E. Matagne
CESAME, Louvain-la-Neuve, Belgium

6AV.4.13 Analysis of Characteristics of Solar Photovoltaic Thermal Hybrid Systems
A. Norsoyan & R. Vardanyan
SEUA, Yerevan, Armenia

6AV.4.14 Influence of the Inclusion of Storage in Grid-Connected Domestic PV-Systems on the Predictability of the Power Exchange with the Grid
H.G. Beyer
University of Agder, Grimstad, Norway
A.G. Imenes
Teknova, Kristiansand, Norway
C. Sepulveda
University of Oldenburg, Germany

6AV.4.15 Flexible Offshore Solar Photovoltaic Systems for Marine Applications
A. Uppada, S.P. Duttagupta & T. Eldho
IIT Bombay, Mumbai, India
V.R. Basam & G. Ravikumar
NSTL, Vishakhapatnam, India

6AV.4.16 Optimized Power Development Strategy of Saudi Arabia Considering Sustainability and Opportunity Loss of Subsidized Oil
A. Tomoda, Y. Yoshizawa, A. Ogawa & G. Mogi
University of Tokyo, Japan

6AV.4.17 Rewable Energy High Penetration Scenarios Using Energyplan: a Case Study for Bressanone
M.G. Prina, G. Garegnani, D. Moser,
R. Vaccaro & W. Sparber
EURAC, Bolzano, Italy

6AV.4.18 PV Integration as a Tool for Transforming Existing Indian Cities as Smart Cities
S. Dutta
Chandigarh College of Architecture, India
U. Roy
IIT Roorkee, India
M. Roy
Jadavpur University, Kolkata, India

6AV.4.19 Combining Smoothing of the Power Injected into the Grid and a Battery Charge from an Intermittent Photovoltaic Production
J. Lhermenault & E. Radvanyi
EDF, Ecuelles, France
C. Ducharme, C. Dumbs & J. Maire
EDF, Paris, France

6AV.4.20 Photovoltaic-Thermal Solar Collectors for the Preheating of Domestic Hot Water – One-Year Measurement Results and Comparison with Simulation
D. Zenhaeusern, A. Baggenstos, O. Türk,
S. Brunold & M. Rommel
HSR, Rapperswil, Switzerland

6AV.4.21 Toolbox for the Design and Simulation of Energy Management Strategies for Battery-Based BIPV Systems
J. Pascual, P. Sanchis & L. Marroyo
Public University of Navarre, Pamplona, Spain

6AV.4.22 Efficiency Effects on Radiative Forcing of Solar Installations
B. Burg, P. Ruch, S. Paredes & B. Michel
IBM, Rüschlikon, Switzerland

6AV.4.23 Off Grid PV-Driven Cooling for Post-Harvest Crops in Desert Areas in Egypt
M. Ayad
Egyptian Solar Energy Systems, Giza, Egypt
P. Schwerdt
Fraunhofer UMSICHT, Oberhausen, Germany
A. Khalil
Cairo University, Giza, Egypt

6AV.4.24 Building a PV Based Microgrid as a Smart Energy Solution for a Small-Size Touristic Village
J. Fernández, G. Moncho, L. Marechal, C. Montes, M. Delgado, J. Rodríguez, M. Friend & M. Cendagorta
ITER, Granadilla de Abona, Spain

6AV.4.25 A Radiative Transfer with Shading Model of Annual Global Solar Insolation
J. Gooding, C. Smith, R. Crook & A.S. Tomlin
University of Leeds, United Kingdom

6AV.4.26 PV's for Powering of Marine Vessels
S. Guha, S. Nashikkar, V. Chowdary & G. Sharma
Indian Maritime University, Kolkata, India

6AV.4.27 Role and Potential of Semi-Autonomous (PV) Power Systems - A Simulation Model to Study Feasibility and Economic Impacts
P. Waegli
Dr. P. Waegli Research, Bremgarten, Switzerland

6AV.4.28 The Value of Responsive Demand in Distribution Systems with PV Generation
T.F. Araújo, W. Uturbey, L.G. Monteiro, W.C. Boaventura, E.N. Cardoso & B.M. Lopes
UFMG, Belo Horizonte, Brazil
L. Xie
A&M University, Texas, United States
W. Negrao-Macedo
UFPA, Belém, Brazil

6AV.4.29 Direct Charging of Electrical Vehicles via PV
S. Krauter
University of Paderborn, Germany

6AV.4.30 Energy Supply in a Building via a Photovoltaic-Thermal Power System
S. Yilmaz, H.R. Ozcalik & E. Kilic
Kahramanmaras Sutcu Imam University, Turkey

6AV.4.31 Local Cost of Seawater RO Desalination Based on Solar PV and Wind Energy: Economics, Global Demand and the Impact of Full Load Hours
U. Caldera
Technical University of Berlin, Germany
D. Bogdanov & C. Breyer
Lappeenranta University, Finland

6AV.4.32 Analysis of the Present Situation of Solar Photovoltaic Systems Integration in the Spanish Ports
F. Díaz & I. Villalba
ULPGC, Las Palmas de Gran Canaria, Spain

6AV.4.33 Optimal Design of PV and HP System
B.C. Nepper-Rasmussen
Technical University of Denmark, Kongens Lyngby, Denmark
T.B. Rasmussen
Technical University of Denmark, Copenhagen, Denmark

6AV.4.34 BIPV Solar Harvesting by Use of Architectural Films
C.H. Oon, K.W. Ng & K. Hock
Temasek Polytechnic, Singapore, Singapore

VISUAL PRESENTATIONS 2AV.2

15:15 - 16:45 Silicon Solar Cell Improvements

2AV.2.1 21 % p-Type Industrial PERC Cells with Homogeneous Emitter Profile
L.-C. Cheng, M.-C. Kao, H.-H. Huang, P.S. Huang & L.-W. Cheng
Topcell Solar, Taoyuan, Taiwan

2AV.2.2 Inkjet Printed Metallization Applied to Silicon Heterojunction Solar Cell
J. Hermans & W.J.M. Brok
Roth & Rau, Eindhoven, Netherlands
P. Papet & B. Strahm
Meyer Burger Research, Hauterive, Switzerland
Y. Yao & A. Richter
Meyer Burger Technology, Gwatt, Switzerland

2AV.2.3 Contact Resistivity Measurements of Point-Contacting by Localised Dielectric Breakdown Structures by the Transmission Line Method
N.J. Western & S.P. Bremner
UNSW, Sydney, Australia

2AV.2.4 Selective Emitter in n-Type c-Si Solar Cells
J. Liu, G.J.M. Janssen, M. Koppes, E.J. Kossen, Y. Komatsu, J. Anker, A. Gutjahr & I. Romijn
ECN, Petten, Netherlands
A. Vlooswijk
Tempress, Vaassen, Netherlands
J.M. Luchies
Amtech Tempress Systems, Vaassen, Netherlands
O. Siarheyeva & E. Granneman
Levitech, Almere, Netherlands

2AV.2.5 Optimization of BBr3 Diffusion Processes for n-Type Silicon Solar Cells
S. Werner, E. Lohmüller, U. Belledin, S. Mack & A. Wolf
Fraunhofer ISE, Freiburg, Germany
A.H.G. Vlooswijk & R.C.G. Naber
Tempress, Vaassen, Netherlands

2AV.2.6 High Efficiency Si Solar Cells with Photonic Crystal Rear Reflector
B. Lee
NREL, Golden, United States
J. Eisenlohr, F. Feldmann, M. Drießen, T. Rachow,
N. Tucher, J.C. Goldschmidt, J. Benick & M. Hermle
Fraunhofer ISE, Freiburg, Germany

2AV.2.7 Effect of Light Induced Degradation and Regeneration on p-Type PERC Cells
J.-R. Huang, K.-Y. Yen, Y.-F. Lin, S.-P. Su,
S.H.T. Chen & L.-W. Cheng
Topcell Solar, Taoyuan County, Taiwan

2AV.2.8 19.8% Conversion Efficiency in Modulated Surface Textured IBC c-Si Solar Cells
A. Ingenito, O. Isabella & M. Zeman
Delft University of Technology, Netherlands

2AV.2.9 Analysis of Key Aspects of a Screen to Achieve Better Metallization
M.L. Lin, P. Kuo, S. Cheng & W. Chen
Motech Industries, Tainan, Taiwan

2AV.2.11 The Effect of Front Side Amouphous Silicon Layer Thickness on Rear Emitter Heterojunction Solar Cells
M.Y. Chen, J. Chang, F.-S. Chen, W.-C. Shieh & Z.-Y. Shih
AU Optronics, Taichung, Taiwan

2AV.2.12 Ultra-Fine Screen and Stencil-Printed Line for Silicon Solar Cells
A. Faes, N. Badel, M. Despeisse & C. Ballif
CSEM, Neuchâtel, Switzerland
J. Fleischer & P.V. Fleischer
MP+L Produktion, Neufinsing, Germany

2AV.2.13 Mass Production of Rear Emitter Solar Cell on n Type Si Wafer by Means of Traditional Process
W. Wang & C. Zhou
CAS, Beijing, China
B. Sun & F. Shen
Bright Solar Energy, Tongxiang, China

2AV.2.14 Passivation Properties of PEDOT:PSS Layers over Crystalline Silicon Wafers
E. Zugasti, J. Armentia, M. Murillo, M. Ezquer,
M.J. Rodriguez & A.R. Lagunas
CENER, Sarriguren-Navarra, Spain

2AV.2.15 Electrically Conductive Adhesives for Photovoltaic (PV) Applications
J. Rodríguez-Parada, M.E. Lewittes,
R.S. Mclean & K.E. Myers
DuPont, Wilmington, United States
M.-F. Mu, P. Feng, B. Xiang, Z. Liu & L.Q. Wu
DuPont R&D Center, Shanghai, China

2AV.2.16 Rear-Colored Double Glass Module Fabricated with Rear-Colored Bifacial p-Type PERC Cells
B. Liu & H. Shen
Sun Yat-sen University, Changzhou, China
Y. Chen, Y. Yang, J. Dong, Z. Feng & P.J. Verlinden
Trina Solar Energy, Changzhou, China

2AV.2.17 Ozone as Promising Additive for HF-H2SO4- and HF-HCl-Mixtures: Cleaning and Etching SG-Silicon
C. Gondek, A. Stapf & E. Kroke
Freiberg University of Technology, Germany

2AV.2.18 Optimized SiN Surface Passivation of Maskless Inductively Coupled Plasma (ICP) Formed Black-Silicon without Additional Self-Bias
J. Hirsch, M. Gaudig & N. Bernhard
Anhalt University of Applied Sciences, Köthen, Germany
M. Gläser & D. Lausch
Fraunhofer CSP, Halle, Germany

2AV.2.19 The Effect of Rear Surface Flatness on the Performance of the Printed-AlOx PERC
Y.-S. Lin, T.-C. Chen, C.-H. Ku, C.-S. Hu & C.-C. Wen
E-TON Solar Tech, Tainan, Taiwan

2AV.2.20 Manufacturing of 300Wp Modules by Improving p-Type PERC Solar Cell Technology
C.-W. Kuo, T.-M. Kuan, L.-G. Wu, C.-C. Huang,
S.-I. Peng & C.-Y. Yu
TSEC, Hsinchu, Taiwan

2AV.2.21 The Effects of Annealing Processes on Effective Lifetime in n-Type Crystalline Silicon
T. Tachibana & Y. Ohshita
TTI, Nagoya, Japan
N. Ikeno & A. Ogura
Meiji University, Kawasaki, Japan

2AV.2.22 Innovative Approach to Simultaneous Laser-Doping and Grooving for Improved Plated-Copper Metallisation
S. Wang, L. Mai, A. Wenham, C. Chan, B. Hallam, C.M. Chong, J. Ji, Z. Shi, S.R. Wenham, Z. Hameiri & A. Sugianto
UNSW, Sydney, Australia

2AV.2.23 A Numerical Analysis on Trench Structure of Interdigitated Back Contact Solar Cells
S.M. Kim, S. Chun, J.-H. Lee, H. Boo, S. Bae, Y. Kang, H.-S. Lee & D. Kim
Korea University, Seoul, Korea South
M.G. Kang & H.-E. Song
KIER, Daejeon, Korea South

2AV.2.24 Effect of Oxygen Partial Pressure on Morphology of Contact Interface and Cell Performance of Screen-Printed Si Solar Cells
S. Cho, H.S. Kim, M.-J. Hwang & J.-Y. Huh
Korea University, Seoul, Korea South

2AV.2.25 New Insights on the Ag Screen Printing and Ni/Cu Plating Performances on Highly-Doped Emitters of Industrial p-Type Silicon Solar Cells
J. Coudrec, J. Dupuis & C. Guerard
EDF R&D, Chatou, France
E. Urrejola & S. Pouliquen
Air Liquide, Jouy en Josas, France
D. Lincot
CNRS, Chatou, France

2AV.2.26 High-Performance Multi-Crystalline Silicon Photovoltaics: Production Advances from Wafers to Modules
C.-W. Lan
NTU, Taipei, Taiwan
M. Yang, A. Yu, B. Hsu & C. Hsu
SAS, Hsinchu, Taiwan
W.-C. Chang & A. Yang
Solartech Energy, Hsinchu, Taiwan

2AV.2.27 Heterojunction a-SiC/c-Si Solar Cell Structures and Their Electrical Characterization
M. Perný, V. Saly, M. Mikolasek & M. Váry
Slovak University of Technology, Bratislava, Slovakia
J. Huran
Slovak Academy of Sciences, Bratislava, Slovakia

2AV.2.28 Efficiency Enhancement for Screen Printed Solar Cells on Quasi-Mono Wafers through Advanced Hydrogenation
B. Hallam, L. Song, S. Wang, M. Abbott, A. Wenham, P. Hamer, A. Azmi & S.R. Wenham
UNSW, Sydney, Australia

2AV.2.29 TiO2/SiO2 Composite Light Scattering Back Reflector with Liquid Source Passivation
H. Nagayoshi, T. Murooka & C. Hagiwara
TNCT, Tokyo, Japan

2AV.2.30 The Current Conduction Mechanism of Novel Silver Thick Film Electrode
T. Takahashi
Namics, Niigita, Japan
T. Tachibana, T. Kamioka, N. Iwata & Y. Ohshita
TTI, Nagoya, Japan

2AV.2.31 Radial Junction Solar Cells by Metal Assisted Etching
G. Baytemir, F. Es & R. Turan
METU, Ankara, Turkey

2AV.2.32 TCO Workfunction in n-Type Amorphous Silicon Oxide / p-Type c-Si Heterojunction Solar Cell: an Opened Issue
L. Serenelli, M. Tucci, M. Izzi, P. Mangiapane & E. Salza
ENEA, Rome, Italy
M. Della Noce, I. Usatii, E. Bobeico, L.V. Mercaldo, L. Lancellotti & P. Delli Veneri
ENEA, Portici, Italy
D. Caputo & G. de Cesare
University of Rome „La Sapienza“, Italy

2AV.2.33 Toward 30µm Printed Ag Finger Width by Ultra Fine Line Double Printing
A. Voltan, O. Borsato & M. Galiazzo
Applied Materials, Olmi di San Biagio di Callalta, Italy

2AV.2.34 An Innovative Hexagonal Geometry of the Metallization for Performance Improvement Simulated in Synopsys Sentaurus for PV Silicon Solar Cell
E. Stuckova
Nottingham Trent University, United Kingdom

2AV.2.35 New and Effective Anti Reflection Coating of SiC-SiO2 Nanocomposite for P-Type Silicon Solar Cell by Sol-GelProcess
A. Jannat, W. Lee, M.S. Akhtar, Z.Y. Li & O.-B. Yanga
Chonbuk Nationa University, Jeonju, Korea South

2AV.2.36 Emitter Patterning for IBC-SHJ Solar Cell Using Laser Hard Mask Writing and Self-aligning
S. Ring, L. Mazzarella, P. Sonntag, S. Kirner, C. Schultz, U. Schmeißer, J. Haschke, L. Korte, B. Stannowski, B. Stegemann & R. Schlatmann
HZB, Berlin, Germany

VISUAL PRESENTATIONS 6AV.5

15:15 - 16:45 Integrating Photovoltaics in our Living Environment: New Solutions from Optimization to Application / PV Applications without a Centralised Grid

6AV.5.2 BIPV Demonstrator Performance and Environmental Impact in the Netherlands
M. Ritzen, Z. Vroon & R. Rovers
Zuyd University of Applied Sciences, Heerlen, Netherlands
C. Geurts
TNO, Eindhoven, Netherlands

6AV.5.3 Application of Thin Film PV for Large Area Facades
J.A.M. Ammerlaan, J. Gilot & R.A.J.M. Andriessen
TNO, Eindhoven, Netherlands
J.-E. Ehlers
ThyssenKrupp, Dortmund, Germany
J.M. Kroon, N.J.J. Dekker & M.J. Jansen
ECN, Petten, Netherlands
D. Cheyns & R. Gehlhaar
imec, Leuven, Belgium

6AV.5.4 Energetic Behaviour of Selected Buildings with Building-Integrated Solar Technology
G. Becker, F. Flade, R. Krippner & B. Schiebelsberger
SeV Bavaria, Munich, Germany
N. Fischer
Munich University of Applied Sciences, Germany

6AV.5.5 Appliance of Photovoltaics in Historical Built Environment
T. ter Velde, N. Treffers & T. Gorter
NHL University of Applied Sciences, Leeuwarden, Netherlands

6AV.5.6 Maximizing the Solar Photovoltaic Yield in Different Building Facade Layouts
S. Freitas & M.C. Brito
University of Lisbon, Portugal

6AV.5.7 Integrated Solar Systems for Noospheric Buildings
O.V. Shepovalova
RAAS, Moscow, Russia

6AV.5.8 PV Module as a Design Element of Barriers for Protection Against Noise
B.S. Sudimac & A.N. Dubljevic
University of Belgrade, Serbia

6AV.5.9 Solar Roofing to a Bamboo Structure Targeting it as a Zero Energy Building
M. Roy, S. Mukherjee & S. Das
Jadavpur University, Kolkata, India

6AV.5.12 BIPV Competitiveness Analysis under Various Framework Conditions & Strategies for Accelerated Adoption in EU Markets
A. El Gammal
Becquerel Institute, Brussels, Belgium
J. Poortmans
imec, Leuven, Belgium
S. Krawietz
LUISS Guido Carli, Rome, Italy

6AV.5.14 Smart-FLeX – Demonstration of Integrated Approach for Design of Glass BIPV Facade
J. Ulbikas, A.J. Galdikas & A. Stonkus
MODERNIOS E-TECHNOLOGIJOS, Vilnius, Lithuania

6AV.5.15 Worldwide Competition Architectural Award Building-Integrated Solar Technology 2014 - Best Practice Solar Buildings
G. Becker, F. Flade, R. Krippner,
B. Schiebelsberger & W. Weber
SeV Bavaria, Munich, Germany

6AV.5.16 Photovoltaic Oriented Building (PVOB)
C. Renken
Bern University of Applied Sciences, Burgdorf, Switzerland

6AV.5.17 PV Production and Wiring Strategies on Complex Shapes
P. Ingenhoven, L. Maturi & D. Moser
Eurac Research, Bolzano, Italy
M. Lovati
EURAC, Bolzano / Bozen, Italy

6AV.5.18 Wall as Component to Utilize BIPV Modules with Reasonable Seasonal Performance in Comparison with Roof and Canopy
A. Rahmani
University of Kurdistan, Sanandaj, Iran

6AV.5.19 Experimental Validation of Optical Simulation for Complex Building Integrated Photovoltaic System
N. Jakica & A. Zanelli
Polytechnic University of Milan, Italy
F. Frontini
SUPSI, Canobbio, Switzerland

6AV.5.20 Optimising Standard Photovoltaic Modules Based on c-Si Solar Cells for an Aesthetical Integration into the Roofscape of the City of Graz

G. Peharz, W. Nemitz & B. Feketeföldi
Joanneum Research, Weiz, Austria
E. Klein & M. Stadlober
University of Graz, Austria

6AV.5.21 Demonstration and Performance of Colored PV Modules for BIPV Applications

Z. Vroon
TNO, Heerlen, Netherlands
M. Ritzen
Eindhoven University of Technology, Heerlen, Netherlands
B. Vermeulen & H. Rooms
TNO, Eindhoven, Netherlands

6AV.5.24 Novel Luminescent Photovoltaic Roof Presented at Versailles during Solar Decahtlon Europe 2014

P. Bernardoni, S. Baricordi, G. Calabrese, V. Guidi,
M. Tonezzer & D. Vincenzi
University of Ferrara, Italy
M. Brocato & R. Zarcone
ENSAPM, Paris, France

6AV.5.25 PV@Façade: Facade-Elements with PV-Active Layers

G.C. Eder
OFI, Vienna, Austria
K.A. Berger
AIT, Vienna, Austria
G. Peharz
Joanneum, Weiz, Austria
C. Hirschl
CTR, Villach, Austria
M. Grobbauer
FIBAG, Stallhofen, Austria
L. Plessing & C. Waldauf
Crystalsol, Vienna, Austria
A. Zimmermann
Sunplugged Photovoltaics, Schwaz, Austria
M. Aichinger
Ertex-Solar, Amstetten, Austria
A. Geyer
Fritz Egger, Unterradlberg, Austria

PROGRAMME

6AV.5.26 Characterization of BIPV(T) Applications in Research Facility 'SolarBEAT'

R.M.E. Valckenborg
SEAC, Eindhoven, Netherlands
J.L.M. Hensen
Eindhoven University of Technology, Netherlands
W. Folkerts
ECN, Eindhoven, Netherlands
A. de Vries
Holland Solar, Utrecht, Netherlands

6AV.5.31 Solar Powered Infotainment Spot: Design, Feasibility Study and Fabrication of an Autonomous PV System

V. Weeda, O. Isabella & M. Zeman
Delft University of Technology, Netherlands

6AV.5.33 Solar PV integrated Lighter-than-Air Platform (LTAP) for Airborne Power Generation Under Different Wind Gust

K. Ghosh, P.S. Relekar, S.P. Duttagupta,
A. Guha & S. Gupta
IIT Bombay, Mumbai, India

6AV.5.34 Hybrid, Micro-inverter and Battery based Standalone System for Rural and Urban Water Delivery

S. Lakeou & J. Nunez
University of the District of Columbia, Washington,
United States

6AV.5.35 Ripple Control Based Control System for Decentralised Photovoltaic Power Plants

C. Bucher
Basler & Hofmann, Zurich, Switzerland
U. Schuster
EBL, Liestal, Switzerland
D. Müller
Solvatec, Basel, Switzerland
A. Toller
Swistec Systems, Fehraltorf, Switzerland

6AV.5.37 Solar Power for Rural Development in Thailand

S. Puninagoon
Techno Clean, Ladlumkaew, Thailand

6AV.5.38 Modeling and Sizing of Large PV-Diesel Hybrid Systems without Energy Storage

J. Munoz & J.M. Carrillo
UPM, Madrid, Spain

6AV.5.39 Economic Evaluation of a Renewable Energy System for Rural Electrification in Morocco- a Case Study

A. Elfathi, A. Bennouna & A. Outzourhit
Cadi Ayyad University, Marrakech, Morocco

6AV.5.41 Reliability Analysis of Distributed Generation by Photovoltaic Systems
M. Zandi, S. Eslami & M. Bahrami
Shahid Beheshty University, Tehran, Iran

6AV.5.42 Modeling and Simulation of Large PV Pumping Systems
J. Munoz, J.M. Carrillo, F. Martinez-Moreno,
L.M. Carrasco & L. Narvarte
UPM, Madrid, Spain

6AV.5.44 Rural Water Supply in Ethiopia with PV Pumps
Ch. Nyman
Soleco, Porvoo, Finland
T. Beshah
BISIT, Kerpen, Germany
T.B. Woldekirkos
Solatec, Addis Ababa, Ethiopia

6AV.5.46 Architectures for Simultaneous Operation of Multiple Solar Water Pumps for Agricultural Purposes
S. Abbas
Sunvolts, Lahore, Pakistan

6AV.5.47 A Compact Low Cost PV Off-Grid Water Sterilizer
J.M. Serra, P. Marques, P. Luis & S. Raimundo
University of Lisbon, Portugal

6AV.5.49 The Analysis of Performance and Verification Experiment for Building Integrated Photovoltaic Roof System
H.-A. Kim, J.-J. Choi, S.-W. Lee, S.-C. Kim & B.-K. Moon
Korea Conformity Laboratories, Seoul, Korea South

6AV.5.50 Nanogrids in India: A Conceptual Solution for Off Grid/ Rural Electrification
A. Desai & I. Mukhopadhyay
PDP University, Gandhinagar, India

6AV.5.52 Optimized Thin Amorphous Bifacial Single Junction Cells for BIPV Application
N. Reininghaus, C. Feser, M. Vehse & C. Agert
NEXT ENERGY, Oldenburg, Germany

NOTES

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VISUAL PRESENTATIONS 2AV.3

17:00 - 18:30 Silicon Solar Cell Improvements

2AV.3.1 Fine-Line Screen-Printed and Plated Metallization for Silicon Heterojunction Solar Cells
M. Despeisse, A. Faes, A. Lachowicz, N. Badel,
P. Gröninger, J. Levrat, K. Thomas & C. Ballif
CSEM, Neuchâtel, Switzerland
P. Papet & B. Strahm
Meyer Burger, Hauterive, Switzerland
Y. Yao & T. Söderström
Meyer Burger, Gwatt, Switzerland

2AV.3.2 Thermal Laser Separation (TLS) – a New Technology for Cutting Silicon Solar Cells for High-Efficiency Half-Cell Modules
J. Röth & N. Bernhard
Anhalt University of Applied Sciences, Köthen, Germany
C. Belgardt & M. Grimm
3D-Micromac, Chemnitz, Germany
S. Eiternick, M. Turek, F. Kaule, C. Klute,
S. Schönfelder & J. Bagdahn
Fraunhofer CSP, Halle, Germany

2AV.3.3 Intermediate Amorphous Silicon Layer for Crystalline Silicon Passivation with Alumina
J.A. García-Valenzuela, A. Caballero, J.M. Asensi,
J. Bertomeu & J. Andreu
University of Barcelona, Spain
L.G. Gerling Sarabia, P. Ortega & C. Voz Sánchez
UPC, Barcelona, Spain

2AV.3.4 Non Mass Analyzed Ion Implantation for High Efficiency Solar Cells
T. Miller, S. Krause, C. Leavitt, B. Koo, V. Bhosle & J. Graff
Applied Materials, Gloucester, United States

2AV.3.5 Low Cost BC-BJ Solar Cell: Case Study with the Zebra Process
G. Galbiati, L.J. Koduvelikulathu, V.D. Mihailetchi,
A. Halm & H. Chu
ISC Konstanz, Germany

2AV.3.6 Novel, Additive-Free Formulation Concept for Metallization Pastes with Optimized Printing and Electrical Properties
M. Schneider, C. Yüce & N. Willenbacher
KIT, Karlsruhe, Germany

2AV.3.7 High Efficiency Silicon Solar Cells with a Thin Base
F. Akhmedov, M. Kagan, A. Nekrasov & V.A. Unishkov
OJSC „NPP KVANT“, Moscow, Russia

2AV.3.8 Investigation of the Front-Side Transparent Conduction Oxide Films Used in Heterojunction Solar Cells with Front Emitter and Rear Emitter
F.-S. Chen, J. Chang, Z.-Y. Shih & M.-Y. Chen
AU Optronics, Taichung, Taiwan

2AV.3.9 The Influence of Doped Regions and Passivation Layers on the Surface Recombination in Silicon Solar Cells
B.W.H. van de Loo, S. Smit & W.M.M. Kessels
Eindhoven University of Technology, Netherlands
G.J.M. Janssen, M. Koppes, Y. Komatsu,
J. Liu, I.G. Romijn & A.W. Weeber
ECN, Petten, Netherlands

2AV.3.10 Comprehensive Comparison of Different Fine Line Printing Technologies Addressing the Seed and Plate Approach with Ni-Cu-Plating
A. Lorenz, A. Kraft, J. Bartsch, A. Filipovic, S. Binder,
K. Krüger, F. Clement & D. Biro
Fraunhofer ISE, Freiburg, Germany
H. Reinecke
University of Freiburg, Germany

2AV.3.11 Surface Passivation for Silicon Solar Cells by ALD AlOx: Surface Preparation Prior AlOx and Post Anneal
Y. Liu, J. Wu, X.-S. Wang & G. Xing
Canadian Solar, Suzhou, China

2AV.3.12 Research on Aluminium Rear Emitter n-Type Silicon Solar Cell and Module
D. Wang, L. Hou, X.-S. Wang & G. Xing
Canadian Solar, Suzhou, China

2AV.3.13 Passivated Emitter and Rear Contact (PERC) Solar Cells Based on Multi Silicon Material
X.-S. Wang, J. Wu, X. Meng & G. Xing
Canadian Solar, Suzhou, China

2AV.3.14 Thermally Stable Doped Layers with Non Conventional Precursors for Bifacial Solar Cells
P. Goyal, E. Urrejola & J. Hong
Air Liquide, Jouy en Josas, France
P. Roca i Cabarrocas & E.-V. Johnson
CNRS, Palaiseau, France

2AV.3.15 Pilot Line Production of Industrial High-Efficient Bifacial n-Type Silicon Solar Cells with Selective Back Surface Field Process
D. Liu, J. Wang, J. Zhai, Z. Wang & Y. Chen
Yingli Green Energy, Baoding, China

2AV.3.16 Impact of Glass Frit in Ag/Al Paste on Electrical Properties of Bifacial N-Type Crystalline Silicon Solar Cells
T. Aoyama & Y. Yoshino
Noritake, Aichi, Japan
N. Sawamoto & A. Ogura
Meiji University, Kawasaki, Japan

2AV.3.17 Low Cost Wax Masking Technique for Electroplated Metallization for Solar Cells Application
K. Kholostov, A. Klyshko & M. Balucani
University of Rome „La Sapienza“, Italy
D. Bernardi
RISE TECHNOLOGY, Rome, Italy
L. Serenelli, M. Izzi & M. Tucci
ENEA, Rome, Italy

2AV.3.18 Front- and Rear-Emitter Screen Printed Silicon Heterojunction Solar Cells with >20% Efficiency
S.Y. Herasimenka, W.J. Dauksher, C.J. Tracy & S. Bowden
Arizona State University, Tempe, United States

2AV.3.19 Improving the Adhesion of Electroplating Electrode by Low Temperature Annealing for Silicon Heterojunction Solar Cells
C.K. Peng, C.H. Chen, C.-M. Yeh, J.-C. Shiao, L.-Y. Li,
K.Y. Wu & H.-W. Lu
ITRI, Hsinchu, Taiwan

2AV.3.20 Solar Cell Surface Polishing and Junction Isolation by Using an Etching Gel
T. Lin & F.-R. Chen
NTHU, Hsinchu, Taiwan
S.M. Yu & W.C. Sun
ITRI, Hsinchu, Taiwan

2AV.3.21 Effect of Thermal Treatments on the Metal Contacts of Interfaces between Low Temperature Ag Pastes and TCO Layers for HIT Solar Cell
M.-S. Lin, K.-Y. Kuo, Y.-H. Lin, L.-P. Chen & C.C. Li
Motech Industries, Tainan, Taiwan

2AV.3.22 Investigation on AlOx/SiNx Back Stack-Layer of PERC Cells Based on Optical Theory by MATLAB
S. Zhang, C. Liu, C. Liu, D. Xu, Y. Zhu & H. Ji
Han‘s Energy, Shanghai, China

2AV.3.23 Different Dielectrics Deposited by PECVD for the Industrial Manufacturing of PERC Solar Cells
T. Zhou, J.-U. Fuchs, J. Rehli, A. Piechulla,
S. Denzer & W. Jooß
centrotherm photovoltaics, Blaubeuren, Germany

2AV.3.24 Effective Passivation of Black Multi-Crystalline Silicon by Solution Pretreatment and Atomic Layer Deposition for Solar Cell Application
H. Shen, Y. Jiang & T. Pu
NUAA, Nanjing, China

2AV.3.25 Electrochemical Characteristics of Firing Reaction for Screen-Printed Ag Contacts of Crystalline Si Solar Cells
H.-.S Kim, S.-.B. Cho & J.-Y. Huh
Korea University, Seoul, Korea South
G. Eytan & M. Dovrat
Xjet Solar, Rehovot, Israel

2AV.3.26 Valence Band Offset and Hole Transport in Amorphous/ Crystalline Silicon Heterojunction Solar Cells
M. Liebhaber, M. Mews, T.F. Schulze, K. Lips,
B. Rech & L. Korte
HZB, Berlin, Germany

2AV.3.27 Surface Texturing for Silicon Solar Cell Application Using ICP PECVD Plasma Technique
A. Frey, J. Engelhardt, J. Ebser, G. Hahn & B. Terheiden
University of Konstanz, Germany

2AV.3.28 Cell Efficiency Improvement of Fully Implanted nPERT Solar Cells Realized through Metallization Optimization
A. Voltan & M. Galiazzo
Applied Materials, San Biagio di Callalta, Italy
F. Oberholtzer, M. Emsley, C.E. Dubé & J. Graff
Applied Materials, Gloucester, United States

2AV.3.29 Passivation Characteristics of SiO2/SiON Stack for n-Type c-Si Solar Cells
N. Balaji, S. Lee, C. Park, S. Chung, H.T.T. Nguyen,
S.Q. Hussain, J. Raja & J. Yi
Sungkyunkwan University, Suwon, Korea South
J. Ramanujam
National Physical Laboratory, New Delhi, India

2AV.3.30 Optimized Rapid Thermal Process for Selective Emitter Solar Cells
A. Djelloul, M. Meziani, M. Mebarki, L. Mahiou & A. Moussi
CRTSE, Algiers, Algeria
K. Bourai & A. Noukaz
CDTA, Algiers, Algeria

2AV.3.31 Towards a New In situ Characterisation Method for Maskless Plasma Textured Black Silicon by Raman Spectroscopy

M. Gaudig, J. Hirsch & N. Bernhard
Anhalt University of Applied Sciences, Köthen, Germany
D. Lausch
Fraunhofer CSP, Halle, Germany
R.B. Wehrspohn
Fraunhofer IWM, Halle, Germany

2AV.3.32 Epitaxial Interdigitated Back (IBC) Solar Cell Test Platform for Novel Light Trapping Schemes
A. Nawabjan, D.M. Bagnall & S.A. Boden
University of Southampton, United Kingdom
A. Tarazona
EcherKon, Crawley, United Kingdom

2AV.3.33 Bifacial Heterojuntion Solar Cells on p-Type Mono-Si Wafers and the Flexibility of HJT Processing
D.L. Bätzner, R. Kramer, L. Andreetta, D. Lachenal,
W. Frammelsberger, B. Legradic, J. Meixenberger, P. Papet,
B. Strahm & G. Wahli
Meyer Burger, Hauterive, Switzerland

2AV.3.34 Dry Etching Process for Solar Cell Manufacturing
J.C. Loretz
SEMCO Engineering, Montpellier, France

2AV.3.35 Ultra Fine Line Electrodes Reproduction by Screen Printing Method
J. Kawanobe & K. Masuri
MURAKAMI, Chiba, Japan

VISUAL PRESENTATIONS 5AV.6

17:00 - 18:30 PV Modules

5AV.6.1 Demonstration and Evaluation of a Low-Cost Solar Simulator for Spatially and Temporally Dynamic Irradiance Conditions
N. Ruas, F. Catthoor, J. Govaerts & H. Goverde
imec, Leuven, Belgium

5AV.6.2 Improving the Non-Uniformity of a Steady State Solar Simulator Using the Hishikawa-Hashimoto Method
U. Hoyer, M. Siller & R. Auer
ZAE Bayern, Erlangen, Germany
C. Brabec
University of Erlangen-Nuremberg, Germany

5AV.6.3 LED Floodlight for Spectral Tuning of a Class A+ Large Area Pulsed Solar Simulator
M. Pravettoni, L. Manni & S. Dittmann
SUPSI, Canobbio, Switzerland

5AV.6.4 LID Free Module Made from High Performance PERC Solar Cells
S. Frigge, H. Mehlich, T. Große,
D. Landgraf & J. Kowalewski
Roth & Rau, Hohenstein-Ernstthal, Germany

5AV.6.5 Determination of Internal Series Resistance of PV Devices: Repeatability and Uncertainty
G. Trentadue, D. Pavanello & H. Müllejans
European Commission DG JRC, Ispra, Italy

5AV.6.6 Mismatch Loss Analysis Based on Solar Cell IV Curve
Z. Zhang, J. Yu & P. Quan
Trina Solar Energy, Changzhou, China
S. Deng
Hohai University, Changzhou, China

5AV.6.7 Output Estimation of the Crystalline Silicon PV Module by Linear Interpolation Method Using Outdoor Data
T. Kitamoto & Y. Ueda
Tokyo University of Science, Japan

5AV.6.8 Precise Performance Characterization of High-Efficiency Crystalline Silicon Solar Modules
L.-Y.-. Liao, W.-P. Chao & J.-L. Kwo
AllReal Technology, Kaohsiung, Taiwan

5AV.6.9 Nameplate Rating of Photovoltaic Modules: Update on EN 50380 and UL 4730 - Impact for the Industry
B. Jaeckel, M. Cosic & C. Flueckiger
UL International, Neu-Isenburg, Germany

5AV.6.10 Concept for Fast and Precise PV Module Outdoor Characterization
D. Kaiser, M. Simmler, T. Faber & B. Hüttl
University of Applied Sciences, Coburg, Germany
F. Becker & M. Sayala
Calyxo, Bitterfeld-Wolfen, Germany
T. Kaden
Fraunhofer THM, Freiberg, Germany
A. Schulze
Rosenheim University of Applied Sciences, Germany

5AV.6.11 Investigation of Outdoor Measurement Accuracy in a-Si/ a-SiGe Multi-Junction Thin Film Solar Cellls
F. Peng, H. Chen, C. Lian, J. Zhou, H. Wu, C. Zhou, L. Ni,
C. Hong, H. Zhao, J. Zhang, Y. Li & X. Xu
Hanergy Advanced Systems, Chengdu, China

5AV.6.12 Characterization of Photovoltaic Panels in Four Locations of Colombian Central Region, from Irradiance and Temperature Input Variable
J. Hernandez, E. Carrion & D.J. Rodríguez
Universidad Distrital Francisco José de Caldas, Bogotá, Colombia

5AV.6.13 PV Module Temperature Estimation Using ERA-Interim Ambient Temperature Database
E. Barykina, A. Hammer & J. Betcke
University of Oldenburg, Germany

5AV.6.14 Performance Analysis of Micromorph PV-Modules in Various Locations in Russia
D. Andronikov, E. Terukov, D. Malevskiy, A. Abramov,
K. Emtsev & M.Z. Shvarts
RAS/ Ioffe, St-Petersburg, Russia
O. Shutkin
Hevel, Novocheboksarsk, Russia
V. Boryachok
Avelar Solar Technology, Moscow, Russia
D. Vasilyev
North-Eastern Federal University, Yakutsk, Russia
A. Babaev & A. Aliev
RAS, Moscow, Russia

5AV.6.15 Evaluation of Different Photovoltaic Technologies Operating under Different Climatic Regimes in Southern Africa by Utilising Continuous Current-Voltage Measurements.
R.D. Schultz, E.E. van Dyk & F.J. Vorster
NMMU, Port Elizabeth, South Africa

5AV.6.16 Electrical and Morphological Degradation Analysis of a-Si:H Modules
E.L. Meyer, G.O. Osayemwenre,
R.T. Taziwa & S.N. Mamphweli
University of Fort Hare, Alice, South Africa

5AV.6.17 Characterisation of Hourly Temperature af a Thin-Film Module from Weather Conditions by Artificial Intelligence Techniques
M. Piliougine Rocha, L. Mora-López,
J. Carretero & M. Sidrach-de-Cardona
UMA, Málaga, Spain

5AV.6.18 Real Time I-V Bench for Outdoor Characterization of Photovoltaic Modules under Hot Environment
Y.M. Soro, A. Tossa & D. Yamegueu
Fondation 2iE, Ouagadougou, Burkina Faso

5AV.6.19 On-Site Inspection of PV Modules Using an Internationally Accredited PV Mobile Lab: A Three-Year Experience Operating Worldwide
M. Navarrete, L. Perez, F. Domínguez, G. Castillo, R. Gomez, J. Coello & V. Parra
Enertis Solar, San Sebastián de los Reyes, Spain

5AV.6.20 Analysis of the Field Performance of a Double Junction Amorphous Silicon Photovoltaic Module and Its Correlation to Standardized Testing
A. Phinikarides, G. Makrides & G.E. Georghiou
University of Cyprus, Nicosia, Cyprus

5AV.6.21 Cell-to-Module Performance Modeling: Validation and Application for Advanced PV Modules
J. Govaerts, T. Borgers, M. Debucquoy, J. Szlufcik, J. Poortmans & H. Goverde
imec, Leuven, Belgium
A. van der Heide & S. Dewallef
SOLTECH, Tienen, Belgium
K. Baert
KU Leuven, Heverlee, Belgium

5AV.6.22 Comparison of Simulation Tools for Photovoltaic Modules
J. Hernandez, L.F. Herrera Giraldo & J.A. Rodríguez Cruz
Universidad Distrital Francisco José de Caldas, Bogotá, Colombia

5AV.6.23 Analysis and Comparison of Electrical PV Modeling Techniques Based on Datasheet Values
L. Callegaro, M. Ciobotaru & V. Agelidis
UNSW, Sydney, Australia

5AV.6.24 Ray-Tracing Analysis of an Optical Thin-Film Filter for Photovoltaic/Thermal Module
W. Al-Shohani, A. Algareu, R. Al-Dadah & S. Mahmoud
University of Birmingham, United Kingdom

5AV.6.25 Mapping of Spectral Mismatch of Multi-Junction Photovoltaic Modules Using Satellite-Retreived Spectral Irradiance Data
P. Vourlioti, T. Huld, A.M. Gracia Amillo & M. Norton
European Commission, Ispra, Italy

5AV.6.26 Novel Semi-Empirical Combined Electro-Thermal Model for Solar Modules
B. Plesz, Z. Kohári, P.G. Szabó & G. Bognár
BME, Budapest, Hungary

5AV.6.27 CTM of Crystalline BIPV-Modules
C. Erban, I. Haedrich & M. Wiese
Fraunhofer ISE, Freiburg, Germany

5AV.6.28 Modelling the Excess Heat Inside Photovoltaic Module Before and After Photocurrent Conversion Process
D. Magare & R. Gupta
IIT Bombay, Mumbai, India
O.S. Sastry & B. Bora
Solar Energy Centre, Gurgaon, India

5AV.6.31 Possibilities and Challenges of Thermal Transient Testing as a Characterization Method for Photovoltaic Devices
B. Plesz, P.G. Szabó, D. Dudola, G. Hantos & S. Ress
BME, Budapest, Hungary

5AV.6.32 A Simple Method of Evaluating Thermograms of Photovoltaic Modules
L. Cerná, T. Finsterle, P. Hrzina & V. Benda
CTU Prague, Czech Republic

5AV.6.33 Study of Installation Conditions for Bifacial Solar Module
Y.-W. Lin, Y.T. Li, K.-W. Lu, H.-S. Wu & E.Y. Wang
ITRI, Hsinchu, Taiwan

5AV.6.34 New Concepts of PV Systems by the Use of Bifacial Modules with Enhanced Energy Harvest
H. Nussbaumer, D. Schär, T. Baumann, F. Carigiet, N. Keller & F.P. Baumgartner
Zurich University of Applied Sciences, Winterthur, Switzerland

5AV.6.35 Study of Shading Test on Unifacial / Bifacial / Embedded Optimizer C-Si PV Module
C.-W. Yang, C.-M. Yang, C.-M. Cheng & M.-Y. Huang
AU Optronics, Taichung, Taiwan

5AV.6.37 Field Performance Assessment and Comparison of Mono & Bifacial PV Modules
M. Marzoli & G. Friesen
SUPSI, Canobbio, Switzerland

5AV.6.38 Energy Yield Estimation of Monofacial and Bifacial Solar Modules
C. Comparotto, M. Noebels & E. Wefringhaus
ISC Konstanz, Germany
N. Ferretti, G. Mancini, D. Rosas & J. Berghold
PI Berlin, Germany

5AV.6.39 Benchmarking Energy Productivity of PV-Modules: Using the Module Ratio to go Beyond STC Power
J. Merten & L. Sicot
CEA, Le Bourget du Lac, France

5AV.6.40 **Accurate Yearly Yield Calculation Using PV Module Fingerprint Method – Applied for MWT, H-Pattern and Thin Film Modules**
N.J.J. Dekker, J.M. Kroon, M.J. Jansen & W. Eerenstein
ECN, Petten, Netherlands

5AV.6.41 **Outdoors Measurements of PV Module Efficiency and Temperature Coefficients**
F. Martinez-Moreno, J.M. Carrillo & E. Lorenzo
UPM, Madrid, Spain

5AV.6.42 **Hourly Models to Estimate the Energy Produced by Photovoltaic Modules of Different Technologies**
M. Sidrach-de-Cardona, J. Carretero, P. Mora Segado, C. Cañete, M. Piliougine Rocha & L. Mora-López
UMA, Malaga, Spain

5AV.6.43 **Martinique Island: A New Performance Panel for the MotherPV Method**
A. Guérin de Montgareuil & F. Mezzasalma
CEA, St-Paul-lez-Durance, France
C.-E. Baltide, S. Darivon, P. Rosamont & L. Bellemare
AME, Ducos, Martinique

5AV.6.45 **Reliability and Durability Impact of High UV Transmission EVA for PV Modules**
H. Gong, G. Wang, M. Gao & L. Zheng
Suntech Power, Wuxi, China

5AV.6.46 **Reliability and Durability Comparison of Different Backsheet for PV Modules**
H. Gong, G. Wang, M. Gao & L. Zheng
Suntech Power, Wuxi, China

5AV.6.47 **Evaluation the Performance of Different Anti-Corrosion Process on PV Module**
J. Ni, Y. Geng, Z. Sun, Z. Wan, D. Rong, Y. He, K. Liu, Y. Li, X. Lv, J. Jiang & Z. Hu
Yingli Green Energy, Baoding, China

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TUESDAY, 15 September 2015

VISUAL PRESENTATIONS 5BV.1

08:30 - 10:00 Meteorology, Online Monitoring, IR Imaging

5BV.1.3 **Annual Variability in the Solar Resource Determined from Meteosat Satellite Data**
T. Huld
European Commission, Ispra, Italy
J. Trentmann
German Meteorological Service, Offenbach, Germany

5BV.1.4 **Application and Effect Test of a Method of Gradually Approaching Error for the Solar Radiation Prediction**
Z. Chen, P.-J. Sun & R. Zhang
CMA, Wuhan, China

5BV.1.5 **An Improved MOS Model for Solar Radiation Forecasting**
P.-J. Sun, Z. Chen, C. Cheng & X. Zhang
CMA, Wuhan, China
L. Bai
Fujian Climate Centre, Fuzhou, China

5BV.1.6 **The Influence of Buildings Around Meteorological Observing Station on the Sunshine Observation**
P.-J. Sun, Z. Chen, W. Yang & D. Ye
CMA, Wuhan, China
F. Xiang
Meteorological Information and Technological Support Center, Wuhan, China

5BV.1.7 **Methodology to Stochastically Generate Synthetic 1-Minute Irradiance Profiles Derived from Mean Hourly Weather Observational Data**
J. Bright, C. Smith, P.G. Taylor & R. Crook
University of Leeds, United Kingdom

5BV.1.8 **Advanced PV Modules Inspection Using Multirotor UAV**
N. Tyutyuyndzhiev & K. Lovchinov
Bulgarian Academy of Sciences, Sofia, Bulgaria
F. Martinez-Moreno, J. Leloux & L. Narvarte
UPM, Madrid, Spain

5BV.1.9 **Advanced Testing of PV Plants Using Portable SCADA Tool**
N. Tyutyuyndzhiev & M. Petrov
Bulgarian Academy of Sciences, Sofia, Bulgaria
F. Martinez-Moreno, J. Leloux & L. Narvarte
UPM, Madrid, Spain

5BV.1.10 Artificial Neural Network Approaches for Modelling Daily Global Radiation Based on Meteorological Data in Gran Canaria Island
L. Mazorra Aguiar, F. Díaz & R. Pérez-Suárez
ULPGC, Las Palmas de Gran Canaria, Spain
P. Lauret
University of Reunion Island, Saint Denis, Reunion
A. Ortegón
I.T.C., Las Palmas de Gran Canaria, Spain

5BV.1.11 A Short-Term Production Forecast Service Based on Real Time Imagery: the steadyEye Service. Feedback on Forecast for Different Plants
C. Deforeit, A. Abello & X. Le Pivert
Steadysun, Le Bourget du Lac, France

5BV.1.12 PV Power Forecast Using a Parametric Model
M. Muñoz, M. García, I. de la Parra & L. Marroyo
Public University of Navarre, Pamplona, Spain

5BV.1.13 Probabilistic Assessment of Solar Resource Using Hidden Markov Models
C. Carter, V. Kostylev, J. Fletcher, C. Mahoney,
M. Palmer & A. Pavlovski
Green Power Labs, Dartmouth, Canada

5BV.1.14 Detecting Underperforming Systems Based on Geographical Peer Group Analysis – Utilizing Tilt, Azimuth, and Shading Values to Improve the Baseline Estimates
A. Kavousian & G. Bruer
Sunrun, San Francisco, United States

5BV.1.15 Estimating Long-Term Performance Decline of Solar Panels and Detecting Failures Using Minimum Data
A. Kavousian & G. Bruer
Sunrun, San Francisco, United States

5BV.1.16 Evaluating the Effect of the Forecast Horizon in the Error of Regional Forecasts of Insolation in Japan: the Kanto Region Case
J.G.S. Fonseca Jr. & K. Ogimoto
University of Tokyo, Japan
T. Oozeki & H. Ohtake
AIST, Tsukuba, Japan

5BV.1.17 Spatio-Temporal Variability of PV Production
J. Remund
Meteotest, Bern, Switzerland
C. Calhau
EDP, Lisbon, Portugal
D. Marcel & L. Perret
Planair, Yverdon-les-Bains, Switzerland

5BV.1.18 Support Tool to Evaluate Year to Year Plant Performance Where Irradiance Data is Not Available
P. Ingenhoven, G. Belluardo & D. Moser
Eurac Research, Bolzano, Italy

5BV.1.19 From Global to Regional Mesoscale Models: Evaluation of Different Numerical Weather Predictions for Solar Forecasting in the Canary and Balearic Islands.
G. Tremoy & X. Le Pivert
Steadysun, Le Bourget du Lac, France

5BV.1.20 SteadySat: a Reactive Satellite-Based Tool for Risk Management in Insular PV Grids
J. Defretin, C. Deforeit & X. Le Pivert
Steadysun, Le Bourget du Lac, France

5BV.1.21 Hour-Ahead Regional Solar Production Forecast Using Satellite Images
J. Defretin, G. Tremoy & X. Le Pivert
Steadysun, Le-Bourget-du-lac, France

5BV.1.22 On the Use of NWP for Cloud Base Height Estimation in Cloud Camera-Based Solar Irradiance Nowcasting
N. Killius
German Aerospace Center, Wessling, Germany
C. Prahl, N. Hanrieder & S. Wilbert
German Aerospace Center, Almeria, Spain
M. Schroedter-Homscheidt
German Aerospace Center, Oberpfaffenhofen, Germany

5BV.1.24 A Static Solar-Tracking Configuration for PV Power Plant to Uniform the Daily Power Supply Curve
J. Thomas & N. Munzke
Karlsruhe Institute of Technology, Eggenstein-Leopoldshafen, Germany

5BV.1.25 Design of a Telemonitoring System for a Grid Connected Photovoltaic System (GCPVS) at Jaen University
P.J. Pérez-Higueras, J.I. Fernández-Carrasco, L. Hontoria,
F. Almonacid & C. Rus-Casas
University of Jaén, Spain

5BV.1.26 Use of Econometrics Models to Forecast Short Term Solar Irradiance
F.H. Ramahatana, M. David & P. Lauret
University of Reunion Island, Tampon, Reunion

5BV.1.28 Estimating Overall MPP Tracking Losses Using Weather Statistics
M. Egler & S. Gordon
OST Energy, Brighton, United Kingdom

5BV.1.29 Solar Spectrum Measurements during 6 Month: Spectral Mismatch Induced on Crystalline Silicon and Amorphous Silicon Photovoltaic Cells

T. Mambrini, A. Migan-Dubois & C. Longeaud
CNRS, Gif-sur-Yvette, France
J. Badosa & M. Haeffelin
LMD, Palaiseau, France

5BV.1.30 Changes in Solar PV Output due to Water Vapour Loading in a Future Climate Scenario

R. Crook, C.J. Smith & P.M. Forster
University of Leeds, United Kingdom

5BV.1.31 From Meteorological Data to Operating Conditions

R. Moreton Villagrá, E. Lorenzo & L. Narvarte
UPM, Madrid, Spain
A. Pinto
University of São Paulo, Brazil

5BV.1.32 Characterization and Classification of Daily Sky Conditions Based on Ground Measurements of Solar Irradiance

I. Koumparou, G. Makrides, M. Hadjipanayi,
V. Efthymiou & G.E. Georghiou
University of Cyprus, Nicosia, Cyprus

5BV.1.33 A Study of the Impact of Climate on the Optimal Geometry of a LCPV System

M. Pavlov
University of Paris-Sud, France
A. Migan-Dubois
GeePs, Gif-sur-Yvette, France
V. Bourdin & M. Pons
LIMSI, Orsay, France
J. Badosa & M. Haeffelin
LMD, Palaiseau, France

5BV.1.34 Automatic Fault Detection and Diagnosis for Distributed PV System Fleets

J. Leloux, L. Narvarte & A. Luna
UPM, Madrid, Spain
A. Desportes
RTone, Lyon, France

5BV.1.35 Automatic Tools for the Detection and Diagnosis of Performance Failures: Results from the FP7 Project PV Crops

J. Leloux, L. Narvarte, R. Moreton Villagrá,
A. Luna & L.G.B. González-Bonilla
UPM, Madrid, Spain
A. Desportes
RTone, Amplepuis, France

M. Collares-Pereira
University of Évora, Portugal
M. Muñoz
Public University of Navarre, Pamplona, Spain
E. Guelbenzu
Acciona Energía, Sarriguren, Spain

5BV.1.36 Development of a Web Application for Yield Optimization of Photovoltaic Systems

H. te Heesen & M. Rumpler
Environmental Campus Birkenfeld, Germany

5BV.1.37 A New Approach to Model Output Statistics for Numerical Weather Prediction Based Solar Power Forecasts

R. Verzijlbergh, P.W. Heijnen, S. de Roode,
A. Los & H. Jonker
Delft University of Technology, Netherlands

5BV.1.38 Generation of Solar Irradiation Data from PV Energy Output: Using Thousands of Distributed PV Systems as Solar Irradiation Sensors

J. Leloux, L. Narvarte & L.G.B. González-Bonilla
UPM, Madrid, Spain
A. Desportes
RTone, Amplepuis, France

5BV.1.39 Site Assesment for a PV System in Colombia

S. Sepulveda & K. Rojas
UFPS, Cucuta, Colombia

5BV.1.40 Design and Analysis Software of Ground-Mounted Photovoltaic Station

Y. Wang, H. Wang & H. Xu
CAS, Beijing, China

5BV.1.42 Soleksat, a Flexible Solar Irradiance Forecasting Tool Using Satellite Images and Geographic Web-Services

S. Cros, M. Turpin, C. Lallemand,
N. Sébastien & N. Schmutz
Reuniwatt, Sainte-Clotilde, Reunion

5BV.1.43 Thin Film Photovoltaic Plants Production Estimation and Forecasting by Artificial Neural Networks

G. Graditi, S. Ferlito & G. Adinolfi
ENEA, Portici, Italy

5BV.1.44 Model Comparison to Estimate the Direct Normal Irradiance from Global Horizontal Irradiance in Korea

C.Y. Yun
KIER, Daejeon, Korea South

5BV.1.46 Inspection and Testing of PV Modules for the Financing of Large-Scale Solar PV Power Plants
A. Ete, B. Lumby, R. Raggatt & V. Burgmeier
SgurrEnergy, Paris, France

5BV.1.47 Obtaining Reliable Results Concerning the Expected Effect of Regional Air Pollution on Tilt Fixed Latitude PVs' Performance at High Polluted Region in the World
U.A. Rahoma, A.A. Hassan, A.A. Abdellah & G.M.G. Khalef
NRIAG, Cairo, Egypt

5BV.1.48 Seasonal Variations in Performance Loss of Photovoltaic Modules in Tropical Region
A. Limmanee, K. Chumpolrat, N. Udomdachanut,
S. Kittisontirak & K. Sriprapha
NSTDA, Klong Luang, Thailand
S. Kaewniyompanit
Thai Tabuchi Electric, Chachoengsao, Thailand
Y. Sato, M. Nakaishi & Y. Sakamoto
Tabuchi Electric, Osaka, Japan

5BV.1.49 Economical Environmental and Performance Analysis for a 200 KW Ground Mounted Photovoltaic System: Koya City Kurdistan of Iraq
S. Abdullah
Koya University, Erbil, Iraq

5BV.1.50 Site Assessment – Analysis of Energy Meteorological Characteristics for a Better Understanding of PV System Performance
M. Zehner, S. Obelz & F. Kaiser
Rosenheim University of Applied Sciences, Germany
R. Haselhuhn
DGS, Berlin, Germany
B. Giesler
Munich, Germany
O. Mayer
GE Global Research, Garching, Germany
R. Gottschalg
Loughborough University, United Kingdom

5BV.1.52 Power Quality Analysis of Hacettepe Technopolis - PV System
O. Tanriverdi & A. Eray
Hacettepe University, Ankara, Turkey

5BV.1.53 Automated Thermal Imaging for Fault Detection on PV-Systems
R. Rasch, S. Hantelmann, R. Dreimann, G. Behrens,
F.U. Hamelmann & J.A. Weicht
University of Applied Science Bielefeld, Minden, Germany

5BV.1.54 Impact of Temporal and Spatial Discretization on the Agreement between Measured and Modeled Performance of Large Photovoltaic Power Plants
H. Capdevila
capdevila ite, Stuttgart, Germany
T. Gerstmaier
Soitec Solar, Freiburg, Germany

VISUAL PRESENTATIONS 3BV.5

08:30 - 10:00 Perovskites, Organic PV and Hybrid Devices

3BV.5.1 Graphene Oxide and Reduced Graphene Oxide Used as Counter Electrode in Flexible DSSC Devices
M.F. Hurtado-Morales, A. Duarte & G. Gerardo
National University of Colombia, Bogotá, Colombia
J. Coronas, C. Telléz & S. Casterlenas
University Zaragoza, Spain

3BV.5.2 A High-Efficiency Novel Nanostructured Sc/TiO2 Photoanode for dye Sensitized Solar Cells
S.A. Mahmoud & S.H. Bendary
Egyptian Petroleum Research Institute, Cairo, Egypt
H. Attia
LIKAT, Rostock, Germany

3BV.5.3 Effect of Porosity of Titania Particle Porous Film for Electrode on Performance of Dye-Sensitized Solar Cell
Y. Mori, S. Aratani, K. Hatano & K. Tsuchiya
Doshisha University, Kyotanabe, Japan

3BV.5.4 High Efficiency Sensitized Solar Cell Based on Novel Ruthenium(II) Complexes with Thiophene Anionic Ligand
S. Kozyukhin, V. Ivanov, V. Emets,
A. Sadovnikov & V. Grinberg
RAS, Moscow, Russia
A. Medvedko
Moscow State University - Lomonosov, Russia
M. Presniakov
NBICS-Centre Kurchatov Institute, Moscow, Russia
E. Apostolova
Mendeleev University of Chemical Technology, Moscow, Russia

3BV.5.5 Low Temperature Fabrication of Flexible Dye-Sensitized Solar Cells with Composite Transparent Conductive ITiO/Ag/ITiO Electrodes
H.-C. Lu, W.-Y. Hung, C.-H. Lin & K.-M. Lee
Chang Gung University, Kweishan, Taiwan

3BV.5.6 Performance Variations and Recovery Effects in Dye Sensitized Solar Cells during Long Term Exposure to Natural Winter Conditions
S.G. Hashmi, P. Lund & J. Halme
Aalto University, Finland

3BV.5.7 Fabrication and Characterization of Inverted Hybrid Solar Cells Based on Conducting Polymers and Nanostructured Zinc Oxide
L. Nkhaili, A. Elmansouri, A. El Kissani,
M. Ait Ali & A. Outzourhit
Cadi Ayyad University, Marrakech, Morocco

3BV.5.8 Growth of High Quality Vertically Aligned ZnO Nanowire Array
C.C. Wu & C.C. Diao
Kao Yuan University, Kaohsiung City, Taiwan
J.-C. Liou
National Kaohsiung University of Applied Sciences, Taiwan
M.-C. Wu
NTHU, Hsinchu, Taiwan

3BV.5.9 Attempts toward AgInSe2-Conjugated Polymer Hybrid Systems Bulk Heterojunction Solar Cells
D. Pathak & T. Wagner
University of Pardubice, Czech Republic
T. Adhikari & J. Nunzi
Queen's University, Kingston, Canada

3BV.5.10 PEDOT:PSS, rGO and CuNWs Based Flexible, Transparent Electrodes for Thin Film Solar Cells
A.S. Shikoh, A. Popelka, F. Touati & M.A. Benammar
Qatar University, Doha, Qatar
Z. Zhu, T.S. Mankowski, M.A. Mansuripur & C.M. Falco
University of Arizona, Tucson, United States

3BV.5.11 Performance of 1,8- Diiodooctane (DIO) Doped PTB7:PCBM Based Organic Solar Cell under Simulated Solar Heating Profile over 24 Hours
B. Augustine & T. Fabritius
University of Oulu, Finland

3BV.5.12 Al-Doped ZnO Nanostructured Electrodes for Small Molecule Organic Solar Cells
S. Wiesner, W. Riedel, D. Greiner,
M. Rusu & M.C. Lux-Steiner
HZB, Berlin, Germany

3BV.5.13 Optical Modeling of Organic Solar Cells Deposited on Substrates Structured by Direct Laser Interference Patterning
M. Soldera & K. Taretto
National University of Comahue, Neuquén, Argentina

3BV.5.14 Enhanced Photovoltaic Performance of Dye-Sensitized Solar Cells Using Three Dimensional ZNO Nanostructure
M.-Y. Hsieh & S.-Y. Kuo
Chang Gung University, Kweishan, Taiwan

3BV.5.15 Morphology Study of Epitaxial Grown PCBM Crystallites on Mica from PCBM:P3HT Solution for Optimized Organic Solar Cell Moprhology
J. Feenstra, M. van Eerden, I. Okkerman, P. Kouwer,
A.E. Rowan & J.J. Schermer
Radboud University, Nijmegen, Netherlands

3BV.5.16 Performance Studies of Dye-Sensitized Solar Cell (DSSC) by Swift Heavy Ion (SHI) Irradiation
H.K. Singh & S. Aggarwal
GGS Indraprastha University, New Delhi, India
D.K. Avasthi
Inter University Accelerator Center, New Delhi, India

3BV.5.17 Thin Film Barrier Multilayers by Vacuum Plasma Polymerization
I. Fernandez-Martínez & A. Wennberg
Nano4Energy, Madrid, Spain
V. Bellido-Gonzalez, B. Daniel, J. Brindley & H. Li
Gencoa, Liverpool, United Kingdom
I. Mora-Seró & E.J. Juárez-Pérez
UJI, Castellón de la Plana, Spain

3BV.5.18 Reduction Capacitance Effect in DSC under Indoor Low Level Lighting by Real-Time One-Sweep Method
Y.-S. Long, S.-T. Hsu, E.Y. Wang, H.-C. Ma & T.-C. Wu
ITRI, Hsinchu, Taiwan

3BV.5.19 Poly(Benzodithiophene-Thienopyrrolodione) (PBDTTPD) Based Polymer Solar Cells Fabricated under Up-Scalable Conditions
A. Calabrese, R. Po, G. Corso & R. Barbieri
ENI Corporate University, San Donato Milanese, Italy

3BV.5.20 Selection of Green Solvents of the PBDTTPD:PCBM Junction Based on the Study of Solubility Parameters
A.M. Cruz Rodriguez, L. Bautista Pérez, L. Molina,
S. Niembro & M. Della Pirriera
Leitat Technological Center, Terrassa, Spain
C. Sprau, S. Sankaran, D. Landerer & A. Colsmann
Karlsruhe Institute of Technology, Germany
C.L. Chochos & V. Gregoriou
Advent Technologies, Patra, Greece

3BV.5.21 Temperature Dependence of the Opto-Electronic and Structural Properties of the MgAg3-MoO3-X System as Recombination Zone in Tandem Organic Solar Cells
A.R. Jeong, S. Fengler, S. Wiesner,
M.C. Lux-Steiner & M. Rusu
HZB, Berlin, Germany

3BV.5.22 Polyaniline-Graphene Nanocomposite as a Buffer Layer for Organic PV Device
O.D. Omelchenko, O.L. Gribkova,
A.R. Tameev & A.V. Vannikov
RAS, Moscow, Russia

3BV.5.23 Device Simulation of Solid-State Perovskite Solar Cells
P. Lin, K. Tan, J. Tan, L. Wu, G. Wan, S. Jin & Y. Lin
Huazhong University, Wuhan, China

3BV.5.25 Investigating the Role of TiO2-Perovskite Interface on the Electrical Performance of Perovskite Solar Cell
B. Tripathi, P. Bhatt, P. Yadav, K. Pandey, C. Kanth P.,
M.K. Pandey & M. Kumar
PDP University, Gandhinagar, India

3BV.5.26 High Efficiency Planar Heterojunction Solar Cells Based on Perovskite Fabricated with Two-Step Solution Process
C.-G. Wu
National Central University, Jhongli, Taiwan

3BV.5.27 Effect of Perovskite Layer Deposition on Different Substrate-Based Solar Cells
A. De Maria, V. La Ferrara, L.V. Mercaldo,
M. Della Noce & P. Delli Veneri
ENEA, Portici, Italy

3BV.5.28 Solution Processed Metal Oxides as Electron Transport Layers for Inverted Polymer Solar Cells
P. Morvillo, R. Diana, E. Bobeico, R. Ricciardi & C. Minarini
ENEA, Portici, Italy

3BV.5.29 Investigation on Stability of Organo-Halide Perovskite Solar Cells
X. Dong, X. Fang, M. Lv, B. Lin, S. Zhang,
N. Yuan & J. Ding
Changzhou University, China

3BV.5.30 Influence of HOOC(CH2)4NH3I on Phase Formation, Morphology and Electronic Properties in the Solution Processed CH3NH3PbI3 / CH3NH3PbCl3 System
P. Prajongtat, D. Wargulski, S. Levcenko,
T. Unold & Th. Dittrich
HZB, Berlin, Germany

3BV.5.32 Nucleation and Growth Mechanism of Perovskite for Controlled Microstructure and Its Effect on Cell Performance
J.-M. Ting & E.T.. Nurlianti
National Cheng Kung University, Tainan, Taiwan

3BV.5.33 Hysteretic Behavior in Perovskite Solar Cells Prepared via Saturation Vapor Pressure Deposition
C. Liu, J. Fan, X. Zhang, Y. Shen, L. Yang & Y. Mai
Hebei University, Baoding, China

3BV.5.34 Application of ZnO as Electron Transport Layer in Planar Structure Perovskite Solar Cells
S.-K. Chang, H.-C. Lee, S.-P. Lin & C.-F. Lin
NTU, Taipei, Taiwan

3BV.5.35 Optimization of the Perovskite Solar Cell Based on TiO2 / CH3NH3PbI3
M. Kadlec, J. Vanek, M. Sionova & M. Weiter
Brno University of Technology, Czech Republic

3BV.5.36 Infrared Light Sensitive Sn/Pb Binary Perovskite Solar Cells with Improved Stability in Air –Charge Injection Interface Structure and Gradient Structure of Sn Distribution
Y. Ogomi, K. Nishinaka, K. Fujiwara,
K. Sakaguchi & S. Hayase
Institute of Technology, Kitakyushu, Japan
Q. Shen & T. Toyoda
University of Electro-Communication, Chofu, Japan

3BV.5.37 Improvement of Conversion Efficiency and Reproducibility for Lead Iodide Perovskite Solar Cell by Using Mixture Solvents
Z. Tang, T. Higuchi, K. Taguchi & T. Minemoto
Ritsumeikan University, Shiga, Japan
S. Tanaka & S. Ito
University of Hyogo, Himeji, Japan
S. Ikeda
Osaka University, Japan

3BV.5.38 Effects of PbI2 Passivation Layer in Methylammonium Lead Iodide Perovskite Solar Cells
T. Chung, S. Kim, S.H. Lee, Y. Kang, H.-S. Lee & D. Kim
Korea University, Seoul, Korea South

3BV.5.40 Adaptation of a Crystalline Silicon Solar Cell Laboratory to Produce Perovskite Solar Devices
L. Ocaña, E. Llarena, O. González, D. Molina, A. Pío,
C. Quinto, M. Friend, M. Cendagorta & C. Montes
ITER, Santa Cruz Tenerife, Spain
A. Linares
AITE, Granadilla de Abona, Spain

3BV.5.41 Screen Printing for Perovskite Solar Cells Metallization
C. Quinto, C. Montes, E. Llarena, O. González, D. Molina, A. Pío, L. Ocaña, M. Friend & M. Cendagorta
ITER, Santa Cruz de Tenerife, Spain
A. Linares
AITE, Granadilla de Abona, Spain

3BV.5.42 Structural, Optical and Electrical Properties of Perovskite/ ZnO Solar Cells
H. Aitdads, S. El Amal Bouzit & A. Outzourhit
Cadi Ayyad University, Marrakech, Morocco

3BV.5.43 Growth and Computational Assessment of Copper Oxide (Cu2O) Films as Hole Transport Material in Hybrid Perovskite Based Solar Cells
M.I. Hossain, A. Belaidi, F.H. Alharbi & N. Tabet
QEERI, Doha, Qatar
M. Faiz
KFUPM, Dhahran, Saudi Arabia

3BV.5.44 Low Cost Planar Perovskite Solar Cell Fabricated by Coprous Iodide as an Electron Blocking Layer
B. Abdollahi Nejand Asl, V. Ahmadi & H. Shahverdi
Tarbiat Modares University, Tehran, Iran

3BV.5.45 Effect of Halide-Mixing on the Electronic Transmission in Organometallic Perovskites
G. Berdiyorov, M. El-Amine Madjet, F. El-Mellouhi, F.H. Alharbi & S. Kais
Qatar Foundation, Doha, Qatar
F.M. Peeters
University of Antwerp, Antwerpen, Belgium

3BV.5.46 Facile Low Cost Hole Conductor Free Perovskite Solar Cell Fabricated by Alumina Scaffold Structure
B. Abdollahi Nejand Asl, V. Ahmadi, H.R. Shahverdi & M. Eskandari
Tarbiat Modares University, Tehran, Iran

3BV.5.47 Flexible Inverted Lead-Free Perovskite Solar Cells
T.H.Y. Vu & J.-M. Ting
National Cheng Kung University, Tainan, Taiwan

3BV.5.48 Organic Photovoltaics for the Indoor Use
Y. Aoki
Rohm, Kyoto, Japan

PROGRAMME

3BV.5.49 Highly Stable Perovskite Films Towards High Efficiency Solar Cells Using Vacuum Deposition
D. Yang & Z. Yang
Shaanxi Normal University, Xi'an, China
J. Zhang & C. Li
Dalian National Laboratory for Clean Energy, China
F. Liu
DICP -CAS, Dalian, China

3BV.5.50 Two-Step Physical Deposition of Uniform and Compact Cuprous Iodide Thin Film as an Appropriate Hole Transport Material in a Perovskite Solar Cell
S. Gharibzadeh, A. Moshaii, N. Mohammadian, A.H. Alizadeh, A. Alizadeh & D. Fathi
Tarbiat Modares University, Tehran, Iran

3BV.5.51 Reduced Graphene Oxide/Metal Oxide Nanoparticle Composites Applied in Polymer Solar Cells
Q. Zheng & S. Cheng
Fuzhou University, China

3BV.5.52 A Spray Deposition Approach for High QualityCH3NH3PbI3 Perovskite Films
Z. Lianga, X. Xu, Z. Bi, J. Wang & G. Xu
CAS, Guangzhou, China
N. Yuan & J. Ding
Changzhou University, China

VISUAL PRESENTATIONS 5BV.2

13:30 - 15:00 Experience, Grid Integration, and Shading

5 5BV.2.1 Case Study of Outlier Event of Solar Irradiance Forecasts from a Numerical Prediction Model
H. Ohtake, T. Takashima, T. Oozeki & J.G.S. Fonseca Jr.
AIST, Tsukuba, Japan
Y. Yamada
JMA, Tsukuba, Japan

5BV.2.2 Study, Verification and Selection of Cooling System Model for PV Modules with Verification Prototype
V.O. Silva, M.E. Morales Udaeta & A.L.V. Gimenes
University of São Paulo, Brazil
F.C. Costa
HU Berlin, Germany

5BV.2.3 Potential Induced Degradation (PID) Diagnosis, Treatment and Module Recovery in a Grid Connected Photovoltaic (PV) Power Station in Greece

A. Chliaoutakis, C. Protogeropoulos, G. Karelas, E. Doukas, M. Talfanidou, E. Foukarakis & E. Papaioannou
Phoenix Solar, Athens, Greece
I. Zouboulis & P. Tsimpris
NTUA, Athens, Greece

5BV.2.4 Two Year Performance Comparison Assessment between Central- and Multistring-Based Inverters Installed in Large-Scale Photovoltaic Power Stations in Greece

A. Chliaoutakis & C. Protogeropoulos
Phoenix Solar, Athens, Greece
J. Kaldellis
TEI of Piraeus, Athens, Greece

5BV.2.5 Energy Performance Results of 240 MW x Year of Spanish Large-Scale PV Plants

R. Moreton Villagrá, E. Lorenzo & F. Martinez-Moreno
UPM, Madrid, Spain

5BV.2.6 Compensation of PV Generator Output Power Fluctuations with Energy Storage Systems

J. Schnabel & S. Valkealahti
Tampere University of Technology, Finland

5BV.2.7 SISIFO: the Open-Source Simulation Tool of PV Systems Developed in PVCROPS

J. Carrillo, A. Makibar, J. Munoz, A. Luna & L. Narvarte
UPM, Madrid, Spain

5BV.2.8 Energy Yield Estimation of a 75MWp PV Plant in Tafilalt (Morocco). Example of Usefulness of SISIFO Tool for Contractual Frameworks

J. Carrillo & J. Munoz
UPM, Madrid, Spain

5BV.2.9 Performance Ratio of PV Plant - State of the Art and Possible Improvement

S. Mansone, F. Bonemazzi, I. Cascone, A. Incalza, A. Guardo & A. Fatica
ENEL Green Power, Rome, Italy

5BV.2.10 Performance of French Photovoltaic Plants via Web Service

H. Colin, S. Guillemin, A. Plissonnier & J. Merten
CEA, Le Bourget du Lac, France
A. Mignonac
CEA, Cadarache, France

5BV.2.11 Module Stabilization Time in Utility-Scale PV Plants: Initial Degradation and Nameplate Tolerance

A. Carretero
skytron energy, Berlin, Germany

5BV.2.12 Control Strategies Comparison for PV Power Ramp-Rate Limitation Using Energy Storage Systems

I. de la Parra, J. Marcos, M. Muñoz & M. García
Public University of Navarre, Pamplona, Spain

5BV.2.13 Maximizing PV Yield Performance with Size Flexibility for BIPV

W. Eerenstein, M.J. Jansen, K.M. de Groot, A.J. Carr, L.A.G. Okel, M.J.A.A. Goris, J.A.M. Van Roosmalen & E.E. Bende
ECN, Petten, Netherlands

5BV.2.14 Verification of Energy Yields of Large Solar Power Plants by Simulation

A. Dietrich
DiSUN, Werder, Germany
U. Rindelhardt
Rindelhardt Consulting, Dresden, Germany

5BV.2.15 Technical Specifications and Quality Control Procedures for Reducing the Uncertainty in PV Installations: Results of the FP7 Project PVCROPS

F. Martinez-Moreno, E. Lorenzo, L. Narvarte & R. Moreton Villagrá
UPM, Madrid, Spain
N. Tyutyuyndzhiev
Bulgarian Academy of Sciences, Sofia, Bulgaria
I. de la Parra
Public University of Navarre, Pamplona, Spain

5BV.2.16 Comparative Study of Nonparametric and Parametric PV Models to Forecast AC Power Output of PV Plants

M.P. Almeida
University of Sao Paulo, São Paulo, Brazil
O. Perpiñán & L. Narvarte
UPM, Madrid, Spain
M. Muñoz
Public University of Navarre, Pamplona, Spain

5BV.2.17 Using a Nonparametric PV Model to Forecast AC Power Fluctuations of PV Plants

O. Perpiñán & L. Narvarte
UPM, Madrid, Spain

5BV.2.18 Using a Nonparametric PV Model to Forecast AC Power Output of PV Plants
M. Almeida
University of Sao Paulo, São Paulo, Brazil
O. Perpiñán & L. Narvarte
UPM, Madrid, Spain

5BV.2.19 Preliminary Photovoltaic Yields of Morocco for "Propre. Ma" Project
N. Aarich, N. Erraissi, M. Akhsassi,
M. Raoufi & A. Bennouna
Cadi Ayyad University, Marrakech, Morocco
A. Hadri & I. Moghraoui
RESING, Marrakech, Morocco
J. Andrey
CNRS, Toulouse, France

5BV.2.20 Analysis of Performance of Photovoltaic Systems: Comparison of Panel and Inverter Brand
O. Tsafarakis & W.G.J.H.M. van Sark
Utrecht University, Netherlands

5BV.2.21 To Review Various Failure Modes of PV Module, Its Detectability and to Evaluate Its Effect on PV Plant Performance
V. Kelkar
Waaree Energies, Surat, India

5BV.2.23 Using Matlab to Study the Mismatch Effects Combined with Dynamic Shading Pattern Simulation on PV Module Level - Case Study Villa Lobos Project in São Paulo, Brazil
R. Herrero Alonso, S. Shimura, J.A. Baesso Grimonni,
E. Aparecida Faria Amaral Fadigas,
R. de Deus Lopes, M. Knorich Zuffo,
R. Silva Simplicio & C. Biasi de Moura
University of São Paulo, Brazil
T. Mendes Germano Costa
Dya Solar, Belo Horizonte, Brazil

5BV.2.24 Assessment of the Longest Operating Photovoltaic Power Station in the Czech Republic
J. Vanek, J. Hylsky, D. Strachala, L. Šimonová & Z. Chobola
Brno University of Technology, Czech Republic

5BV.2.25 Modelling of the Solar Energy Falling onto the Panel of Solar Car and Web-Aplication for Simulating the Car Motion Along the Road
R. Gardashov
Azerbaijan Academy of Scienses, Baku, Azerbaijan
M. Eminov
University of Applied Sciences Kiel, Germany

5BV.2.26 PVSim-Gui, a Characterization Tool for Parameter Extraction, Modeling and Simulation of PV Devices
O. Shekoofa
Tsinghua University, Beijing, China

5BV.2.28 I-V Characteristic Evaluation of Photovoltaic Modules String from First Quadrant to Fourth Quadrant
Y. Hirata
Tokyo University of Science, Nagano, Japan

5BV.2.30 Long Term Energy Production for PV Plants with One or More Years of Operation
C. Hidalgo
DNV GL, Hospitalet de Llobregat, Spain

5BV.2.32 Multi-Technology Photovoltaic Module Test Bench on the Sirta Meteorological and Climate Observatory
J. Badosa, M. Haeffelin, G. Le Bars & J. Nassar
CNRS, Palaiseau, France
V. Bourdin
LIMSI, Orsay, France
T. Mambrini & A. Migan-Dubois
CNRS, Gif-sur-Yvette, France

5BV.2.33 Performance of Silicon Heterojunction Photovoltaic Modules in Qatar Environment
A. Abdallah, D. Martinez, B. Figgis, O. El Daif & N. Tabet
Qatar Foundation, Doha, Qatar

5BV.2.34 Analysis of PV Grid Installations Performance, Comparing Measured Data to Simulation Results to Identify Problems in Operation and Monitoring
B. Wittmer & A. Mermoud
PVsyst, Satigny, Switzerland

5BV.2.35 New Developments in Antimonyfree Glass and Performance Comparison of PV Modules in Field
P. Kheruka & R. Velayudhanpillai
Gujarat Borosil, Mumbai, India

5BV.2.36 Performance of Distributed PV in the UK: a Statistical Analysis of over 7000 Systems
J. Taylor, A.M. Everard, J. Briggs & A.R. Buckley
University of Sheffield, United Kingdom
J. Leloux
UPM, Madrid, Spain

5BV.2.37 System-Oriented Modelling for Optical Optimisation of Solar Cells for Different Geographical Locations and Environments
Y. Li, Z. Ouyang & A.J. Lennon
UNSW, Sydney, Australia

5BV.2.38 Comparative Analysis of the Performance of String- and Central Inverter Topology at a Large PV Utility Plant with Varying Topography.
K. Paasch
University fo Southern Denmark, Sønderborg, Denmark
M. Nymand
University of Southern Denmark, Odense, Denmark
S.B. Kjær
Danfoss Solar Inverters, Nordborg, Denmark

5BV.2.39 Performance Results from the Best Performing Grid-Connected PV System in Sweden
O. Kleven & H. Persson
Norut Narvik, Norway

5BV.2.40 Quality Standard for Energy Yield Studies
A. Schumann
SolPEG, Hamburg, Germany

5BV.2.41 Validating the Model for a 250 kW Size Grid Connected PV-System in Rwanda Based on Sparse Operational Data
F. Habyarimana
KIST, Kigali, Rwanda
H.G. Beyer
University of Agder, Grimstad, Norway

5BV.2.42 Low-Cost-Outdoor-EL: Cost-Efficient Extensive on-Site Quality Analysis of Solar Modules
K. Mertens & H. Kösters
Münster University of Applied Sciences, Steinfurt, Germany
M. Diehl
photovoltaikbüro, Rüsselsheim, Germany

5BV.2.43 Assesment of Electric and Monetary Impact of Hot Cells Using Thermography and Thermal Modelling
B. Kubicek & R. Ebner
AIT, Vienna, Austria
G.C. Eder
OFI, Vienna, Austria
H. Sonnleitner
ENcome Energy Performance, Klagenfurt, Austria
A. Angerer
Angerer, Kapfenberg, Germany

5BV.2.44 Installation and Evaluation of a Li-Ion Battery Demonstrator for PV Power Plants
A. Padros & E. Guelbenzu
Acciona Energía, Sarriguren, Spain
I. de la Parra & J. Marcos
Public University of Navarre, Pamplona, Spain

5BV.2.45 Survey on Yield of Photovoltaic Systems in India 2014
A. Pooppal
Karunya University, Coimbatore, India
H. te Heesen
Environmental Campus Birkenfeld, Germany

5BV.2.46 Curtailed Energy of PV Systems – Dependency on Grid Loading Limit, Orientation and Local Energy Demand
B. Matthiss, D. Stellbogen, M. Eberspächer & J. Binder
ZSW, Stuttgart, Germany

5BV.2.47 Survey on Yield of Photovoltaic Systems in France 2014
M. Gromaire
Ecole des Mines d'Albi, France
H. te Heesen
Environmental Campus Birkenfeld, Germany

5BV.2.48 Continuous AC and DC Monitoring of Outdoor PV Systems: Comparison of Eight Different Technologies
A. Pozza, G. Trentadue & R.P. Kenny
European Commission, Ispra, Italy

5BV.2.50 Independent Verification of a Method Using Free Software for Simulation of Complex Shaped Photovoltaics
M. Lovati, G. Belluardo, P. Ingenhoven,
D. Moser & L. Maturi
EURAC, Bolzano, Italy

5BV.2.51 IR Thermography Inspection of PV Modules in Large PV Plants with UAV
J. Coello, L. Perez, V. Parra & R. Gomez
Enertis Solar, San Sebastián, Spain

5BV.2.52 Quantifying Soiling Losses in the Atacama Desert
P. Darez
Mainstream Renewable Power, Dublin, Ireland

5BV.2.53 Solar Assessment and Feasability Study of PV Power Plant in Algeria using RETScreen
K. Abdeladim, S. Bouchakour, A. Hadj Arab, F. Boukhtouche
Cherfa, A. Razagui & B. Taghezouit
CDER, Algiers, Algeria

5BV.2.54 Validation of Energy Management Strategies for a BIPV System with a Lithium Ion Battery Demonstrator
L. Fialho, T. Fartaria & M. Collares-Pereira
University of Évora, Portugal
I. Landibar
Ingeteam, Sarriguren, Spain
J. Chacon
Cegasa, Vitoria-Gasteiz, Spain
L. Narvarte
UPM, Madrid, Spain

5BV.2.55 Validation of Energy Management Strategies for a BIPV System with a Vanadium Redox Flow Battery Demonstrator
L. Fialho, T. Fartaria & M. Collares-Pereira
University of Évora, Portugal
P. Ridley
REDT, Dublin, Ireland
I. Landibar
Ingeteam, Sarriguren (Navarra), Spain
L. Narvarte
UPM, Madrid, Spain

5BV.2.56 Validation of Energy Management Strategies for PV Plants with a Vanadium Redox Flow Battery Demonstrator
L. Fialho, T. Fartaria & M. Collares-Pereira
University of Évora, Portugal
P. Ridley
REDT, Dublin, Ireland
I. Landibar
Ingeteam, Sarriguren (Navarra), Spain
L. Narvarte
UPM, Madrid, Spain

5BV.2.57 National Solar Repository (NSR) – 5-year Country-Wide Assessment of PV Systems' Performance in Singapore
R.S. Baker, J. Tan, M. Bieri, L. Licheng, W.K. Cher,
K. Zhang, T. Reindl & A.M. Nobre
SERIS, Singapore, Singapore
R. Rüther
Federal University of Santa Catarina, Florianópolis, Brazil

5BV.2.58 Impact of Environmental Conditions on the Performance of a 300 kWp Solar PV Plant in Djibouti
D. Hassan Daher
CERD, Djibouti, Djibouti
L. Gaillard, C. Ménézo & M. Amara
INSA Lyon, Villeurbanne, France

5BV.2.59 25 Years of Technological and Economical Learning in PV Systems
T. Nordmann, T. Vontobel & R. Lingel
TNC Consulting, Feldmeilen, Switzerland

5BV.2.60 Settlement of Configuration and Performance of a Solar Radiation Measurement System Aiming the Brazilian Solar Potential Characterization
J.L. de Oliveira Bernal,
M.E. Morales Udaeta, P. Helio Kanayama & A.L.V. Gimenes
University of São Paulo, Brazil

5BV.2.61 PV Modules in Nordic Climate: Effects of Soiling and Snow
A. Derås Pettersen, J.H. Krogh Selj & E. Stensrud Marstein
Institute for Energy Technology, Kjeller, Norway

5BV.2.62 PV Engineering at Very High Altitudes
D. Gudopp, T. Leschinsky,
P. Freunscht & A. Castanos Garcia
deea solutions, Frankfurt, Germany

VISUAL PRESENTATIONS 1BV.6

13:30 - 15:00 Fundamental material, Studies and Modelling / New Materials and Concepts for Modules

1BV.6.1 A Study towards the Possibility of Cadmium Telluride (P)-Silicon (N) Hetero-Junction Solar Cells from Numerical Analysis
J. Wu & X.-S. Wang
Canadian Solar, Suzhou, China

1BV.6.2 A Theoretical Analysis of CuInSe2, CuGaSe2 and CuInGaSe2 Thin Film Solar Cells
H. Hanif & B. Mari
UPV, Valencia, Spain

1BV.6.3 Green's Expression for Saturation Current Vs. Bandgap: Applications in Si and CIGS Solar Cells
L. Abenante
ENEA, Rome, Italy

1BV.6.4 General Solution to Minority-Carrier Transport in Uniformly Doped Si Solar Cells with Lambertian Light Trapping
L. Abenante
ENEA, Rome, Italy

1BV.6.5 Analytic Electro-Optical Modelling of c-Si Solar Cells with Lambertian Light Trapping
A. Bozzola, P. Kowalczewski, M. Liscidini & L.C. Andreani
University of Pavia, Italy

1BV.6.6 Towards the Efficiency Limits of Silicon Solar Cells: How Thin Is Too Thin?
L.C. Andreani & P. Kowalczewski
University of Pavia, Italy

1BV.6.7 **Density Functional Tight Binding Modeling of Amorphous Silicon and Related Materials**
G. Penazzi & T. Frauenheim
University of Bremen, Germany
M. Celino
ENEA, Rome, Italy

1BV.6.8 **Comparative Study of Advanced Photovoltaic Modeling Using One-Diode and Two-Diodes Models**
F. Fairouz, H. Mohammad & H. Qasem
KISR, Al-Shuwaikh, Kuwait

1BV.6.9 **The Demonstration of Colossal Magneto-Capacitance with the Promising Characteristics of Thin Film Solar Cell**
C.F. Hsieh
ITRI, Hsinchu, Taiwan

1BV.6.10 **High-Rate Sputtering Deposition of High- and Low-Refractive Index Films from Conductive Composites**
L.Q. Zhou, R. Simões, B. Gabriel & V. Neto
University Aveiro, Portugal
Q.H. Fan
South Dakota State University, Brookings, United States

1BV.6.11 **Temperature Dependence of the Homo in Rubrene Film Growth**
C.P. Cheng, C.-F. Hsueh, Y.-W. Chan, C.-W. Lee,
S.-W. Fang & T.-W. Pi
National Chiayi University, Taiwan

1BV.6.12 **Electronic and Optical Properties of Nickel Alloyed Iron Disulphide Pyrite for Photovoltaic Application**
N. Ouarab, M. Boumaour, A. Larabi & A. Bahfir
CRTSE, Algiers, Algeria

1BV.6.13 **Optical Properties of Plasmonic FeS2/Au or FeS2/Ag Nanoparticles**
R. Eyi & S. Lee
University of Arkansas, Fayetteville, United States

1BV.6.14 **Preparations and Photovoltaic Properties of Quantum Dot-Sensitized Solar Cells (QDSSCs) Using Electrospun Polymer Nanofibers Containing Inorganic Fillers**
M.-R. Kim & J.-K. Lee
Pusan National University, Busan, Korea South

1BV.6.16 **Modeling Droplet Size and Nano-Particle Size in Ultrasonic Spray for Deposition of TiO2 Thin Films for Solar Cell Applications**
R. Taziwa, E.L. Meyer & N. Takata
University of Fort Hare, Alice, South Africa

1BV.6.17 **Influence of the Deposition Parameters on the Optical and Structural Properties of CuO Thin Films Deposited by RF Sputtering**
H. El Aakib, M. Elyaagoubi & A. Outzourhit
Cadi Ayyad University, Marrakesh, Morocco

1BV.6.18 **Estimation of Potentially Achievable Efficiency of Cu2O-Based Solar Cells by Numerical Simulation**
D.A. Kudryashov & A.S. Gudovskikh
SPbAU RAS, St Petersburg, Russia

1BV.6.19 **Nondestructive Study of the Depth Distribution of the Recombination Parameters of Solar Silicon**
V.G. Litovchenko, V.M. Naseka & A.V. Sarikov
NAS ISP, Kiev, Ukraine

1BV.6.20 **Future Requirements for Inline Inspection in PV Industry**
E. Rüland & C. Berge
GP Solar, Neuried, Germany

1BV.6.21 **Based Photoluminescence Inspection of Crystalline Silicon As-Cut Wafers**
R. Kemmler & M. Regehly
greateyes, Berlin, Germany

1BV.6.23 **Interaction between EVA Encapsulants and Ribbon Coating during the Lamination Process**
C. Liciotti
Brandoni Solare, Castelfidardo, Italy
F. Grosselle
QMC, Cittadella, Italy

1BV.6.24 **Accurate Model of Photovoltaic Module According to Experimental Data**
M. Zandi, M. Bahrami & S. Eslami
Shahid Beheshti University, Tehran, Iran

1BV.6.25 **Algerian Quartz Sandstone as Raw Material for Silicon Solar Grade Elaboration**
A. Kefaifi, A. Kheloufi & N. Drouiche
C.R.T.S.E., Algiers, Algeria
T. Sahraoui
University SAAD DAHLAB, Blida, Algeria

1BV.6.30 **Long Term Stability Tests of Solution for Production of Photovoltaic Solar Cells Modules at a Reduced Cost**
J. Buddgård, T. Lagerstedt & A. Machirant
JB EcoTech, Lidingö, Sweden

1BV.6.31 Nanophosolar Project: Photocurrent Enhancement in Photovoltaic Modules by Inorganic Down Shifting Phosphor Materials

M. Machado, N. Yurrita, F.J. Cano & O. Zubillaga
Tecnalia, San Sebastian, Spain
C. Boncompain & A. Miller
PRA, London, United Kingdom
M. Rodriguez & J. Inarejos
AIDO, Valencia, Spain
P. Chirico, I. Clark & R. Dixon
Intrinsiq Materials, London, United Kingdom
B. Breen
3GSolar, Jerusalem, Israel
S.B. Tovim
Hanita Coatings, Kibbutz Hanita, Israel
N. Smith
Eurofilms Extrusion, Shropshire, United Kingdom
D. Brito
Femete, Canarias, Spain
S. Pocock
REA, London, United Kingdom
M. Trifonova
BPVA Bulgarian Photovoltaic Association, Sofia, Bulgaria
A. Joist
MANAGESS Energy, Canarias, Spain

1BV.6.32 Improving EVA Properties, with Regard to PID Problem - Introduction of a New Crosslinking Agent

D. Ulbricht & S. Schauhoff
Evonik, Hanau, Germany

1BV.6.33 Integrated Switch for Substring Reconfiguration to Optimize Module Power under Partial Shading

P. Bauwens & J. Doutreloigne
Ghent University, Belgium

1BV.6.34 Manouver to Prevent PV Modules from Causing PID and Snail Track

T. Yoshida & T. Hirano
MORESCO, Kobe, Japan
Y. Fan & Y. Kishimoto
KIES New Energy, Yokohama, Japan

1BV.6.35 Novel Conducting Encapsulation Foil for High Efficiency Interconnection of Solar Cells

P. Sánchez-Friera, B. Puerto & D. Alvarez
Fundación PRODINTEC, Gijón, Spain
I. Fidalgo & R. Merino Martínez
STRE, Asturias, Spain

1BV.6.36 Material Developments Allowing for New Applications, Increased Long Term Stability and Minimized Cell to Module Power Losses

A. Schneider, A. Halm & R. Harney
ISC Konstanz, Germany
I. Fidalgo & R. Merino Martínez
STRE, Asturias, Spain

1BV.6.37 A Novel PV Module Assembly for Back Contact Solar Cells

T.-Y. Su, P.-K Chang, K.-W. Tung & M.-Y. Huang
AU Optronics, Taichung, Taiwan

1BV.6.38 Stress Measurements in Interconnected Solar Cells with Raman Spectroscopy

W. Mühleisen, J. Schicker, L. Neumaier,
C. Hirschl & N. Vollert
CTR, Villach, Austria
S. Seufzer
KIOTO, St. Veit, Austria
A. Plösch
Energetica, Klagenfurt-Viktring, Austria
M. Pedevilla
Ulbrich of Austria, Müllendorf, Austria
J. Scheurer
Polytec PT, Waldbronn, Germany
T. Fischer
Teamtechnik, Ingersheim, Germany
M. Schwark
AIT, Vienna, Austria

1BV.6.39 Technical and Economical Assessment on Wire Soldered Cell Metallization

M. Galiazzo, M. Bertazzo & T. Micheletti
Applied Materials, San Biagio di Callalta, Italy
M. Zanuccoli
University of Bologna, Italy
P. Magnone
University of Padova, Vicenza, Italy

1BV.6.40 New Module Concepts, incl. Embedded Power Electronic or Storage Options, Interconnections and Encapsulation

C. Panofen, P. Pasmans & J. Gaury
DSM, Urmond, Netherlands

1BV.6.41 Light Transmittance Enhancement & Lifetime Performance of Anti-Reflective PV Module Cover Glass

D. Reardon
DSM Advanced Surface, Geleen, Netherlands

1BV.6.42 The Optics of External Light Trapping for Thin Film Solar Cells
L. van Dijk
Utrecht University, Eindhoven, Netherlands
J. van de Groep & A. Polman
AMOLF, Amsterdam, Netherlands
R.E.I. Schropp
ECN, Eindhoven, Netherlands
M. Di Vece
Utrecht University, Netherlands

1BV.6.43 When PV Modules Are Becoming Real Building Elements: White Solar Module, a Revolution for BIPV
L.-E. Perret-Aebi, J. Escarré, L. Sansonnens,
S. Nicolay & J. Bailat
CSEM, Neuchâtel, Switzerland
H.-Y. Li, F. Galliano, P. Heinstein, C. Ballif & G. Cattaneo
EPFL, Neuchâtel, Switzerland
S. Eberhard & A. Schöni
Solaxess, Neuchâtel, Switzerland

1BV.6.44 Increasing Module Power: Detailed Experimental and Theoretical Analysis of Finger and Ribbon Optics
I. Haedrich, M. Padilla, A. Jötten, M. Mundus,
W. Warta & H. Wirth
Fraunhofer ISE, Freiburg, Germany

1BV.6.45 Printed Thin Film Module Interconnects
J. Fields, G. Pach, K.. Horowitz, T. Stockert,
P. Woodhouse & M.F.A.M. van Hest
NREL, Golden, United States

1BV.6.46 A Light Trapping Module by Microstructure Surface
C.-Y. Peng, H.-T. Yan, S.-Y. Wen & Z.-J. Ji
ITRI, Hsinchu, Taiwan
P. Chen
Gintung Energy, Taoyuan, Taiwan

1BV.6.47 Study of the Physical Properties of Zinc Oxide Thin Films Prepared by the Solgelmethod and Doped Lithium for Photovoltaic Applications
K. Meziane, A. Elhichou & A. Almaggoussii
Cadi Ayyad University, Marrakech, Morocco

1BV.6.48 Eutectic Sn-Bi Plating on the Metal Grids of Silicon Solar Cells Enabling New Methods of Cell Interconnection
P.-C. Hsiao
UNSW, Gordon, Australia
A.J. Lennon
UNSW, Sydney, Australia

1BV.6.49 EVA Encapsulant in PV Modules with a High Energy ConversionEfficiency1
S. Jiang, K. Wang, H. Zhang, Y. Ding & Q. Yu
Changzhou University, China

VISUAL PRESENTATIONS 5BV.3

15:15 - 16:45 Power Conversion, Storage and Testing

5BV.3.1 Novel MPPT Algorithm for PV Systems under Fast Weather Variations
N. Chapalain & N. Voyer
Mitsubishi Electric, Rennes, France
M. Koyama
Kanazawa Institute of Technology, Japan
Y. Hiroshi & N. Shuichi
Mitsubishi Electric, Amagasaki, Japan

5BV.3.3 Characterising the Accuracy of Measurements by PV Micro-Inverters
V. Musolino, P.-J. Alet, L.-E. Perret-Aebi & C. Ballif
CSEM, Neuchâtel, Switzerland

5BV.3.4 A New Methodology for Evaluating Solar Trackers Based on IEC 62817:2014.Ed.1
L. Casajùs, I. Sánchez, I. Munoz Morales & A.R. Lagunas
CENER, Navarra, Spain

5BV.3.5 Design and Control of DC-DC Grid-Connected Converter for Photovoltaic Power
Y. Wang, C. Ju, W. Huan, M. Shanshan & H. Xu
CAS, Beijing, China

5BV.3.6 Control System of the Optimal Photovoltaic Module Orientation
M. Kitaeva, A.V. Yurchenko & A.V. Okhorzina
Tomsk Politechnical University, Russia

5BV.3.8 Meta-Heuristic Gaussian Firefly Algorithm for Optimal Tuning Control of Single-Phase Photovoltaic System
M. Louzazni & E. Aroudam
University Abdelmalek Esaadi, Tetouan, Morocco

5BV.3.9 Assessment of Maximum Power Point Tracking Techniques for PV System Applications
A. Nasr, M.A. Farahat & M.A. Enany
Zagazig University, Egypt

5BV.3.10 A Fuzzy Logic Based Supervision of Photovoltaic Energy Storage Using Battery-Supercapacitor
Z. Cabrane, M. Ouassaid & M. Maaroufi
University Mohammed V, Rabat, Morocco

5BV.3.11 Contracted-Power Reduction Using PV Generators with Li-ion Energy Storage Systems
A. Makibar & L. Narvarte
UPM, Madrid, Spain

5BV.3.12 Use of PV Plants Monitoring to Characterize PV Arrays Power
J. Carrillo & F. Martinez-Moreno
UPM, Madrid, Spain

5BV.3.13 A Modified Incremental Conductance MPPT Technique Applied to PV Pumping System
S. Abdourraziq & R. El Bachtiri
Sidi Mohamed Ben Abdellah University, Faculty of Sciences Dhar El Mahraz, Fez, Morocco

5BV.3.15 Simulation of the Ageing of a C/NMC Li-Ion Battery in Different Stand-Alone and Grid-Connected Photovoltaic Applications
B. Pilipili Matadi, F. Bourry & A. Delaille
CEA, Le Bourget-du-Lac, France
Y. Bultel
CNRS, Saint-Martin-d'Hère, France

5BV.3.16 Mathematical Modeling of Stand-Alone PV Power Systems with the Use of Hybrid Energy Storage Units Based on Ultra Capacitors
S.M. Karabanov, D.V. Suvorov, A.S. Karabanov,
D.Y. Tarabrin, E. Slivkin & G.P. Gololobov
RSREU, Ryazan, Russia

5BV.3.17 Test Bench for "Smart Modules" on the Berne University of Applied Sciences (BUAS)
U. Muntwyler, D. Bolzli, D. Gfeller,
L. Borgna & E. Schüpbach
BUAS, Burgdorf, Switzerland

5BV.3.18 Integration of Batteries into Utility Scale Photovoltaic Plants
R. Merz & D. Feßler
University of Applied Sciences Karlsruhe, Germany

5BV.3.19 Preliminary Developments of a Low Cost Data Acquisition System for the 3x20 Grid-Connected PV Plants of the "Propre.Ma" Project
N. Erraissi, N. Aarich, M. Akhsassi,
M. Raoufi & A. Bennouna
Cadi Ayyad University, Marrakech, Morocco

5BV.3.20 Hierarchical and PWM Multi-Level Power Supply System of Photovoltaics
J.-C. Liou & W.-J. Wen
KUAS, Kaohsiung, Taiwan
C.-C. Wu
Kao Yuan University, Kaohsiung, Taiwan

5BV.3.21 Method of Reducing Losses of PV Power Plants Based on CIGS Technology with Transformerless Inverters
P. Hrzina, L. Cerná, T. Finsterle & V. Benda
CTU Prague, Czech Republic
M. Hruška & P. Hruška
SolOps, Rícany, Czech Republic

5BV.3.22 Performance of Photovoltaic Power Systems under Grid Protection Constraints
J. Sachau & M. Ney
University of Luxembourg, Luxembourg
M. Cendagorta-Galarza López
ITER, Santa Cruz de Tenerife, Spain

5BV.3.24 Comparative Performance Assessment of Different Solar Module Technologies
A. Sharma, R.B. Stephen & P. Parmar
TERI, New Delhi, India

5BV.3.26 Energy Management of Battery-Supercapacitor in Photovoltaic Energy Storage
M. Ouassaid, Z. Cabrane & M. Maaroufi
Mohammed V University of Rabat, Morocco

5BV.3.27 Performance Characterization of a Vanadium Redox Flow Battery in a BIPV System
L. Fialho, T. Fartaria & M. Collares-Pereira
University of Évora, Portugal
P. Ridley
REDT, Dublin, Ireland
I. Landibar
Ingeteam, Sarriguren, Spain
L. Narvarte
UPM, Madrid, Spain

5BV.3.29 Comparison between two Accelerated Test Procedures on Batteries Suitable for Photovoltaic Applications
W. Merrouche, D. Ghribi & I. Gaci
CDER, Algiers, Algeria
L. Djellal & M. Trari
USTHB, Algiers, Algeria
S. Blaifi
University of Médéa, Algeria

5BV.3.30 Losses Estimation in the Performance Analysis of Stand-Alone Photovoltaic Systems without MPPT.
G. Jiménez-Castillo, F.J. Muñoz-Rodriguez & C. Rus-Casas
University of Jaén, Spain

5BV.3.31 Dealing with Uneven Illumination of a CPV System Integrated in the Built Environment
J. Veen, F. Mellema & P. Sonneveld
HAN University of Applied Sciences, Arnhem, Netherlands

5BV.3.32 Use of NiFe Batteries in Solar System
C. Luerßen
SERIES, Singapore, Singapore
P. Adelmann
University of Ulm, Illerkirchberg, Germany
T.M. Walsh
SERIS, Singapore, Singapore

5BV.3.33 Low-Cost Bidirectional DC Charge Controller with High Transfer Ratio
A. Kloenne
University of Applied Sciences Karlsruhe, Germany

5BV.3.34 Active Power Control in PV Systems Using a Curve Fitting Algorithm Based on the Single-Diode Model
E. Batzelis, T. Sofianopoulos & S. Papathanassiou
NTUA, Athens, Greece

5BV.3.35 Influence of a Solar Module's Fill-Factor on the Static MPP Tracking Performance of Single Phase PV Inverters
D. Gfeller, L. Borgna & U. Muntwyler
BUAS, Burgdorf, Switzerland

5BV.3.36 Innovative Gathering and Energy Management System Integrated within PV Module
W. Grzesiak, T. Maj, A. Polak & P. Mackow
Institute of Electron Technology, Cracow, Poland
E. Klugmann-Radziemska
Gdansk University of Technology, Poland
S. Zawora
Zamel, Pszczyna, Poland
K. Drabczyk
Polish Academy of Sciences, Cracow, Poland
S. Gulkowski
Lublin University of Technology, Poland
P. Grzesiak
Cracow University of Economics, Crakow, Poland

5BV.3.37 Design and Contribution of a Novel Dual-Axis Solar Tracking System with a Fisheye Camera
Z. El Jaouhari, S. Moughyt, O. El Kadmiri,
L. Masmoudi & Z. El Kadmiri
University Mohammed V, Rabat, Morocco
Y. Zaz
Abdelmalek Essaadi University Tetuan, Tetouan, Morocco

5BV.3.38 Optimised PV-System for East and West Roofs Considering DC/DC-Optimiser - Evaluation of Field Trials
M. Brune
E.ON, Essen, Germany
S. Malingriaux
E.ON, Gelsenkirchen, Germany

5BV.3.39 Optimal Design and Performance Evaluation of A Series Active Power Filter (SAPF) Fed by Solar Energy
B. Yahia, B.C. Rachid & L. Nora
University Constantine 1, Algeria

5BV.3.40 Simulation and Wind Tunnel Testing of a Special Racking System for PV Modules on Flat Commercial Rooftop
Y. Shu, J. Xu, Z. Zhang, P. Quan, C. Fu, X. Xue, Y. Zong,
J. Yu, P.J. Verlinden & Z. Feng
Trina Solar Energy, Changzhou, China

VISUAL PRESENTATIONS 1BV.7

15:15 - 16:45 New Materials and Concepts for Cells

1 1BV.7.1 Visible Photocurrent from a Nanocrystal-Activated Nanowire Schottky-Barrier Solar Cell
D.A. Jacques, P. Hardy, R. Jarrett, P. Khagram & R. Crook
University of Leeds, United Kingdom

1BV.7.2 A Proposal for Crystalline Silicon Solar Cells with the Back-Side SiGe Quantum Dot Arrays Grown by Solid-Source Molecular Beam Epitaxy
Y. Hoshi & N. Usami
Nagoya University, Japan
T. Tayagaki
Kyoto University, Japan
P. Yunin, A. Novikov & D. Yurasov
RAS, Nizhny Novgorod, Russia

1BV.7.3 InAs/InGaP Quantum Dot Solar Cells with an AlGaAs Interlayer
P.M. Lam, J. Wu, S. Hatch, M. Tang, D. Kim & H. Liu
University College London, United Kingdom
J. Wilson & R. Allison
Dstl, Fareham Hants, United Kingdom
I. Ramiro
UPM, Madrid, Spain
V.G. Dorogan, M. Benamara, Y.I. Mazur & G.J. Salamo
University of Arkansas, Fayetteville, United States

1BV.7.4 Process Technologies for Nano-Wall Top Cell in Crystalline Si Tandem Solar Cells
Y. Ichikawa, M. Hirai & S. Yoshiba
JAIST, Koriyama, Japan
M. Konagai
Tokyo Institute of Technology, Japan

1BV.7.5 Self-Organized Texture of GaAs by Wet Etching for Light Trapping in MQW Solar Cell
K. Watanabe, T. Inoue, H. Sodabanlu,
M. Sugiyama & Y. Nakano
University of Tokyo, Japan

1BV.7.6 Light Trapping for Silicon Photovoltaic Cells Designed for Solar-Pumped Laser Illumination
Y. Takeda & T. Ito
Toyota Central R&D Labs, Nagakute, Japan

1BV.7.7 Conductive Plasmonic Metasurfaces for Front-Contacted Silicon Heterojunction Solar Cells
M.W. Knight, J. van de Groep & A. Polman
AMOLF, Amsterdam, Netherlands
Y. Kuang
Eindhoven University of Technology, Netherlands
P.C.P. Bronsveld
ECN, Petten, Netherlands
R.E.I. Schropp
ECN, Eindhoven, Netherlands

1BV.7.8 Novel Light Trapping Scheme Based on Single-Side Modulated Photonic Nanostructure for Back-Contact Thinner-Wafer Solar Cells
T. Tayagaki & Y. Kishimoto
Kyoto University, Uji, Japan
Y. Hoshi & N. Usami
Nagoya University, Japan

1BV.7.9 Nonlinear Optical Response of Double Plasmonic Interfaces for Potential Use in Solar Cells
M. Zolfaghari Borra, H. Nasser, B.C. Yildiz Karakul,
R. Turan & A. Bek
METU, Ankara, Turkey
M.E. Tasgin
Hacettepe University, Ankara, Turkey

1BV.7.10 Semiconducting Silicon-Tin Alloy Nanocrystals, a Material to Enhance Absorption below the Energy Gap of the Silicon
M. Lozach, V. Svrcek & K. Matsubara
AIST, Tsukuba, Japan
D. Mariotti
University of Ulster, Newtownabbey, United Kingdom

1BV.7.11 Silicon Wire Structures for New Concept a-Si:H/c-Si Tandem Solar Cells
A.S. Gudovskikh, D.A. Kudryashov,
I.A. Morozov & E.V. Nikitina
SPbAU RAS, St Petersburg, Russia

1BV.7.12 Modeling of Selective Energy Contacts for Hot Carrier Solar Cells
A. Julian, Z. Jehl, Y. Okada & J.F. Guillemoles
University of Tokyo, Japan

1BV.7.13 Stability Performances in Chalcogenide PV Devices
B. Ghosh, P. Banerjee, S. Bhattacharyya,
R. Mandal & M. Chakraborty
Jadavpur University, Kolkata, India

1BV.7.14 Utilizing Process-Induced Film Morphology for Nanostructured Solar Cells
S. Menezes & Y. Li
InterPhases Solar, Moorpark, United States
A. Samantilleke
University of Minho, Braga, Portugal

1BV.7.15 CZTS Nanocrystals: Preparation, Characterization and Band Gap Regulation
X. Ren & W. Dang
Shaanxi Normal University, Xi'an, China
F. Liu
CAS, Dalian, China

1BV.7.16 Analysis of the Doping Effect on p-i-n Structured Si Nanocrystals by Energy-Filtered Tem and Atom Probe Tomography for All-Si Tandem Solar Cells
K. Nomoto, T.C.-J. Yang, L. Wu, T. Zhang, B. Puthen-Veetil,
Z. Lin, X. Jia, G. Conibeer & I. Perez-Wurfl
UNSW, Sydney, Australia
A.J. Breen, P.J. Felfer, A.V. Ceguerra,
J. Cairney & S.P. Ringer
University of Sydney, Australia

1BV.7.17 Self-Assembling Sn Nanoparticles for Crystalline Silicon Solar Cells
I.-S. Yu
National Dong Hwa University, Hualien, Taiwan
H.E. Cheng & J.-N. Su
STUST, Tainan, Taiwan
T.-C. Wu
MIROC, Kaohsiung, Taiwan

1BV.7.18 Fabrication of ZnO Nanorods on AZO Substrates as Photoelectrodes for Dye-Sensitized Solar Cell Application
C. Li & S. Hou
Kochi University of Technology, Kami, Japan

1BV.7.20 Optimization of Pore Diameter of Macroporous Silicon Used as the Cathode of Hybrid Solar Cell
A.B.M. Ismail & A.S. Islam
University of Rajshahi, Bangladesh, Bangladesh

1BV.7.22 Characteristics of Cu-Based I-V-Vi2 Photovoltaic Absorber with Different Types of Hybrid Ink
A. Cho, S. Banu, S.J. Ahn, J.H. Yun, J. Gwak, S.K. Ahn, Y. J. Eo, J.-S. Cho, J.H. Park, J.S. Yu, K. Kim, K.S. Shin & K. Yoon
KIER, Daejeon, Korea South

1BV.7.23 Antireflective GaAs Subwavelength Structures Fabricated with Metal-Assisted Chemical Etching and Agglomeration of Au Catalysts
Y. Song & J. Oh
Yonsei University, Incheon, Korea South

1BV.7.24 Fabrication of Crystalline Silicon Wire-Structure Using Al1-xOx Film as a Passivation Layer for Solar Cell Application
S. Shirayanagi, Y. Yashiki & S. Kato
JST, Koriyama, Japan
M. Konagai
Tokyo Institute of Technology, Japan

1BV.7.25 Effect of Ag Nanoparticles Embedded AZO/ZnO Multilayers as Front TCO on the QE Spectra of the a-Si/a-Si Double Tandem Solar Cells
A. Mandal, A. Kole, T. Ghosh, D. Basak & P. Chaudhuri
IACS, Kolkata, India

1BV.7.26 New Heterostructure on the Base of Si Nanoparticles Embedded in Dielectric Layers Deposited on n-Type Si Wafer
P. Vitanov, A. Harizanova & T. Ivanova
Bulgarian Academy of Sciences, Sofia, Bulgaria
A. Ulyashin
SINTEF, Oslo, Norway

1BV.7.27 Solar Energy Conversion through Nanostructured Surface Prepared by Roll-to-Roll Deposition
G. Zhavnerko & V.Y. Shiripov
Izovac Technologies, Minsk, Belarus
O. Sergeev
NEXT ENERGY, Oldenburg, Germany

1BV.7.28 Simulation and Comparison of InAs/GaAs and GaSb/GaAs Quantum Dot Solar Cells
B. Benyettou & A. Aissat
University of Blida, Algeria
T. Sofiane & L. Brahim
University of Sidi Bel-Abbess, Algeria

1BV.7.29 The Impact of Incident Spectrum and Power on the Performances of GaInAs Thermophotovoltaic Cells
P. Jurczak, A. Onno & H. Liu
University College London, United Kingdom

1BV.7.30 Experience on Caustic-Fusion Ilmenite to Produce TiO2 for DSSC
A. Mostavan, S. Soepriyanto & A. Mostavan
ITB, Bandung, Indonesia

1BV.7.31 Ultra Thin Porous Silicon Solar Cells
F. Palma, M. Balucani, K. Kholostov & V. Varlamava
University of Rome „La Sapienza“, Italy
M. Izzi, L. Signorelli & M. Tucci
ENEA, S. Maria di Galeria - Rome, Italy

1BV.7.32 Photoemission and Optical Studies of Earth Abundant PV Absorbers CuSbS2 and Cu3N
M. Birkett, T.J. Whittles, V.R. Dhanak & T.D. Veal
University of Liverpool, United Kingdom
A. Welch & A. Zakutayev
NREL, Golden, United States

1BV.7.33 Aluminum Induced Glass Texturing Process for Thin Film Solar Cell Applications
M. Ünal, H. Nasser, M. Günöven & R. Turan
METU, Ankara, Turkey
I. Sökmen
Sisecam Science and Technology Center, Kocaeli, Turkey

1BV.7.34 Estimation of Effective Carrier Lifetimes of Plasmonic Silicon Solar Cells Using Impedance Spectroscopy
E. Thouti & V.K. Komarala
IIT Dehli, New Dehli, India
S. Kumar
National Physical Laboratory, New Delhi, India

1BV.7.35 Development and Characterization of Quantum-Dot Solar Cells Sensitized Using Chemical Bath Deposition Method
A.B. Nikolskaia, L.L. Larina, A.V. Todinova,
M.F. Vildanova & O.I. Shevaleevskiy
RAS, Moscow, Russia
V.D. Dao & H.-S. Choi
Chungnam National University, Daejeon, Korea South

1BV.7.36 Innovative Tandem Cell: Perovskite on a-Si:H/c-Si Heterostructure
F. Matteocci, S. Razza, S. Casaluci,
N. Yaghoobiniya & A. di Carlo
University of Rome II, Italy
L. Serenelli, M. Izzi, A. Mittiga & M. Tucci
ENEA, Rome, Italy

1BV.7.37 Reflection Suppression in a GaAs0.77p0.23/Si Tandem Step-Cell
S. Saylan, S. Abdul Hadi, A. Nayfeh & M.S. Dahlem
Masdar Institute, Abu Dhabi, United Arab Emirates
T. Milakovich & E.A. Fitzgerald
MIT, Cambridge, United States

1BV.7.38 Efficiency Enhancement of GaAs Solar Cells Using Nano-Grooved Back Reflector
A. Alimardani, E. Asl-Soleimani & A. Afzali-Kusha
University of Tehran, Iran

1BV.7.39 Effect of Si Doping on Performance of Quantum Dot Solar Cells
S. Naitoh, N. Miyashita, K. Toprasertpong, R. Tamaki,
T. Hoshii, M. Sugiyama & Y. Okada
University of Tokyo, Japan

1BV.7.40 Ultrathin GaAs Solar Cells with a Nanostructured Silver Mirror
N. Vandamme, J. Goffard, B. Behaghel, A. Cattoni,
A. Lemaître & S. Collin
CNRS, Marcoussis, France
A. Delamarre & M. Sugiyama
University of Tokyo, Japan
J.F. Guillemoles
CNRS, Chatou, France

1BV.7.41 Cu2ZnSn(S,Se)4 Absorbers onto Transparent Conducting Back Contacts for Bifacial Solar Cells Concepts
M. Espindola-Rodriguez, Y. Sánchez, S. López-Marino,
H. Xie, D. Sylla, V. Izquierdo-Roca, P. Pistor,
E. Saucedo & M. Placidi
IREC, Sant Adrià de Besòs - Barcelona, Spain
O. Vigil-Galan
UPALM, Mexico City, Mexico

1BV.7.42 Deposition of Cds Quantum Dots on Aligned ZnO Nanorods
L. Atourki, K. Bouabid & A. Ihlal
University of Agadir, Morocco

1BV.7.44 Performance Enhancement of Tunnel Diode by Embedding InAs Quantum Dot Layer
K. Park, S.J. Kang, S.K. Lee, S. Ravindran,
J.-W. Min & Y.T. Lee
GIST, Gwangju, Korea South

1BV.7.45 Evaluation of the Optical Properties of the Up-Converter Combined with Quantum Dots when Implemented in Bifacial Silicon Solar Cells
A.C. Pan & L.S.G. Cardoso
PUCRS, Porto Alegre, Brazil

1BV.7.46 Study of the Optical and Electrical Behavior of (ZnO)(1-x)(Co3O4)x Semiconductor Composites Obtained in the Thin Layer Form by the Spray Pyrolysis Technique
K.M.A. Boureguig, H. Tabet-Derraz,
A. Bouzidi & N. Benramdane
Djillali Liabes University, Bel Abbes, Algeria

1BV.7.47 In Situ Growth of SnS Thin Films by Reactive Sputtering for Solar Cells
F. Liu & X. Hao
UNSW, Sydney, Australia

1BV.7.48 Comparative Study of Sputtered and Spin-Coated TiO2 Thin Films for Extremely Thin Absorber-ETA Solar Cell Applications
A. Hosseini
METU, Ankara, Turkey

1BV.7.49 Innovative Tendencies in Development of Solar Cells and Systems
D.S. Strebkov & O.V. Shepovalova
RAAS, Moscow, Russia

1BV.7.51 Iron Pyrite (FeS2) for Solar Energy Conversion: from Potential and Problems to Application
S. Shukla, H. Ge, N. Mathews, Q. Xiong & T. Sritharan
Nanyang Technological University, Singapore

1BV.7.52 Preparation and Investigation of Layers Based on Oxides of Copper and Zinc for Solar Energy Converters
V. Afanasyev, A. Bobkov, A. Maksimov, V. Moshnikov,
N. Mukhin & D. Redka
SPbETU, Saint Petersburg, Russia
E.I. Terukov
RAS/ Ioffe, Saint Petersburg, Russia

1BV.7.53 Hydrogen Passivation of Silicon Nanowire Structures
R. Benabderrahmane Zaghouani, S. Aouida,
N. Bachtouli & B. Bessais
CRTEn, Hammam-Lif, Tunisia

VISUAL PRESENTATIONS 5BV.4

17:00 - 18:30 Manufacturing Quality, Recycling and Sustainability

5BV.4.2 Life Cycle Assessment of Silver Replacement with Copper Based Metallization in TetraSun PV Modules
P. Sinha
First Solar, Tempe, United States
M. de Wild-Scholten
SmartGreenScans, Groet, Netherlands

5BV.4.3 In-Line Quality Control Device for the Degree of Crosslinking of the Embedding Material Ethylene Vinyl Acetate in PV Modules
C. Hirschl, L. Neumaier, W. Mühleisen, M. DeBiasio,
R. Leitner, S. Puchberger & M. Kraft
CTR, Villach, Austria
G. Oreski & A. Rauschenbach
PCCL, Leoben, Austria
G.C. Eder
OFI, Vienna, Austria
S. Seufzer
KIOTO, St. Veit, Austria
C. Berge & E. Rüland
GP Solar, Neuried, Germany

5BV.4.4 New Dimensions in Lock-in Thermography for Shunt Classification in PV-Material with New HD Thermal Resolution Cameras
S. Sturm
InfraTec, Dresden, Germany

5BV.4.6 The Analysis of Work Effectiveness of Various PV Technologies in the Conditions of South-Eastern Poland
J.M. Olchowik, P. Dragan & S. Gulkowski
Lublin University, Poland
R. Tomaszewski
Pope John Paul II University, Biala Podlaska, Poland

5BV.4.7 Cabriss: an European Project to Develop a Circular Economy Based on Recycled, Reused and Recovered Indium, Silicon and Silver Materials for Photovoltaic and Other Applications
L. Federzoni & D. Pelletier
CEA, Le Bourget du Lac, France
W. Palitzsch
Loser Chemie, Langenweißbach, Germany
K. Mork
ReSiTec, Kristiansand, Norway
A. Ulyashin
SINTEF, Oslo, Norway
I. Gordon
imec, Leuven, Belgium
E. Neubauer
RHP-Technology, Seibersdorf, Austria
N. Adamovic
Vienna University of Technology, Austria
M.-C. Hoffmann
PROJEKTkompetenz, Salzburg, Austria
N. Defrenne
PV Cycle, Paris, France

5BV.4.9 Life Cycle Assessment of Photovoltaic Power Systems in Russia
S.M. Karabanov & D.V. Suvorov
RSREU, Ryazan, Russia
P.P. Bezrukikh
Krzhizhanovsky Institute JSC, Moscow, Russia
P.P.jr. Bezrukikh
LUKOIL, Moscow, Russia

5BV.4.10 Manufacturing High Efficiency Photovoltaic Module with Nano-Sized Anti-Reflection Patterns Using Direct Transfer Printing Process
J.-H. Shin, Y.-J. Yoo, H.-J. Choi, Y.-D. Kim & H. Lee
Korea University, Seoul, Korea South

5BV.4.11 Investigation of Standardized Test Condition for PV Encapsulants by Pressure Cooker Test (PCT)
Y.T. Li, Y.-H. Lee, W.-L. Yang, H.-H. Hsieh,
H.-S. Wu & E.Y. Wang
ITRI, Hsinchu, Taiwan
C.-M. Tung & P. Yu
NCTU, Hsinchu, Taiwan

5BV.4.12 Methods to Improve and Evaluate Solderability of Solar Cell Metallizations
P. Gierth & L. Rebenklau
Fraunhofer IKTS, Dresden, Germany

5BV.4.13 State-of-the-Art in PV Recycling: Silicon & Thin-Film Technologies
W. Palitzsch, P. Schönherr & U. Loser
Loser Chemie, Langenweißbach, Germany

5BV.4.15 Minimization of Electrical Losses for PV Modules Located in Places with High Solar Irradiance
J. Rabanal-Arabach, A. Schneider,
E. Cabrera & R. Kopecek
ISC Konstanz, Germany

5BV.4.16 Electricity Systems with Ambitious Levels of PV: a Prospective Consequential Lifecycle Approach
C. Jones & P. Gilbert
University of Manchester, United Kingdom
M. Raugei & E. Leccisi
Oxford Brookes University, United Kingdom

5BV.4.17 Advanced Imaging Characterization and Modelling of Defects in Organic Solar Cells
R. Rösch, D. Fluhr, R. Öttking, B. Muhsin & H. Hoppe
Ilmenau University of Technology, Germany

5BV.4.18 Site Simulation Shows Interdependence of Energy and Fresh Water Consumption in PV Wafer Production
M. Schottler
AVEREM process engineering, Stuttgart, Germany
M. de Wild-Scholten
Smart Green Scans, Groot, Netherlands

5BV.4.19 A Comprehensive Protocol for Assessing the Quality of the Lamination Process of Thin Film Glass/Glass Modules
A. Virtuani & S. Dittmann
SUPSI, Canobbio, Switzerland
D. Pic & J.-L. Allary
NEXCIS, Rousset, France

5BV.4.20 Research and Development Center for Thin Film Technology in Photovoltaics
E. Terukova, A.S. Abramov, D.A. Andronikov,
S.N. Abolmasov, K.V. Emtsev, A.V. Kukin, I.A. Nyapshaev,
A.V. Semenov, M.Z. Shvarts, E.I. Terukov & D. Orekhov
RAS/ Ioffe, St. Petersburg, Russia

RAS/ Ioffe, St-Petersburg, Russia

5BV.4.21 Measurement Uncertainties of a Compact Array Spectrometer
F. Schubert, K. Klameth, S. Darou & D.M. Spinner
Aescusoft, Freiburg, Germany

5BV.4.23 Statistical Selection of PV Modules for Batch Testing
G. Corbellini
SUPSI, Canobbio, Switzerland

5BV.4.25 Low-Frequency Noise Quality Testing of Silicon Concentrator Photovoltaic Cell with Very High Efficiency
Z. Chobola, M. Lunnak & J. Vanek
Brno University of Technology, Czech Republic

5BV.4.26 Integrated PV-Recycling – More Efficient, More Effective
W. Palitzsch, P. Schönherr & U. Loser
Loser Chemie, Langenweißbach, Germany

5BV.4.27 About the Implementation of Our Zero Waste Concept for the PV Recycling
W. Palitzsch, P. Schönherr & U. Loser
Loser Chemie, Langenweißbach, Germany

5BV.4.28 The Challenge for Manufacturers of cSi PV When Moving to High Efficiency PV Themanagement of Waste Gases from the NF3 Chamber Clean Required by aSi PV Manufacture
C.P. Jones
Edwards Limited, North Somerset, United Kingdom

VISUAL PRESENTATIONS 2BV.8

17:00 - 18:30 Silicon Solar Cell Characterization and Modelling / Industrial Aspects of c-Si Solar Cells

2BV.8.1 Spatially Resolved Light Trapping of Silicon Wafers from Photoluminescence Imaging Using Long Wavelength Excitation
M.K. Juhl, T. Trupke, M. Abbott, B. Mitchell & B. Hallam
UNSW, Sydney, Australia

2BV.8.2 Temperature Coefficients of Silicon Solar Cells
K. Ramspeck, A. Metz & F. Haas
h.a.l.m. elektronik, Frankfurt, Germany
S. Winter & F. Plag
PTB, Braunschweig, Germany

2BV.8.3 Accelerating Boron-Oxygen Related Regeneration: Lessons Learned from the BORNEO Project
A. Herguth, S. Wilking, R. Horbelt, S. Ebert,
C. Beckh & G. Hahn
University of Konstanz, Germany
T. Niewelt, J. Broisch, M.C. Schubert & W. Warta
Fraunhofer ISE, Freiburg, Germany
F. Wolny
SolarWorld Innovations, Freiberg, Germany

2BV.8.4 Modelling and Characterisation of BBr3 Boron Diffusion Process for N-Type Si Wafer Solar Cells
M. Li, F.-J. Ma, K. Devappa Shetty,
A.G. Aberle & G.G. Samudra
SERIS, Singapore, Singapore
B. Hoex
UNSW, Sydney, Australia

2BV.8.5 Merits of the Exponentially Decaying P-Type Doping Profile in the Emitter of P+/n Crystalline Silicon Solar Cells
M.Y. Ghannam & F. Alajmi
Kuwait University, Safat, Kuwait

2BV.8.6 Analysis of Low Temperature Current-Voltage Measurements under Illumination of Silicon Heterojunction Solar Cells
M. Mikolasek, J. Kovác, M. Perný, V. Saly & L. Harmatha
Slovak University of Technology, Bratislava, Slovakia
J. Huran
Slovak Academy of Sciences, Bratislava, Slovakia

2BV.8.7 Numerical Calculation of Single Diode Solar Cell Modelling Parameters Using the Multi-Dimensional Newton-Raphson Method
F. Ghani & G. Rosengarten
RMIT University, Melbourne, Australia
M. Duke
University of Waikato, Hamilton, New Zealand

2BV.8.8 Rapid Calculation of Series and Shunt Resistance Values for a Solar Cell
F. Ghani & G. Rosengarten
RMIT University, Melbourne, Australia

2BV.8.9 Coloring Si Wafer-Based PV Modules with Optical Reflecting Filters: Simulated Structures and Performances
S.C. Brofferio & G. Bernasconi
Polytechnic University of Milan, Italy

2BV.8.10 A 2D Model to Simulate Front Metallic Electrode of Silicon-Based Solar Cell Using Finite Element Method
S. Li, S. Li & B. Hou
Soochow University, Suzhou, China

2BV.8.11 Numerical Simulation of Suppression of Carrier Tunneling Effect in Interdigitated Back-Contacted Back-Junction Silicon Solar Cell by Lateral Diffusion
C.-M. Wei & W.-L. Lu
Motech Industries, Tainan, Taiwan

2BV.8.12 Preventing Light Induced Degradation of Multi Crystalline Solar-Cells
T. Luka, S. Eiternick & M. Turek
Fraunhofer CSP, Halle, Germany

2BV.8.14 Influence of Different Doping Processes on Emitter Quality of Silicon Solar Cells: an Atomic Scale Study
M. Raghuwanshi, P. Pareige, E. Cadel & S. Duguay
Université et INSA de Rouen, Saint Etienne du Rouvray, France
A. Lanterne, J. Le Perchec & S. Gall
CEA, Le Bourget-du-Lac, France

2BV.8.15 Predominant Passivation Behavior Analyses on Boron Doping Profile for n-Type c-Si
P.-T. Hsieh, C.J. Huang, Z. Peng, W.-T. Chung, Y.-J. Lin,
P.-K. Chang, C. Kuo & C.C. Li
Motech Industries, Tainan, Taiwan

2BV.8.16 Study of the Solutions to Potential Induced Degradation in Multi-Si Solar Cells
F. Jiang, J. Jin & H. Jin
Jinko Solar, Haining, China

2BV.8.17 Correlative Microstructural Analysis and Determination of Local Grain Orientation of Multi-Crystalline Silicon Solar Cells
S. Richter, S. Timmel, D. Lausch, M. Gläser,
S. Meyer & C. Hagendorf
Fraunhofer CSP, Halle, Germany

2BV.8.18 Passivation Behaviour Study of Al2O3/SiNx:H Stacks on c-Si by in situ Photoluminescence
F. Lebreton, F. Silva, S. Abolmasov & P. Roca i Cabarrocas
CNRS, Palaiseau, France
S. Filonovich
TOTAL, Paris la Defense, France
A. Zauner
Air Liquide, Jouy-en-Josas, France

2BV.8.19 Manipulating Reverse Current in 21% n-MWT Cells
B. Newman, B.B. Van Aken, M. Koppes, A. Gutjahr,
L.A.G. Okel, J. Löffler, I.G. Romijn, C.J.J. Tool,
N. Guillevin & E.E. Bende
ECN, Petten, Netherlands
J. Wang, J. Zhai, Z. Wang, Y. Chen, Y. Wang & D. Liu
Yingli Green Energy, Baoding, China

2BV.8.20 Advanced Modeling of Silicon Wire Solar Cell with Radial p-n Junction and Wire-Shape Analysis to Optimization
S. Ahn, C. Park, Y.-J. Lee & J. Yi
Sungkyunkwan University, Suwon, Korea South
C.-S. Han
Jeonnam Technopark, Jeollanam-do, Korea South
C. Jeong
KITECH, Gwangju, Korea South

2BV.8.21 Effective Minority Carrier Lifetime Measured in QSS Mode and Silicon Surface Treatments
S. Aouida, R. Benabderrahmane Zaghouani, N. Bachtouli & B. Bessais
CRTEn, Hammam-Lif, Tunisia

2BV.8.22 Solving the Code of Series Resistance on Large Area Solar Cells: Average and Local Power Losses of External and Lateral Balancing Currents
J. Carstensen, J.-M. Wagner, A. Schütt & R. Adelung
University of Kiel, Germany

2BV.8.23 Bias Dependent Electron-Beam Induced Current (Li-EBIC) Imaging for Diagnostics of Silicon Solar Cells
S. Großer & C. Hagendorf
Fraunhofer CSP, Halle, Germany

2BV.8.24 Nondestructive Characterization and Microscopic Properties of Rear Contact Voids in PERC Cells
S. Großer, S. Eiternick & M. Turek
Fraunhofer CSP, Halle, Germany

2BV.8.25 Simulation and Measurement of Angle Resolved Reflectance from Black Si Surfaces
R. Schmidt Davidsen, K. Wu, M. Stenbæk Schmidt, A. Boisen & O. Hansen
DTU, Lyngby, Denmark

2BV.8.26 Modeling of Finger Interruptions in PV Solar Cells by Distributed Circuit Simulations
P. Magnone
University of Padova, Vicenza, Italy
D. Giaffreda, F. Ceccaroni & C. Fiegna
University of Bologna, Cesena, Italy
D. Tonini, M. Martire & M. Galiazzo
Applied Materials, San Biagio di Callalta, Italy

2BV.8.27 Capacitance of Vertical Parallel Junction Silicon Solar Cell under Monochromatic Modulated Illumination
G. Sissoko, G. Sahin, A. Diao, M. Ndiaye & N. Thiam
University of Cheikh Anta Diop, Dakar, Senegal

2BV.8.28 Simulation Study of Back Contacted Silicon Hetero-Homojunction Solar Cell: Impact of Highly Doped Layer and Contact Geometry
M. Mikolasek, P. Príbytný, J. Marek, A. Chvála, M. Molnár, J. Kovác & D. Donoval
Slovak University of Technology, Bratislava, Slovakia

2BV.8.30 Discrepancies between SILAVCO and PC1D Device Simulators in the One-Dimensional Modelling of Light-Trapping Si Solar Cells
L. Abenante
ENEA, Rome, Italy

2BV.8.31 Extension of 1-D Analysis for a First Approximation of Optical and Recombination Losses in MWT Silicon Solar Cells
A. Razzaq
KU Leuven, Belgium
J. Chen, F. Duerinckx & J. Poortmans
imec, Heverlee, Belgium

2BV.8.32 Detail Study on Electronic Bonding States on SiN Passivation Film and Interface for Si Solar Cell Applications
Y. Yamashita, N. Ikeno, T. Katsumata, K. Kurishima, R. Imai, Y. Suzuki & A. Ogura
Meiji University, Kawasaki, Japan
H. Oji & I. Hirosawa
JASRI, Sayo, Japan
T. Tachibana & Y. Ohshita
TTI, Nagoya, Japan

2BV.8.33 Silicon Heterojunction Technology: Monitoring and Analysis of the Performance of Solar Cells Varying Temperature and Insolation
O. El Daif, A. Abdallah & N. Tabet
Qatar Foundation, Doha, Qatar
S.M. de Nicolas & S. De Wolf
EPFL, Neuchâtel, Switzerland

2BV.8.34 Solar Cells Modelling Using Radial Basis Functions Neural Network
A. AlAmoudi, A. Baras & R. Jones
K.A. CARE, Riyadh, Saudi Arabia

2BV.8.35 A New Tool to Predict Thermal and Electrical Behavior of Silicon Solar Cells
R. Couderc, M. Amara & M. Lemiti
INSA Lyon, Villeurbanne, France

2BV.8.36 New Scanning Scheme for Separation of Residual Stress Components in Silicon Wafers Using Near Infra-Red Digital Polariscopy Technique
R.G.R. Prasath, K. Skenes & S. Danyluk
Georgia Institute of Technology, Atlanta, United States
T. Newton
Polaritek Systems, Atlanta, United States

2BV.8.37 Understanding the AgAl Contact Spiking in p+ Boron Emitters
L.J. Koduvelikulathu, T. Buck, D. Rudolph,
V.D. Mihailetchi & R. Kopecek
ISC Konstanz, Germany

2BV.8.38 Interpretation of Difference in Luminescence Intensity Correlated with Silicon Defects Recombination Mechanisms
R. Stojan & J. Vanek
Brno University of Technology, Czech Republic

2BV.8.39 LEDs with Active Cooling in Combination with Fast-Feedback Control Loops for Highly Accurate and Flexible Light Sources for Solar Cell Characterization
J. Suthues & T. Brammer
Wavelabs Solar Metrology Systems, Leipzig, Germany

2BV.8.40 Systematic Optimization of Boron Diffusion for Emitter Formation in Solar Cell Applications
P. Ebrahimi, M. Kolahdouz, M. Iraj & E. Asl-Soleimani
University of Tehran, Iran

2BV.8.41 Multijunction Planar High-Voltage Silicon Solar Cells
O.V. Shepovalova & V.M. Evdokimov
RAAS, Moscow, Russia
A. Morocha
National Research University of Electronic Technology, Moscow, Russia

2BV.8.45 LID Recovery Tool for PERC Solar Cells
M. Martire, M. Zamuner & M. Galiazzo
Applied Materials, S. Biagio di Callalta, Italy

2BV.8.46 Quality Estimation of N-Mono Wafers in Silicon Heterojuction Solar Cells Using Photoluminescence Imaging
Z.-Y. Shih, F.-S. Chen, J. Chang, W.-C. Hsieh & M.-Y. Chen
AU Optronics, Taichung, Taiwan

2BV.8.47 Precise Cell Performance Estimation Based on Wafer PL Measurement
H. Schremmer, A. Bergmann, J. Grohs & N. Cüppers
Hennecke Systems, Zülpich, Germany

2BV.8.48 Cost of Ownership Analysis and Tracking within PV Manufacturing Lines
J. Kinauer & M. Jacob
AIS Automation, Dresden, Germany

2BV.8.49 Advanced Simulation of Silicon Solar Cell Production Lines Using Discrete Event Simulation Software
R.C.G. Naber & A.H.G. Vlooswijk
Tempress, Vaassen, Netherlands

2BV.8.50 Industrial Inert Drying System for High Effiency Heterojunction Solar Cells
C. Clement, S. Schörner & H. Bell
Rehm Thermal Systems, Blaubeuren, Germany
P. Gierth & L. Rebenklau
Fraunhofer IKTS, Dresden, Germany

2BV.8.52 Review of Critical Firing Furnace Features and Their Impact on Cell Performance
G. Cheng, D. Ruf, T. Myers & E. Cheng
Despatch Industries, Lakeville, United States

2BV.8.53 Investigation of Interface between Sputtered NiV/Ag and TCO Layer in Back Side Metallization for High Efficiency Heterojunction Solar Cell
J. Chang, F.-S. Chen, M.-Y. Chen, W.-C. Shieh & Z.-Y. Shih
AU Optronics, Taichung, Taiwan

2BV.8.54 A Novel and Low-Cost Technique to Fabricate n-Type Region of Silicon Solar Cells
J.-W. Liao, C.-Y. Kuo, T. Lin, C. Tseng & F.-R. Chen
NTHU, Hsinchu, Taiwan
S.-Y. Wei, S.M. Yu & W.C. Sun
ITRI, Hsinchu, Taiwan

2BV.8.55 A Novel Approach for Single Side Wet Chemical Etching of Crystalline Silicon Solar Cells
M. Corda, B. Wattenberg, B. Mandlmeier & J. Seeberger
Singulus Stangl Solar, Fürstenfeldbruck, Germany

2BV.8.56 Crystalline Silicon Solar Cells Rating Using Mechanical Test Results and Oxidation Susceptibility Index of Silver Busbar
V. Gade, K. Doss, T. Kukielka, N. Shiradkar & A. Rawers
Jabil Circuit, St. Petersburg, United States

2BV.8.57 Development of New Concept Stringer System for Module Fabrication of Crystalline Silicon Solar Cells
S.H. Kim
KETI, Gyeonggi-do, Korea South
K.-I. Jung
Zeus, Gyeonggi-do, Korea North
D. Kim
Korea University, Seoul, Korea South

2BV.8.58 Multi-Crystalline Silicon Solar Cells Made on Solar Grade Polycrystalline Silicon
J.W. Chen, Y.H. Mai, J.H. Chen, H.B. Zhu & Y. Xu
Hebei University, Baoding, China

2BV.8.60 Impact of Point of Use (POU) High Purity Water Recovery and Reuse on Solar Manufacturing Costs and Resource Demands
A. Yazdani
Exergy, Irvine, United States

2BV.8.61 Longlife Valve Technology for OEM Processing Equipment and Specified Water Piping System in PV Cell Production
H. Mueller
Georg Fischer Piping Systems, Schaffhausen, Switzerland

2BV.8.62 An Optimization Study of Fluid Transfer on RPECVE Reactor Using COMSOL Multiphysics- Numerical Simulation
A.M. Talla, Y. Cuminal & S. Pincemin
UM2, Montpellier, France

2BV.8.63 Process Improvements and Cost Savings Realised by Installing a New Generation POCl3 Vaporiser and Bulk Chemical Delivery System at One of the Largest Photovoltaic Cell Production Lines
S. Knight
HORIBA, Northampton, United Kingdom

2BV.8.64 A Novel Insulating Method of Interconnection for Back-Contact Solar Cell
W. Long, W. Zhang, J. Wu, X.-S. Wang & G. Xing
Canadian Solar, Suzhou, China

2BV.8.65 Understanding the Impact of Rapid Thermal Processing (RTP) on the Light Induced Degradation (LID) of Mono and Multi Crystalline Silicon Solar Cells
A. Ebong, N. Chen, V. Unsur & A.A. Chowdhury
UNC Charlotte, United States

2BV.8.66 Multivariate Analysis of Wafer Process Data
R. Evans
UNSW, Sydney, Australia
E. Stegemann, T. Dinkel, B. Klöter, P. Stoye & K. Petter
Hanwha Q CELLS, Bitterfeld-Wolfen, Germany

2BV.8.67 The Swiss Inno-HJT Project: Performance of Si-HJT Systems Produced in a Pilot R&D Line
B. Strahm
Roth&Rau, Hauterive, Switzerland
D.L. Bätzner, W. Frammelsberger, D. Lachenal, B. Legradic, J. Meixenberger, P. Papet & G. Wahli
Meyer Burger, Hauterive, Switzerland

M. Despeisse, C. Allebé, P.-J. Alet, N. Badel, M. Bonnet-Eymard, F. Debrot, A. Faes, A. Lachowicz, J. Levrat & C. Ballif
CSEM, Neuchâtel, Switzerland
Y. Yao, C. Rychen, T. Söderström, J. Heiber, M. Lanz & S. Leu
Meyer Burger, Gwatt, Switzerland
J. Hiller & V. Fakhfouri
Pasan, Neuchâtel, Switzerland

NOTES

WEDNESDAY, 16 September 2015

VISUAL PRESENTATIONS 3CV.1

08:30 - 09:30 Thin Film Si Cells and Modules

33CV.1.1 Development and Validation of a Phenomenological Model Describing Degradation and Annealing of a-Si:H Solar Cells
M. Görig & B.E. Pieters
Forschungszentrum Jülich, Germany

3CV.1.2 Development of Flexible Tandem Solar Cells with Very High Frequency Plasma Enhanced Chemical Vapor Deposition (VHF PECVD) Technique at Low Temperature
D. Fischer, B. Leszczynska, M. Albert,
J.W. Bartha & C. Strobel
Technical University of Dresden, Germany
J. Kuske
FAP, Dresden, Germany
N. Prager & M. Fahland
Fraunhofer FEP, Dresden, Germany

3CV.1.3 Monolithic Interconnection of Silicon Based Thin-Film Solar Cells on Aluminium Substrates
S. Geißendörfer, O. Siepmann, A. Schweitzer,
O. Sergeev & M. Vehse
NEXT ENERGY, Oldenburg, Germany

3CV.1.4 Improvement and Analysis on Color Variation on a-Si Thin Film Modules
C. Peng, C. Hong, S. Yang, H. Chen, Q. Jiang, P. Sun,
J. Zhang, Y. Li & X. Xu
Hanergy Advanced Systems, Chengdu, China

3CV.1.6 Engineering Improvements in the Amorphous/Microcrystalline Silicon Tandem Thin Film Solar Modules at Chint Solar
X. Niu, S. Liu, W. Li, L. Liu, W. Han, S. Wang,
H. Huang & C. Lu
Chint Solar, Hangzhou, China

3CV.1.7 GZO/Ag/GZO Multilayer Electrodes for Full-Transparent Hydrogenated Amorphous Silicon Solar Cells
D.J. Lee, J.-W. Lim & S.J. Yun
ETRI, Daejeon, Korea South
M. Shin
Korea Aerospace University, Goyang, Korea South
T.Y. Kim
Chungnam National University, Daejeon, Korea South

3CV.1.8 Optical Transmittance and Reflectance Analysis of GZO/Ag/GZO Films for Full-Transparent Hydrogenated Amorphous Silicon Solar Cells
M. Shin
Korea Aerospace University, Goyang-City, Korea South
D.J. Lee, J.-W. Lim & S.J. Yun
ETRI, Daejeon, Korea South

3CV.1.9 Amorphous Silicon-Oxynitride p-Layers in Amorphous Silicon Thin-Film Solar Cells
A. Neumüller, O. Sergeev, M. Vehse & C. Agert
NEXT ENERGY, Oldenburg, Germany
E. Wendler
Friedrich Schiller University Jena, Germany

3CV.1.10 Nanocrystals Formation in SI3N4/a-Si:H Multi-Layered Films Deposited by PECVD from Silane Diluted with Nitrogen
P. Sutta, P. Calta, R. Medlín, M. Netrvalová & J. Savková
University of West Bohemia, Plzen, Czech Republic

3CV.1.11 Influence of Argon Plasma Treatment at i/p- Interfaces in Silicon Thin-Film n-i-p Solar Cells
A. Neumueller, S. Geißendörfer, O. Sergeev, U. Kirstein,
M. Vehse & C. Agert
NEXT ENERGY, Oldenburg, Germany

3CV.1.12 Changing of the Parameters of the "three-Diode Model" by Light-Induced Degradation at Different Degradation Temperatures of a-Si/µc-Si Solar Cells
J.A. Weicht, R. Rasch, G. Behrens & F.U. Hamelmann
University of Applied Sciences Bielefeld, Minden, Germany

3CV.1.13 A Path towards the Compatibility of Flexible Metallic Substrate and Thin Film Solar Cells through Intermediate Layer Ceramic Stacks
M.F. Menéndez, L.J. Andrés Menéndez, A. Menéndez,
P. Sánchez, D. Gómez Plaza & A. Menéndez-Velázquez
ITMA, Avilés, Spain
R. Ortiz, M.D.C. Lopez,
E. Sanchez Cortezon & J.M. Delgado Sánchez
Abengoa Solar, Sevilla, Spain

3CV.1.14 Depth Profiling Analysis of Thin Film Solar Cells by Pulsed Glow Discharge - Time of Flight Mass Spectrometry
A. Alvarez-Toral, L. Lobo, A. Sanz-Medel,
R. Pereiro & B. Fernández
University of Oviedo, Spain
P. Sánchez & A. Menéndez
ITMA, Avilés, Spain

3CV.1.15 Density of State Measurements of RF Power, SiF4, and CH4–Tuned–Hydrogenated Microcrystalline Silicon Carbon Alloy Thin Films Using Photocurrent Methods
N. Puspitosari, S. Gaiaschi,
C. Longeaud & M.E. Gueunier-Farret
CNRS, Gif-sur-Yvette, France
E.V. Johnson
CNRS, Palaiseau, France

3CV.1.16 Thermal Annealing Effect on Oxidation of Near Stoichiometric Amorphous SixC1-X RF Co-Sputtered Thin Film
A.-I. El Khalfi, E.M. Ech-chamikh, Y. Ijdiyaou, M. Azizan,
L. Nkhaili, A. El Kissani, A. Essafti & A. Outzourhit
Cadi Ayyad University, Marrakech, Morocco

3CV.1.17 Hydrogen Dilution Effects on Undoped Silicon Oxide Layer and Amorphous Silicon Thin-Film Solar Cell Performance
Y.-H. Chen, C.-C. Lin, J.-C. Liu & H.-W. Lu
ITRI, Hsinchu, Taiwan

3CV.1.18 LiF-Al As The Electron Collector For a-Si:H Based Photovoltaic Cell
E. Ore & G. Amaratunga
University of Cambridge, United Kingdom
J. Melskens, A. Smets & M. Zeman
Delft University of Technology, Netherlands

3CV.1.19 Optimization of Thin-Film Silicon Solar Cells Based on 1-D Asymmetric Periodic Gratings
R. Vismara, O. Isabella & M. Zeman
Delft University of Technology, Netherlands

3CV.1.20 Partially Transparent a-Si Thin Film PV Modules for Agriculture Application
Y. He, C. Peng, W. Yong, Y. Xu, Z. Shen, Y. Guo, H. Zhao,
J. Zhang & Y. Li
Hanergy Advanced Systems, Chengdu, China

3CV.1.21 Microstructural, Optical and Electrical Properties of Nanocrystalline Silicon Carbide Alloys Prepared by PECVD and their Application in n-i-p nc-Si:H Solar Cells
D. Lim, J.H. Park, J. Yoo, S.K. Ahn, K. Yoon,
A. Cho & J.-S. Cho
KIER, Daejeon, Korea South

3CV.1.22 Correcting Temperature-Dependent Efficiency Model for Commercial Double Junction Thin Film Silicon Modules
L. Locatelli, N. Narayan, O. Isabella & M. Zeman
Delft University of Technology, Netherlands
A. Battaglia & A. Canino
3Sun, Catania, Italy
C. Gerardi
ST Microelectronics, Catania, Italy

VISUAL PRESENTATIONS 5CV.2

13:30 - 15:50 PV Modules

5CV.2.1 Evaluation of Gel Content-Measurement-Method for Mass Production of Glass-Foil Based Crystalline Silicon PV Modules
S. Kunath, M. Mette & M. Vogel
Hanwha Q CELLS, Bitterfeld-Wolfen, Germany
E. Malguth
LayTec in-line, Berlin, Germany

5CV.2.2 Influences of Lamination Conditions on Device Durability for EVA-Encapsulated PV Modules
J. Zhu, D. Wu, D. Montiel Chicharro, M. Owen-Bellini,
T. Betts & R. Gottschalg
Loughborough University, United Kingdom

5CV.2.3 Measuring the Degree of Crosslinking of EVA: Results of a European Round Robin Test on Soxhlet Extraction
G. Oreski
PCCL, Leoben, Austria
C. Hirschl, L. Neumaier, W. Mühleisen,
S. Puchberger & M. Kraft
CTR, Villach, Austria
G.C. Eder
OFI, Vienna, Austria
R. Frank
KIOTO, St. Veit, Austria
M. Tranitz
Fraunhofer ISE, Freiburg, Germany
M. Schoppa
PI Berlin, Germany
M. Wendt
Fraunhofer CSP, Halle, Germany
N. Bogdanski
TÜV Rheinland, Cologne, Germany
A. Plösch
Energetica, Klagenfurt, Austria

5CV.2.4 Evaluation of the Influence of Climate and Microclimate on the Ageing Behaviour of PV Encapsulations
B. Hirschmann, F. Wagner & G. Oreski
PCCL, Leoben, Austria
G. Pinter
University of Leoben, Austria

5CV.2.5 Compatibility Studies of PERC Solar Cell Metallisation and PO-Based Encapsulants
M. Gragert, Y. Yao, R. Grischke & T. Söderström
Meyer Burger, Thun, Switzerland
M. König
Roth & Rau, Hohenstein-Ernstthal, Germany

5CV.2.6 FEM-Simulation of Water Vapor Ingress into Glass-Glass-Modules with Polymeric Edge Sealant and Validation by a New Experimental Set Up for Permeation Tests for Sealing Material

E. Klimm, F. Vogt, A. Piekarczyk, A. Ballion, K.-A. Weiß & M. Köhl
Fraunhofer ISE, Freiburg, Germany

5CV.2.7 Evaluation of Backsheet Endurance by [UV-Water Cooking Test] and Module Reliability by [TC-HF-UV-DH] Sequential Test

M. Chang, H. Chen, C. Chen, C.H. Hsueh & W.J. Hsieh
AU Optronics, Taichung, Taiwan

5CV.2.8 Long Term Accelerated Weathering Tests on "Coupons" to Develop New Classes of Backsheets

F. Rummens
RENOLIT, Oudenaarde, Belgium

5CV.2.9 Influence of MVTR of Air-Side Layer of Backsheet on the Reliability of Backsheet Itself and Consequently on the Reliability of Solar PV Modules

R. Singh & A.K. Singh
RenewSys, Bangalore, India

5CV.2.10 Acetic Acid Transmission Rates of PV Backsheets

G. Oreski, M. Brasch & A. Mihaljevic
PCCL, Leoben, Austria
C. Hirschl
CTR, Villach, Austria
G. Pinter
University of Leoben, Austria

5CV.2.11 Thermal Stress Analysis on Encapsulation and Backsheet Materials for PV-Modules

S. Wendlandt, R. Berthold, M. Hanusch, A. Drobisch, J. Berghold, M. Schoppa & P. Grunow
PI Berlin, Germany
B. Stegemann & O. Sucherneck
Berlin University of Applied Sciences, Germany
S. Krauter
University of Paderborn, Germany

5CV.2.12 Modelling and Measuring the Performance of Textured Front Surfaces under Diffuse Radiation

N. Reiners, M. Kristuf, S. Omidi & U. Blieske
Cologne University of Applied Sciences, Germany

5CV.2.14 Sensitivity of Different Bills of Materials to PID: Fast Test Method

D. Bertani
RSE, Milan, Italy
C. Liciotti
Brandoni Solare, Castelfidardo, Italy

5CV.2.15 Potential-Induced Degradation for Prolonged Humidity-Freeze Test

J. Chen, H. Chen, C.H. Hsueh & M. Chang
AU Optronics, Taichung, Taiwan

5CV.2.16 Investigation of the Micro-Climate of Microcrystalline Silicon-Modules and CIGS-Modules and its Impact on Potential-Induced Degradation

E. Fokuhl, V. Wesselak, S. Voswinckel, P. Manz, B. Trautmann & C. Schmidt
Nordhausen University of Applied Sciences, Germany

5CV.2.17 Dos and Don'ts of Leakage Current Measurement

S. Voswinckel, V. Wesselak, K. Watzlawik, E. Fokuhl & C. Schmidt
Nordhausen University, Germany

5CV.2.18 On the Recovery of PID Affected Silicon Solar Modules

T. Kaden & H.J. Möller
Fraunhofer THM, Freiberg, Germany

5CV.2.19 Outdoor PID Acceleration Testing in Japan: Effects of Regular Wetting and Interruption

K. Sakurai, R. Sato, M. Akitomi, R. Morinaga & A. Masuda
AIST, Ibaraki, Japan

5CV.2.20 New Acceleration Testing Method "Highly Accelerated Thermal Cycling Test" : Acceleration Method through Degradation Mode Analysis

K. Morita, Y. Tsuno, Y. Yasuda & S. Kera
TÜV Rheinland, Yokohama, Japan
M. Fujimori & T. Kohno
Hitachi, Tokyo, Japan

5CV.2.21 Study of Developing SEMI PV Shipping Standards in Taiwan

S.-T. Hsu, Y.-S. Long, T.-C. Wu & E.Y. Wang
ITRI, Hsinchu, Taiwan

5CV.2.22 Soiling and Abrasion Testing of Functional Surfaces for Solar Energy Systems Adapted to Extreme – Arid and Maritime – Climatic Conditions

E. Klimm, T. Kaltenbach, D. Philipp, M. Masche, K.-A. Weiß & M. Köhl
Fraunhofer ISE, Freiburg, Germany

5CV.2.23 Indoor Accelerated Testing Procedure to Evaluate Aging Behavior of Weathered Poly-Silicon PV Module with High Intensity Irradiance
L.-Y.-. Liao & J.-L. Kwo
AllReal Technology, Kaohsiung, Taiwan
C.-H. Lin
TERTEC, Taoyuan, Taiwan
H.-C. Hsieh
BSMI, Taipei, Taiwan
C.-F. Shih
NCKU, Tainan, Taiwan

5CV.2.24 Mechanical and Chemical Characterization of Solder Joints After Accelerated Ageing Tests
I. Dürr, J. Walter, A. Kraft, K.-A. Weiß & U. Eitner
Fraunhofer ISE, Freiburg, Germany
M. Volk
Gebr. Schmid, Freudenstadt, Germany

5CV.2.25 Reduced Shading Effect on Half-Cell Modules – Measurement and Simulation
J. Schneider & H. Hanifi
Fraunhofer CSP, Halle, Germany

5CV.2.26 Investigation on Effect of Long-Term Durability by Metal Busbar Microstructure
Z. Peng, P.-T. Hsieh, C.J. Huang & C.C. Li
Motech Industries, Tainan, Taiwan

5CV.2.27 Results from Extended Degradation and Outdoor Tests of NICE Modules
F. Madon, J. Degoulange & R. Einhaus
Apollon Solar, Lyon, France
P. Lefillastre & L. Sicot
CEA, Le Bourget du Lac, France

5CV.2.28 Reflectance Measurements for Testing the Effect of Module Cleaning on the Glass Surface
N. Ferretti, T. Weber, F. Schneider & J. Berghold
PI Berlin, Germany

5CV.2.29 Reliability results for high-efficiency foil-based back-contact PV modules
V. Rosca, M.J.A.A. Goris, L.A.G. Okel, B.B. Van Aken,
N. Guillevin, A.A. Mewe, I. Cesar & L.J. Geerligs
ECN, Petten, Netherlands

5CV.2.30 Accelerated Damp Heat Test Combining Current Stressor
H. Chen, C.H. Hsueh, C. Chen & M. Chang
AU Optronics, Taichung, Taiwan

5CV.2.31 In-Situ Monitoring of Solar PV Modules during Accelerated Aging Tests by Means of Measuring the Dark IV Curve
S. Stecklum, D. Philipp, C. Eckerle, G. Mülhöfer & C. Völker
Fraunhofer ISE, Freiburg, Germany

5CV.2.32 Worst-Case Partial Shading Conditions for Crystalline Silicon Solar Cells with Different Reverse-Current Characteristics
L. Podlowski, S. Janke & B. Litzenburger
PI Solar Technology, Berlin, Germany
D. Cormode
Solon, Tucson, United States
S. Wendlandt, J. Berghold & J. Taubner
PI Berlin, Germany

5CV.2.33 Back-Contact MWT Modules Made with Electrically Conductive Adhesive Interconnection and Conductive Backsheets: Study of Performance and Reliablity through Material Testing, Accelerated Aging and Field Testing
G. Beaucarne
Dow Corning, Seneffe, Belgium
T. Savisalo
Cencorp Clean Energy, Mikkeli, Finland

5CV.2.34 PV Module Hot Spot Investigation Based on 1 GW Worldwide Database
M. Chang, C. Chen, H. Chen, C.H. Hsueh, K.L. Ho & E. Yen
AU Optronics, Taichung, Taiwan

5CV.2.35 Long Term Statistics on Micro Cracks and their Impact on Performance
J. Arp
PV Lab Germany, Potsdam, Germany
B. Jaeckel
UL International, Roitzsch, Germany

5CV.2.36 Reliability and Energy Performance of Crystalline Silicon Modules Containing Cells with Small Defects
D. Xia, P. Quan, J. Xia, J. Yu, Z. Feng,
Z. Zhang & P.J. Verlinden
Trina Solar, Changzhou, China

5CV.2.37 Anti-Soiling Coatings for PV Modules
P. Sommeling & W. Eerenstein
ECN, Petten, Netherlands

5CV.2.38 Annual Degradation Rates of Bulk Crystalline PV Modules Estimated from Indoor and Outdoor Measurements
T. Ishii, A. Masuda & Y. Hishikawa
AIST, Tsukuba, Japan

5CV.2.39 Experimental Study on Detection Technology of PV Modules with Shorten Bypass Diode
S. Nishikawa, C. Nagao & R. Kase
Nihon University, Tokyo, Japan

5CV.2.40 Accelerated Simulated Methods and Analysis for Snail Tracks of PV Modules in Laboratory
J.H. Liu, Z.S. Liu, E. Liu & H. Jin
Jinkosolar, Jiaxing City, China

5CV.2.41 Long Term Record of PV Modules. Results from Hanwha Q Cells Test Fields and Reference Installations Allover the World
D. Buß, E. Herzog, M. Strobel & M.B. Köntopp
Hanwha Q CELLS, Bitterfeld-Wolfen, Germany

5CV.2.42 Hot Spot Performance Comparison of Field and Lab for p-Type c-Si Modules
C.H. Hsueh, J. Chen, H. Chen & M. Chang
AU Optronics, Taichung, Taiwan

5CV.2.43 Soiling Loss Analysis on Various Photovoltaic Technologies Installed at Rooftop in Metropolitan/Urban Environment
R. Bohra, R.R. Gowda & M.R. Krishnan
Infosys, Bangalore, India

5CV.2.44 Substring-Level Energy-Yield Assessment of Photovoltaic Modules Subject to Partial Shading Conditions
G. Van den Broeck, B. Herteleer, K. Baert & J. Driesen
KU Leuven, Heverlee, Belgium
H. Goverde & F. Catthoor
imec, Leuven, Belgium

5CV.2.45 Cell Degradation under Prolonged DH Test and HAST
C.-W. Lin, C.-W. Yang & M.-Y. Huang
AU Optronics, Taichung, Taiwan

5CV.2.46 Numerical Model for the Prediction of the Electric Response of Solar Cells in Presence of Cracks
I. Berardone & M. Corrado
Polytechnic University of Turin, Italy
M. Paggi
IMT Lucca, Italy

5CV.2.47 Field Performance Comparison of Several Anti-Soiling Coatings on Photovoltaic Glass
B. Brophy, Z.R. Abrams & P. Gonsalves
Enki Technology, San Jose, United States
K. Christy
SunEdison, Belmont, United States

5CV.2.48 Energy and Economic Analysis of Uniform and Non-Uniform Cooling Methods for PV Panels by Experimental Setup
H.M.S. Bahaidarah
King Fahd University, Dhahran, Saudi Arabia

5CV.2.49 Thermo-Economic Feasibility Study of Converging Channel Heat Exchanger for PV System Installed in Dhahran
A.A. Bozdar Baloch & H. Bahaidarah
KFUPM, Dhahran, Saudi Arabia

VISUAL PRESENTATIONS 4CV.3

15:15 - 16:45 Concentrator and Space Applications for Multi-Junction Solar Cells

4CV.3.1 Space Demonstration of CIGS Solar Cells and Modules with Japanese Small Satellites
S. Kawakita, M. Imaizumi & H. Kusawake
JAXA, Ibaraki, Japan

4CV.3.2 Effects of the Front Electrode Angle on the Device Performance of In0.16Ga0.84As Solar Cells
R.-H. Horng
National Cheng Kung University, Taichung, Taiwan
F.-L. Wu, S.-L. Ou, Y.-C. Kao & S.-H. Shi
National Chung Hsing University, Taichung, Taiwan

4CV.3.3 Triple-Junction CPV Cells: Luminescent Coupling in a Wide Temperature Range
V.D. Rumyantsev, A.V. Chekalin,
D.A. Malevskiy & P.V. Pokrovskiy
RAS/ Ioffe, St. Petersburg, Russia

4CV.3.4 Improvements of the SI-Traceable Calibration of the Short Circuit Current of Multi Junction Component Solar Cells
F. Witt, I. Kröger, T. Fey & S. Winter
PTB, Braunschweig, Germany
J.M. Fernández-Marín & T. Gomez Rodríguez
INTA, Madrid, Spain

4CV.3.5 Copper Diffussion in GaAs Solar Cells for Space Applications
R.H. van Leest, G.J. Bauhuis, P. Mulder,
E. Vlieg & J.J. Schermer
Radboud University, Nijmegen, Netherlands
R. Van der Heijden & E. Bongers
Airbus Defence and Space, Leiden, Netherlands

4CV.3.6 Performance Enhanced Characterization of InGaP/ InGaAs/Ge Triple-Junction Solar Cell Based on Down-Shifting and Antireflection Using EU-Doped Silicate Phosphor Layer

W.-J. Ho, G.-C. Yang, C.-W. Yeh & R.-S. Sue
NTUT, Taipei, Taiwan
H.-P. Shiao
Win Semiconductor, Taoyuan, Taiwan

4CV.3.7 Four Junction Lattice Matched Solar Cells for Space Application

R. Campesato, M. Casale, G. Gori, E. Greco,
G. Gabetta & M. Ficcadenti
CESI, Milan, Italy

4CV.3.8 Effects of 10 MeV Proton Irradiation on III-V Solar Cells

E. Yaccuzzi, M. Barrera, S.E. Rodríguez, M.L. Ibarra,
J. García, E.M. Godfrin, M. Alurralde & J. Plá
CNEA, San Martín, Buenos Aires, Argentina
M. Ochoa, E. Barrigón, C. Algora & I. Rey-Stolle
UPM, Madrid, Spain

4CV.3.9 Formation of Crystalline Germanium on SiOx/Si Substrate for InGaP/GaAs/Ge Triple-Junction Solar Cells

E. Lee, J.S. Yeo, J.H. Lee & D.I. Cheong
Agency for Defense Development, Daejeon, Korea South
S.W. Kim, J.J. Lee, Y.H. Park & H.-J. Choi
Yonsei University, Seoul, Korea South

4CV.3.10 Graphene Layer Introduction in the Growth of Ge Film on SiOx/Si Substrate for InGaP/GaAs/Ge Triple-Junction Solar Cells

D.I. Cheong, E. Lee, J.S. Yeo & D.H. Baek
Agency for Defense Development, Daejeon, Korea South
S.W. Kim, J.J. Lee, Y.H. Park & H.-J. Choi
Yonsei University, Seoul, Korea South

4CV.3.11 Numerical Modelling of a PV Concentrator System Based on a Dual-Diode Cell Model Taking into Account Cooling by a Heat Sink

A.V. Okhorzina & N. Bernhard
Anhalt University of Applied Sciences, Köthen, Germany
A.V. Yurchenko
Tomsk Politechnical University, Russia

4CV.3.13 Analysis and Improvement of GaAsP/SiGe Tandem on Si by IQE Data

B. Conrad, A.H. Soeriyadi, L. Wang, M. Diaz, D. Li, X. Zhao,
A. Barnett & I. Perez-Wurfl
UNSW, Sydney, Australia
A. Lochtefeld
AmberWave, Salem, United States

A. Gerger
SolAero Technologies, Albuquerque, United States
C. Ebert
Veeco MOCVD, Somerset, United States

4CV.3.14 Investigation of Coupling Effects through Photoluminescence Spectroscopy

V. Paraskeva, M. Norton, M. Hadjipanayi & G.E. Georghiou
University of Cyprus, Nicosia, Cyprus
G. Timò & F. Trespidi
RSE, Piacenza, Italy

4CV.3.15 A Direct Method of Analysing the Current Matching Condition in a Multi-Junction Solar Cell

A.H. Soeriyadi, L. Wang, B. Conrad, M. Diaz, X. Zhao, D. Li,
A. Barnett & I. Perez-Wurfl
UNSW, Sydney, Australia
A. Lochtefeld
AmberWave, Salem, United States
A. Gerger
SolAero Technologies, Alburquerque, United States
C. Ebert
Veeco MOCVD, Somerset, United States

4CV.3.16 Evaluation of 1.0 eV GaInNAsSb Solar Cells for Multi-Junction Applications and Annealing Effects

N. Miyashita, N. Ahsan & Y. Okada
University of Tokyo, Japan

4CV.3.17 Can Heterojunction III-V Cells Outperform the Homo-junction GaAs Cell ?

G.J. Bauhuis, Y.-Y. Hu, P. Mulder & J.J. Schermer
Radboud University, Nijmegen, Netherlands

4CV.3.18 The Segmental Approximation of Multijunction Solar Cells Photovoltaic Characteristics

S.A. Mintairov, V.V. Evstropov, R.A. Salii, M.Z. Shvarts,
N.K. Timoshina & N.A. Kalyuzhnyy
RAS/ Ioffe, St. Petersburg, Russia

4CV.3.19 Studying Anomalous Open-Circuit Voltage Drop-Out in Concentrated Photovotaics Using Computational Numerical Analysis

M. Stevens, C. Downs & D. Emerson
Tufts University, Medford, United States

4CV.3.20 Design and Long-Term Outdoor Monitoring of DSC Module with a Low Level Solar Concentrator

M.F. Vildanova, S. Kozlov, A. Proskuryakov,
O. Alexeeva & O.I. Shevaleevskiy
RAS, Moscow, Russia
M. Ruehlmann
Hamburg University of Technology, Germany

4CV.3.29 On Dyes and Dye Alignment Strategies for Luminescent Solar Concentrators
M.G. Debije & Schenning
Eindhoven University of Technology, Netherlands

4CV.3.30 Development of a CPV System Integrated in the Built Environment
P.J.M. van Kan, M. van der Sluys & P.J. Sonneveld
HAN University of Applied Sciences, Arnhem, Netherlands

4CV.3.31 Optical Properties of Light Diffusers as Targets for Concentrated Solar Beams Characterization
A. Parretta
ENEA, Bologna, Italy
M. Tucci
ENEA, S. Maria di Galeria, Italy

4CV.3.32 Optical Behavior of Static Concentrator Systems in Experiment and Theory for Application to Micro-Concentrator Solar Cells
B. Reinhold
ISA-Potsdam, Germany
M. Lux-Steiner
HZB, Berlin, Germany

4CV.3.33 Design and Fabrication of a Concentrating System Adapted to Microcells Array
S. Jutteau & M. Paire
EDF R&D, Chatou, France
F. Proise, L. Lombez & J.F. Guillemoles
CNRS, Chatou, France

4CV.3.34 Characterization and Reliability Campaign of Ecosole C-Modules and Components
C. Cancro, G. Graditi, R. Fucci, G. Ciniglio, M. Pellegrino, A. Borriello & A. Romano
ENEA, Portici, Italy

4CV.3.35 Combined Heat and Power Generation with an HCPV System at 2000x
F. Montagnino & F. Paredes
IDEA, Palermo, Italy
G. Bonsignore, S. Agnello, F.M. Gelardi, L. Sciortino & M. Cannas
University of Palermo, Italy
M. Barbera, A. Collura & U. Lo Cicero
INAF, Palermo, Italy

4CV.3.36 New Optical Concepts for Ultra High Concentration Photovoltaic Modules
J.P. Ferrer Rodríguez, F. Almonacid & P.J. Pérez-Higueras
University of Jaén, Spain
K. Shanks, T.K. Mallick & E.F. Fernández
University of Exeter, Cornwall, United Kingdom

4CV.3.37 Optical and Electrical Characterization of Large Area LSC Systems
P. Bernardoni, S. Baricordi, G. Calabrese, V. Guidi, M. Tonezzer & D. Vincenzi
University of Ferrara, Italy

4CV.3.40 High Power Narrow Infrared Laser Beam Converter for Space and Atmosphere Wireless Energy Transfer Systems
V. Tugaenko & O. Zayats
RSC „Energy“, Korolev, Russia

4CV.3.41 Investigation of Thermal Characteristics of Multifunctional Hybrid Photovoltaic Module for Tethered-Solar Power Satellite
D. Sato & N. Yamada
Nagaoka University, Japan
K. Tanaka
ISAS / JAXA, Kanagawa, Japan

4CV.3.42 Radiation Resistance in High-Efficiency IIII-V/CIGS Mechanical Stacking Solar Cells
S. Kawakita, M. Imaizumi & H. Kusawake
JAXA, Tsukuba, Japan
K. Makita, T. Sugaya, J. Nishinaga & H. Shibata
AIST, Tsukuba, Japan
S. Sato & T. Ohshima
JAEA, Gunma, Japan

4CV.3.43 Temperature-dependent modeling of concentrator-photovoltaic module
H. Lv, J. Dai, C. Huang, Z. Li & F. Sheng
Hubei University of Technology, Wuhan, China

4CV.3.44 Impact of Minority Carrier Lifetime and Temperature on SiC Based Rear Contact SiGe Solar Cell for Concentrator Photovoltaic (CPV) Applications
R. Pandey & R. Chaujar
Delhi Technological University, New Delhi, India

4CV.3.45 In0.3Ga0.7As 1.0eV Sub-Cell Grown on GaAs Substratewith an 2nm Amorphous In0.6Ga0.4As Buffer Layer
P. Gao & Q. Sun
Tianjin Institute of Power Scource, China
F. Gao & G. Li
SCUT, Guangzhou, China

4CV.3.46 Photoluminescence-Based Current-Voltage Characterisation of Individual Subcells in Multi-Junction Devices
D. Alonso-Álvarez, X. Bubnova & N.J. Ekins-Daukes
Imperial College London, United Kingdom

4CV.3.47 **Laser Annealed Ge Epitaxial Film on Si Wafer, a Cost-Effective Virtual Ge Substrate for III-V Tandem Solar Cells**
Z. Liu, X. Hao, J. Huang, A.W.Y. Ho-Baillie & M.A. Green
UNSW, Sydney, Australia

4CV.3.48 **Fabrication of Low Concentration Multi-Junction Solar Cells with Smart Stacking and Areal Current Matching Techniques**
N. Yamada, M. Baba & D. Hirai
Nagaoka University of Technology, Japan
K. Makita & T. Sugaya
AIST, Tsukuba, Japan

4CV.3.49 **Outdoor Testing of the Ecosole HCPV Module with Single Module Inverter**
M. Carpanelli, G. Borelli, D. Verdilio,
D. De Nardis & F. Migali
Becar, Monteveglio, Italy

VISUAL PRESENTATIONS 2CV.4

17:00 - 18:30 Silicon Solar Cell Improvements

2CV.4.1 **Green Nano-Laser Opening Metal Contact on Back-Contact n-Type Silicon Solar Cells**
K.-C. Lai, Z.L. Yao, C.-C. Chuang, C.C. Li & C.-C. Wang
Motech Industries, Tainan, Taiwan

2CV.4.2 **Temperature Sensitivity of Solar Cell Efficiency: Theory and Implications**
O. Dupré & R. Vaillon
INSA, Villeurbanne, France
M.A. Green
UNSW, Sydney, Australia

2CV.4.3 **Rather High Speed Regeneration of BO-Defects: Regeneration Experiments with Large Cell Batches**
T. Pernau, O. Romer, W. Scheiffele, A. Reichart & W. Jooß
centrotherm photovoltaics, Blaubeuren, Germany

2CV.4.4 **Hybrid Laser-Etching-Process for Wafer Texturing**
V. Blattmann & D. Trusheim
Fraunhofer ILT, Aachen, Germany

2CV.4.5 **Pyramidal Texture on Monocrystalline Silicon Wafers by Acidic HF-HCl-H2O2 Mixtures**
A. Stapf, C. Gondek & E. Kroke
Freiberg University of Technology, Germany

2CV.4.6 **Photovoltaic Cells Based on Silicon with Clusters of Nickel Impurity Atoms**
K. Iliyev, M. Azizov, B.A. Abdurakhmanov,
S. Valiyev & E.B. Saitov
Tashkent State Technical University, Uzbekistan

2CV.4.7 **Evaluation of the Effective Specific Contact Resistivity Induced Series Resistance Losses in MWT-PERC Solar Cells**
J. Wu, X. Meng, X.-S. Wang & G. Xing
Canadian Solar, Suzhou, China

2CV.4.8 **Current Transportation Enhancement with ZnO Nanoroads for Silicon Nanowire Solar Cell**
R. Jia, Z. Feng, W. Zhang, K. Tao, B. Dou, Y. Sun & Z. Jin
CAS, Beijing, China

2CV.4.9 **A Study on Blistering in Tunnel Oxide Junction of Silicon Solar Cells**
H. Kim, S.M. Kim, Y. Kang, H.-S. Lee & D. Kim
Korea University, Seoul, Korea South
K. Ji, S.-Y. Lee, S.-W. Ahn & H.M. Lee
LG Electronics, Seoul, Korea South

2CV.4.10 **The Influence of Metallization Process on Interdigtiated Back Contact Silicon Solar Cell Performances**
S.-Y. Liu, Z.L. Yao, C.-M. Wei, Y.-K. Tsao, B.-S. Lee,
Y.L. Lee, K.-C. Lai & C.-C. Chuang
Motech Industries, Tainan, Taiwan

2CV.4.11 **Simulation and Optimization of Flexible Thin Film Silicon Solar Cells**
B. Abebe & C. Pflaum
University of Erlangen-Nuremberg, Germany

2CV.4.12 **Biomimetic Optimization of the Grid Design on Silicon Solar Cells**
L. Neumaier, W. Mühleisen & C. Hirschl
CTR, Villach, Austria

2CV.4.13 **High Performance Mono-Like Silicon Solar Cells and Modules by Using Industrial Mass Production Technology**
C.-W. Kuo, T.-M. Kuan, L.-G. Wu, C.C. Huang,
S.-I. Peng & C.-Y. Yu
TSEC, Hsinchu, Taiwan

2CV.4.14 **Understanding the Impact of Boron Diffusion on N-Type Silicon Bifacial Solar Cells**
S. Simayi, Y. Kida, K. Shirasawa & H. Takato
AIST, Koriyama, Japan

2CV.4.15 Investigation of Light-Induced Regeneration Behavior on P-Type Multi-Crystalline PERC Cells
K.-Y. Yen, S.-P. Su, J.-R. Huang,
S.H.T. Chen & L.-W. Cheng
TOPCELL Solar, Taoyuan County, Taiwan

2CV.4.16 Anti-PID SiOx:H/SiNy:H Layers Deposited by PECVD on P-Type C-Si Solar Cells
C. Charpentier, Y. Marot, F. Coeuret, A. Zauner, E. Urrejola,
J. Hong & S. Pouliquen
Air Liquide, Jouy en Josas, France

2CV.4.17 Anti-LID SiCN:H Layers Deposited by PECVD on p-Type Wafers with Controlled Interstitial Oxygen Concentration and Related Defects
S. Pouliquen, Y. Marot, F. Coeuret,
J. Hong & C. Charpentier
Air Liquide, Jouy en Josas, France
M. Martel
CEA, Le Bourget du Lac, France
J.-Y. Poriel
AET-Technologies, Meylan, France

2CV.4.18 Graphene Oxide as the Antireflection Etching Mask on Si
L.-C. Chen, C.-T. Yu, Y.-C. Peng, S.-D. Tzeng, C.-M. Wang,
C.-C. Lin & C.-H. Lin
National Dong Hwa University, Hualien, Taiwan

2CV.4.19 Optimization of the KOH Texturing Process and the Effect of Rear Texturing on the Performance of n-PERT Solar Cells with Epitaxial Emitter
A. Hajjiah
Kuwait University, Safat, Kuwait
M. Haslinger, M. Récaman-Payo, I. Kuzma Filipek, Y. Li,
F. Duerinckx, J. John, J. Szlufcik & J. Poortmans
imec, Leuven, Belgium

2CV.4.20 LIFT Processes for Metallization of Silicon Solar Cells Using ps- and ns-Pulsed Lasers
D. Munoz-Martin, Y. Chen, M. Morales & C. Molpeceres
UPM, Madrid, Spain
M. Grishin
EKSPLA, Vilnius, Lithuania

2CV.4.21 Properties of Al2O3 Passivation Layer by Plasma Assisted Atomic Layer Deposition Method
H.-E. Song, M.G. Kang & J.I. Lee
KIER, Daejeon, Korea South

2CV.4.22 From Lab to Fab: Bifacial N-Type Cells Entering Industrial Production
J. Lossen, C. Comparotto, V.D. Mihailetchi, F. Buchholz,
J. Libal & E. Wefringhaus
ISC Konstanz, Germany
M. Rossetto, F. Fizzotti & F. Traverso
MegaCell, Carmignano di Brenta, Italy

2CV.4.23 Optical and Passivation Characterization of Amorphous and Poly-Crystalline AlN Layers
L. Montañez Huamán, A. Guerra,
F. De Zela & R. Weingärtner
PUCP, Lima, Peru
A. Ben Or
HZB, Berlin, Germany
A. Winnaker
University of Erlangen-Nuremberg, Germany

2CV.4.24 A Benchmarking Study of the Application of a Distributed Bragg Reflector as Back-Reflector on n-Pasha Solar Cells
S.L. Luxembourg, P. Spinelli, A. Ingenito,
J. Liu & A.W. Weeber
ECN, Petten, Netherlands
O. Isabella & M. Zeman
Delft University of Technology, Netherlands

2CV.4.25 Efficiency Improvement in Crystalline Silicon Solar Cells with Plated Electrodes by Light-Induced Plating
M.S. Jeong, J.I. Lee, M.G. Kang & H.-E. Song
KIER, Daejeon, Korea South

2CV.4.26 Mercury: Towards over 22% Efficient IBC Cells with FFE and Wide BSF
A.R. Burgers, I. Cesar, A.A. Mewe, N. Guillevin,
L.J. Geerligs & P. Spinelli
ECN, Petten, Netherlands

2CV.4.27 Analysis and Performance of Dispensed and Screen Printed Front Side Contacts on Cell and Module Level
C. Rodriguez
SERIS, Singapore, Singapore
M. Pospischil, A. Padilla, M. Kuchler, M. Klawitter, T. Geipel,
M. Padilla, T. Fellmeth, R. Efinger, M. Linse, H. Gentischer,
F. Clement & D. Biro
Fraunhofer ISE, Freiburg, Germany
M. König & M. Hörteis
Heraeus, Hanau, Germany
L. Wende
ASYS, Dornstadt, Germany
O. Doll
Merck, Darmstadt, Germany

2CV.4.29 **Photonic Nanostructures for Solar Cells: Comparison of Different Etching Techniques Regarding Their Impact on Lifetimes and Contacting**
C. Trompoukis, E. Simoen, I. Abdo, L. Tous, V. Depauw, I. Gordon, R. Mertens & J. Poortmans
imec, Leuven, Belgium
A. Stesmans
University of Leuven, Belgium
K.D. Lee
Obducat Technologies, Lund, Sweden
O. El Daif
Qatar Foundation, Doha, Qatar

2CV.4.30 **Understanding the Recombination Activity of Diffused Boron Emitters for High Efficiency n-Type PERT Solar Cells**
T. Desrues, S. Gall, C. Lorfeuvre, S. Manuel & Y. Veschetti
CEA, Le Bourget du Lac, France

2CV.4.31 **Direct Laser Beam Interference Patterning Combined with Wet Chemical Etching as a Tool to Control Surface Morphology of Multicrystalline Silicon**
S. Indrišiunas, B. Voisiat, A. Reza, I. Šimkiene, R. Mažeikien, A. Selskis & G. Raciukaitis
Center for Physical Sciences and Technology, Vilnius, Lithuania

2CV.4.32 **Processing to Achieve High Performance on Multi-Crystalline Silicon Wafers**
C. Chan, A. Wenham, B. Hallam, H. Li, M. Abbott & S.R. Wenham
UNSW, Sydney, Australia

2CV.4.33 **Interface States Observation between Atomic Layer Deposited AlOx Layer and SI by Photoelectron Spectroscopy**
N. Ikeno, Y. Yamashita & A. Ogura
Meiji University, Kawasaki, Japan
T. Chikyow
NIMS, Tsukuba, Japan

2CV.4.34 **Over 21.5 % Efficient Fully Screen Printed n-Type Solar Cell on Epitaxially Grown Siliconwafers with Builtin Boron Rear Side Emitter**
V. Mertens, S. Bordihn, A. Mohr, K. Petter, J.W. Müller & D.J.W. Jeong
Hanwha Q CELLS, Bitterfeld-Wolfen, Germany
R. Hao & T. Ravi
Crystal Solar, Santa Clara, United States

2CV.4.35 **Wafer Incoming Inspection Value for Solar Cell Makers**
A. Schlezinger
Applied Materials, Santa Clara, United States

THURSDAY, 17 September 2015

VISUAL PRESENTATIONS 3DV.1

08:30 - 09:30 CdTe, CIS and Related Thin Film Devices I

3DV.1.1 **Life Time Expectation of CIGS Solar Cells under High Irradiation Level Form 1 Sun to 5 Suns Intensity**
K.S. Kim
KIER, Yuseong-gu, Korea South

3DV.1.2 **Characterization of CZTS Films Grown Using Vacuum and Solution Based Methods, through UPS, XPS and XANES Measurements**
G. Gordillo, R.A. Becerra, S.D. Cruz & C.L. Calderón
National University of Colombia, Bogotá, Colombia
P.B. Peréz
CINVESTAV, Mérida, Mexico
I. Lauermann
HZB, Berlin, Germany

3DV.1.3 **Comparison Study of Micro-Structural Properties of CZTS Thin Films Grown Using Vacuum and Solution Based Methods**
G. Gordillo, R.A. Becerra, E. Ramirez, J.S. Oyola Villegas & A.A. Ramírez
National University of Colombia, Bogotá, Colombia

3DV.1.4 **A 9.2% Efficient CZTSSe Solar Cell with Atomic Layer Deposited Zn-Sn-O Buffer**
X. Li, Z. Su, S.K. Batabyal & L.H. Wong
Nanyang Technological University, Singapore, Singapore

3DV.1.5 **Tin Sulfide (SnxSy) Thin Films Obtained by Co-Evaporation: Influence on the Properties of Annealing in Different Atmospheres.**
V. Robles, J.F. Trigo, C. Guillén & J. Herrero
CIEMAT, Madrid, Spain

3DV.1.6 **High-Efficiency Cadmium-Free CuInxGa1-X(SeS)2 Thin-Film Solar Cells with Chemically Deposited SnS2 Buffer Layer**
T. Huang, C.-C. Huang, Y.-F. Chang & M.-C. Wu
NTHU, Hsinchu, Taiwan

3DV.1.7 **Morphology and Phase Evolution of Cu2ZnSnS4 during Preheating Treatment and Sulfurization**
J. Tan, L. Wu, K. Tan, P. Lin, G. Wan, S. Jin & Y. Lin
Huazhong University, Wuhan, China

3DV.1.8 Nanowire of Hydrothermally Grown Hierarchical ZnO Nanowires for a High Efficiency Cu(In,Ga)Se2 Thin Film Solar Cell
Y.-F. Chang, C.-C. Huang, T. Huang & M.-C. Wu
NTHU, Hsinchu, Taiwan

3DV.1.9 CdTe Thin Film Solar Cell Performance under High- and Low-Intensity Light Irradiance
K. Shen, W. Li & D. Wang
USTC, Anhui, China

3DV.1.10 Effect of in situ Annealing on the Sub-Micron Thick Cu(In,Ga)Se2 Thin Films
D.-K. Hwang, B.-S. Ko, D.H. Kim & S.J. Sung
DGIST, Dalseong-Gun, Korea South

3DV.1.11 Semitransparent CIGS Module for Building Integrated Photovoltaics
F. Roux, P. Faucherand, H. Fournier, L. Grenet, F. Emieux, N. Karst & S. Perraud
CEA, Grenoble, France
V. Renzi, P. Messaoudi & P. Lefillastre
CEA, Le Bourget du Lac, France
A. Guillou & P.-Y. Thoulon
Crosslux, Rousset, France

3DV.1.12 Investigation of MoNa and MoK Cosputtering and Its Influence on Alkaline Diffusion into CIGS
W. Hempel & W. Wischmann
ZSW, Stuttgart, Germany
E. Franzke, C. Adelhelm & L. Klaiber
PLANSEE, Reutte, Austria

3DV.1.13 Printed Photovoltaic Thin Films for Low Cost Production of Solar Cells – Printing of Polymers
S. Pötz & G. Oreski
PCCL, Leoben, Austria
P. Esfandiari, C. Waldauf & A. Neisser
Crystalsol, Vienna, Austria

3DV.1.14 Laser Ablation Process for Rear-Side Contact Preparation of Photovoltaic Films Based on CZTS Powder
G. Peharz & V. Satzinger
JOANNEUM RESEARCH, Weiz, Austria
C. Waldauf & A. Neisser
Crystalsol, Vienna, Austria

3DV.1.15 Effect of Process Conditions on the Properties of SnS Nano Particles and Thin Films for Solar Cell Application
N.K. Youn, S.J. Ahn, A. Cho, J. Gwak, K. Yoon, K.S. Shin, S.K. Ahn, J.S. Cho, J.H. Park, J.S. Yoo, K. Kim, J.H. Yun & Y.-J. Eo
KIER, Daejeon, Korea South

3DV.1.16 CZTSe Solar Cells Based on Co-Evaporated Thin Films
J. Gwak, J.H. Yun, S.K. Ahn, K. Kim, A. Cho, Y. J. Eo, J.-S. Cho, S.J. Ahn, J.H. Park, J. Yoo, K.S. Shin, K.H. Yoon & H.R. Choi
KIER, Daejeon, Korea South
H.R. Choi
KIER, Seoul, Korea South
J.H. Kim
Chonnam National University, Gwangju, Korea South
H. Cheong
Sogang University, Seoul, Korea South

3DV.1.17 Nanoporous CZTS Thin Film Prepared by Solution Process for 3d P-N Junction Solar Cells
S.-J. Sung, S.-N. Park, D.-H. Kim, D.-K. Hwang, K.-J. Yang & J.-K. Kang
DGIST, Dalseong-gun, Korea South

3DV.1.18 Effects of S and Se Contents on the Physical and Photovoltaic Properties of Cu2ZnSn(Sx,Se1-X)4 Thin Films: 9.45 % Efficient Device Fabrication
D.-H. Kim, D.-H. Son, Y.-I. Kim, K.-J. Yang, S.-J. Sung, D.-K. Hwang, S.-N. Park, J.-H. Sim & J.-K. Kang
DGIST, Daegu, Korea South

3DV.1.19 Transparent Amorphous Oxide Semiconductor as an n-Type Buffer Layer in Cu(In,Ga)Se2 Solar Cells
T. Koida, Y. Kamikawa-Shimizu, A. Yamada, H. Shibata & S. Niki
AIST, Tsukuba, Japan

3DV.1.20 Effect of Microstructure on Chlorine Activation of CdTe Thin Film Solar Cells
O. Zywitzki, T. Modes, M. Dienel, H. Morgner & C. Metzner
Fraunhofer FEP, Dresden, Germany

3DV.1.21 A General and Flexible Circuit Model for Thin Film PV Modules, Simulating the Impact of the Interconnection Schemes and Defects
M. Meuris
imec, Diepenbeek, Belgium
H. Goverde, F. Madeo, J. Poortmans & F. Catthoor
imec, Leuven, Belgium
F. Crupi
University of Calabria, Rende, Italy

3DV.1.22 Towards Improvement of Ga Rich Cu(In,Ga)Se2 Solar Cells: an Atomic Scale Study
M. Raghuwanshi, E. Cadel, P. Pareige & S. Duguay
INSA Rouen, Saint Etienne du Rouvray, France
L. Arzel & N. Barreau
University of Nantes, France

3DV.1.23 Modifying the Sulfur Gradient in Sequentially Processed CIGSe Absorber under Atmospheric Pressure Using Elemental Chalcogenides
C. Wolf, H. Rodríguez-Alvarez, S. Schmidt, D. Greiner, H.-W. Schock, C.A. Kaufmann & R. Schlatmann
HZB, Berlin, Germany

3DV.1.25 Cu(in,Ga)Se2 Solar Cell with High Efficiency Beyond 16% Achieved by Sputtering from a Copper-Poor Quaternary Target
L. Ouyang, D.-M. Zhuang, M. Zhao, R. Sun, L. Guo, M. Cao & Z. Gao
Tsinghua University, Beijing, China

3DV.1.26 The Influence of High-Cracked Selenium Flux on the CIGS Thin Film Structure and J-V Performance
G. Li, W. Liu, Y. Liu, S. Lin, X. Li, Y. Zhang, Z. Zhou, Q. He & Y. Sun
Nankai University, Tianjin, China

3DV.1.27 High Performance CZTSe Solar Cells with Suede Absorber Surface and Relatively Cu-Poor Composition Using Improved Crystallization Process
Y. Zhang, J. Li & Y. Sun
Nankai University, Tianjin, China
M. Luo & J. Tang
Wuhan National Laboratory for Optoelectronics, China

3DV.1.28 Tailoring the Thickness of MoSe2 Layer for High Performance CZTSe and CZTSSe Solar Cells by a Soft Pre-Alloying Process
J. Li, Y. Zhang & Y. Sun
Nankai University, Tianjin, China
D. Nam & H. Cheong
Sogang University, Seoul, Korea South

3DV.1.29 A Simple Method to Make a Non-Etching Stable Back Contact for CdTe Solar Cells without Using Copper
K. Velappan, C. Drost, B. Siepchen, B. Späth & C. Kraft
CTF Solar, Dresden, Germany
S. Peng
Triumph International Engineering, Shanghai, China
W. Jaegermann & H.-J. Schimper
Technical University of Darmstadt, Germany

3DV.1.31 Growth of Cu2ZnSn(S1-X, SeX)4 Films by Selenization of Cu-Zn-Sn-S Precursors - Effects of the Selenization Time
R. Sun, D.-M. Zhuang, M. Zhao, M. Xie, L. Ou-Yang & L. Guo
Tsinghua University, Beijing, China

3DV.1.32 Nanostructured Hybrid of Photovoltaic Solar Cell and Supercapacitor
S. Eminov, A. Aliyev, K. Jalilova, A. Rajabli, N. Ismayilov, G. Mamedova & J. Guliyev
ANAS, Baku, Azerbaijan

3DV.1.33 XPS Se 3d Peak at 59 eV for Na Diffused in Bridgman CuInSe2+x
S. Park, C.H. Champness & I. Shih
McGill University, Montreal, Canada

3DV.1.34 Local Measurements of Photocurrent and Band Gap in CdTe Solar Cells
Y. Yoon, J. Chae, A. Katzenmeyer, H. Yoon, J. Schumacher, S. An, A. Centrone & N. Zhitenev
University of Maryland, Gaithersburg, United States

3DV.1.35 10.1% Efficiency CZTSSe Thin-Film Solar Cells Fabricated by 2-Methoxyethanol -Based Solution Process
S.-H. Wu & C.-F. Shih
National Cheng Kung University, Tainan, Taiwan
Y.-Y. Wang
ITRI, Hsinchu, Taiwan

3DV.1.36 Effect of Cd and Te2 Vapor Phase Mixture in CMBD on Growth Rate and Morphology of CdTe Films for Use in Thin-Film Solar Cells
T.M. Razykov, N. Amin & K. Sopian
National University of Malaysia, Bangi, Malaysia
B. Ergashev & K.M. Kouchkarov
Academy of Sciences of Uzbekistan, Tashkent, Uzbekistan
C.S. Ferekides & Y. Goswami
University of South Florida, Tampa, United States
H.S. Ullal
NREL, Golden, United States
H.M. Upadhyaya
Brunel University, London, United Kingdom

3DV.1.37 Spatial Atmospheric Atomic Layer Deposition of Zinc Oxysulfide Buffer Layers for CIGS Solar Cells
C. Frijters, P. Poodt, P.J. Bolt & A. Illiberi
TNO, Eindhoven, Netherlands

3DV.1.38 Design and Optimization of CIGS Selenization by Rapid Thermal Processing
A.M. Lankhorst & L. Thielen
Celsian Glass & Solar, Eindhoven, Netherlands
C. Herrera, R. Aninat, E. Sanchez Cortezon & J.M. Delgado Sánchez
Abengoa Solar, Sevilla, Spain

3DV.1.39 Effect of Se Flux on the Properties of Polycrystalline CuInSe2 Thin Films and Solar Cells
M. Islam
University of Tsukuba, Japan
A. Yamada, K. Matsubara & S. Niki
AIST, Tsukuba, Japan
T. Sakurai & K. Akimoto
University of Tsukuba, Ibaraki, Japan

3DV.1.40 Electrochemical Deposition of Fluorine Doped Cadmium Telluride for Application in Photovoltaic Device Fabrication
A. Ojo, H.I. Salim & I.M. Dharmadasa
Sheffield Hallam University, United Kingdom

3DV.1.41 Distribution of ZnS Secondary Phase in Cu2ZnSnS4 Solar Cells and Solar Conversion Efficiency
D. Nam, S. Cho & H. Cheong
Sogang University, Seoul, Korea South
J.-H. Sim, K.-J. Yang, D.-H. Son, J.-K. Kang & D.H. Kim
DGIST, Daegu, Korea South
M. Kwon & C.W. Jeon
Yeungnam University, Gyeongsan, Korea South

3DV.1.42 Quantitative Analysis of Matrix Elements and Sodium in Photovoltaic Cu(In, Ga)Se2 Thin Films by the Use of Time-of-Flight Secondary Ion Mass Spectrometry
K. Kaufmann
Anhalt University of Applied Sciences, Köthen, Germany
S. Wahl, S. Meyer & C. Hagendorf
Fraunhofer CSP, Halle, Germany
E. Jarzembowski
Martin Luther University, Halle, Germany

3DV.1.43 Degradation of CIGS Solar Cells Due to Alkali Migration under Damp Heat and Illumination
M. Theelen, V. Hans & H.L.A.H. Steijvers
TNO, Eindhoven, Netherlands
N. Barreau
University of Nantes, France
Z. Vroon
TNO, Heerlen, Netherlands
M. Zeman
Delft University of Technology, Netherlands

3DV.1.44 Improvement of CIGSSe Module Performance by Systematic Optimization of the Si3N4 Barrier Coating and Controlled Na Doping from Rotatable Mo:Na Targets
V. Alberts, E. Scholtz, J. Olivier, G. Bonthuys,
S. van den Heever, M. Roux & H. Arendse
PTiP Innovations, Stellenbosch, South Africa

3DV.1.45 Studies of AgInS2 Thin Films Prepared by Chemical Spray Pyrolysis Technique
A.S. Maligi, K.G. Deepa & N. Jampana
Indian Institute of Science, Bangalore, India

3DV.1.46 A Comparison between Alkali Doping Methods for Cu2ZnSnSe4 Solar Cells Fabricated onto Flexible Steel Substrates
S. López-Marino, Y. Sánchez, M. Espindola-Rodriguez,
M. Neuschitzer, H. Xie, M. Placidi, M. Dimitrievska,
S. Giraldo, V. Izquierdo-Roca & E. Saucedo
IREC, Sant Adrià de Besòs - Barcelona, Spain
L. Samain & L. Fourdrinier
CRM Group, Liège, Belgium
T. Raadik & J. Krustok
Tallinn University of Technology, Estonia

3DV.1.47 Advanced R&D Platform for Highest Efficient CIGS-Modules
B. Cord
SINGULUS TECHNOLOGIES, Kahl am Main, Germany
M. Fürfanger
AVANCIS, Torgau, Germany
O. Weiß
Heraeus Noblelight, Hanau, Germany
A. Schmalstieg
Institute for Scientific Instruments, Berlin, Germany

3DV.1.48 Silver Nanowire Networks: an Alternative to Conventional TCO Layers in Thin Film Solar Cells?
D. Borchert & M. Schregel
Fraunhofer ISE, Gelsenkirchen, Germany

3DV.1.49 CZTS Absorber Layer for Thin Film Solar Cells from Electrodeposited Metallic Stacked Precursors (Mo/Cu-Sn/Zn)
M.I. Khalil, O. Atici, A. Lucotti & L. Magagnin
Polytechnic University of Milan, Italy
S. Binetti & A. Le Donne
University of Milan, Italy

3DV.1.50 Defect Analysis of Cu2ZnSnSe4 Solar Cells Based on Co-Evaporation Processes
S.K. Ahn, J. Moon, H.R. Choi, K. Kim, J. Gwak, J.H. Yun,
A. Cho, Y. J. Eo, J.-S. Cho, S.J. Ahn, J.H. Park, J.S. Yoo,
K.S. Shin & K.H. Yoon
KIER, Daejeon, Korea South

3DV.1.51 Benefit of Grid on TCO for Thin Film CIGS Cells: Experimental Verification
J. van Deelen, C. Frijters, M. Barink & A. Hovestad
TNO, Eindhoven, Netherlands

3DV.1.52 Impact of Optical Constants and Assumptions on Optical Modeling of Textured CIGS
J. van Deelen, M. Xu & B. Kniknie
TNO, Eindhoven, Netherlands

3DV.1.53 7% Higher CIGS Cell Efficiency by Antireflection Coating (ARC)
M. Burghoorn, J. van Deelen, B. Kniknie,
Z. Vroon & P. Buskens
TNO, Eindhoven, Netherlands

3DV.1.54 High-Efficiency Ink-Based Cu(In,Ga)(S,Se)2 Thin Film Solar Cells on Stainless Steel Foils Fabricated by Sulfurization After Selenization Processes
Y.-F. Chen, L.-T. Cheng, C.-M. Chang, C.-C. Li,
C.-C. Chiang, S.-W. Chan, W.-S. Lin & S.Y. Tsai
ITRI, Hsinchu, Taiwan

3DV.1.56 Hybrid Functional Investigation of Theincorporation of Sodium and Potassium inCuInSe2 and Cu2ZnSnSe4
E. Ghorbani & J. Kiss
University of Mainz, Germany
H. Mirhosseini & C. Felser
MPI for Chemical Physics of Solids, Dresden, Germany
T. Kühne
University of Paderborn, Germany

3DV.1.57 High Open Circuit Voltage Pure Sulfide CIGS Submodule
H. Hiroi, Y. Iwata, K. Horiguchi, S. Adachi,
N. Sakai & H. Sugimoto
Solar Frontier, Atsugi, Japan

3DV.1.58 Characterization of Na depleted Cu(In,Ga)(S,Se)2 Thin-Film Solar Cell
K. Kitani & T. Kato
Solar Frontier, Atsugi, Japan

3DV.1.59 Capacitance and Admittance Studies on Metastable and Sodium-related Defects in Cu(In,Ga)(S,Se)2 Thin Film Solar Cell
T. Kato, K. Kitani & H. Sugimoto
Solar Frontier, Atsugi, Japan

VISUAL PRESENTATIONS 3DV.2

13:30 - 15:00 Silicon-Heterojunction Devices and Light Management

3DV.2.1 Deposition of Silicon Layers with Rates Up to 300nm/s“
J.-P. Heinß, B. Pfefferling, S. Saager & D. Temmler
Fraunhofer FEP, Dresden, Germany

3DV.2.2 Sputter Damage to Amorphous Silicon Layers for Heterojunction Solar Cells
B.-M. Meiners, S. Holinski, P. Schäfer,
S. Hohage & D. Borchert
Fraunhofer ISE, Gelsenkirchen, Germany

3DV.2.3 Novel „Mirror“ Concept for a Simplified Fabrication of Silicon Heterojunction Solar Cells Using the Adapted PECVD Cluster Tool of Indeotec SA
O. Shojaei, F. Jeanneret & A. Limouzin
INDEOtec, Neuchâtel, Switzerland
A. Descoeudres, L. Barraud & M. Despeisse
CSEM, Neuchâtel, Switzerland
C. Ballif
EPFL, Neuchâtel, Switzerland

3DV.2.4 Transmission Electron Microscope Investigation of Heterojunction Crystalline Silicon Solar Cell
L.-P. Chen, M.-S. Lin, Y.-H. Lin, K.-Y. Kuo & C.-C. Li
Motech Industries, Tainan, Taiwan

3DV.2.6 Influence of Surface Morphology on Performance of Texturized Silicon Heterojunction Solar Cell Efficiency
L.-P. Chen, M.-S. Lin, Y.-H. Lin, K.-Y. Kuo,
C.C. Li & K. Wang
Motech Industries, Tainan, Taiwan

3DV.2.7 Interdigitated Back Contact Silicon Thin-Film Heterojunction Solar Cells on Glass
J. Haschke, P. Sonntag, O. Gabriel, D. Amkreutz & B. Rech
HZB, Berlin, Germany

3DV.2.8 Electron Beam Induced Etching (EBIE) with High-Purity Hydrogen - an Alternative In Situ Dry Clean Process for Silicon Surfaces
E. Bodenstein & D. Temmler
Fraunhofer FEP, Dresden, Germany

3DV.2.9 Optimization of Properties of ZnO:B Films by Annealing Treatment for Conversion Efficiency Improvement in Thin Film Silicon Solar Cells
W. Li, S. Liu, Y. Li, L. Liu, L. Zhang, S. Wang, H. Huang, C. Lu & X. Niu
Chint Solar, Hangzhou, China

3DV.2.10 3D Camera-Based System for Measurements of Scattered and Emitted Light
M. Jošt, J. Krc & M. Topic
University of Ljubljana, Slovenia

3DV.2.11 Light Management in High Efficiency n-Type Silicon Heterojunction Solar Cells
C. Yu, M. Yang, Y. Zhang, Y. Yang, J. Zhang & X. Xu
Hanergy Advanced Systems Group, Chengdu, China
H. Yan
Beijing University of Technology, China

3DV.2.12 Mass-Produced 2D Nanophotonic Crystals for Advanced Light Trapping in Crystalline Silicon Thin Film Solar Cells
P. Gao & J. Ye
CAS, Ningbo, China

3DV.2.13 Metal Versus Dielectric Back Reflector for Microcrystalline Si Solar Cells on Different Front TCO
L.V. Mercaldo, I. Usatii, E.M. Esposito & P. Delli Veneri
ENEA, Portici, Italy
J.W. Schüttauf, E. Moulin & F.-J. Haug
EPFL, Neuchâtel, Switzerland
M. Ghosh & M. Meier
Forschungszentrum Jülich, Germany

3DV.2.14 Disordered Photonic Nanostructures for Advanced Light Trapping in Solar Cells
C. Trompoukis, V. Depauw, I. Gordon, R. Mertens & J. Poortmans
imec, Leuven, Belgium
I. Massiot & A. Dmitriev
Chalmers University of Technology, Goteborg, Sweden
O. El Daif
Qatar Foundation, Doha, Qatar
K.D. Lee
Obducat Technologies, Lund, Sweden

3DV.2.15 Electrochemically Deposited Zinc Oxide Nanostructures as a Novel Light-Trapping Concept in Silicon Heterojunction Solar Cells
O. Sergeev, M. Ahrlich, M. Juilfs, M. Kellermann, A. Neumüller & M. Vehse
NEXT ENERGY, Oldenburg, Germany

3DV.2.17 Thickness Controlled Two-Dimensional Silicon Nanosheets with Tunable Light Absorption and Emission from Visible to Infrared Region
H.-J. Choi, S.W. Kim, J.J. Lee & Y.H. Park
Yonsei University, Seoul, Korea South
D.I. Cheong, E. Lee & J.S. Yeo
Agency for Defense Development, Daejeon, Korea South

3DV.2.18 Morphologic Influence on Surface Textures for HIT Solar Cells via Anisotropic Wet Chemical Etching with Additives
M.-S. Lin, Y.-H. Lin, L.-P. Chen, K.-Y. Kuo & C.C. Li
Motech Industries, Tainan, Taiwan

3DV.2.19 A Fair Comparison between Periodic and Random Inverted Nano-Pyramid Structured Solar Cells
J. Müller, A. Herman, A. Mayer & O. Deparis
University of Namur, Belgium

3DV.2.20 Influence of Deposition Parameters on Elemental Concentrations, Electrical and Optical Properties of Magnetron Co-Sputtered Al-Doped ZnO Films
A. Gorgulla, D.-P. Ertel, G. Hahn & B. Terheiden
University of Konstanz, Germany

3DV.2.21 Effects of Electrode Distance and Target Angles on Elemental Concentrations and Film Properties of Al Doped ZnO Films Prepared by Magnetron Co-Sputtering
A. Gorgulla, K. Hagedorn, G. Hahn & B. Terheiden
University of Konstanz, Germany

3DV.2.22 Resistance Changes of ITO Layers in HIT Solar Cells due to Unequal Thermal Treatments Arising from the Fabrication Process
Y.-H. Lin, L.-P. Chen, K.-Y. Kuo, M.-S. Lin, J.-J. Wang & C.C. Li
Motech Industries, Tainan, Taiwan
C.-H. Chang, C.-H. Shen & J.-M. Shieh
National Nano Device, Hsinchu, Taiwan

3DV.2.23 In-Line Plasma Multitexturing of Crystalline Silicon Wafers for High Efficient Heterojunction Solar Cells
O. Sergeev, A. Neumüller, M. Kellermann & M. Vehse
NEXT ENERGY, Oldenburg, Germany

3DV.2.24 Novel Multi-Textured Periodic Glass Surface Morphologies with High Transmittance and Step Coverage of AZO Films for a-Si Thin Film Solar Cells
S. Qamar Hussain, G.D. Kwon, S. Ahn, S. Kim, A.H.T. Le, N. Balaji, H. Park, D. Pribat & J. Yi
University of Sungkyunkwan, Suwon, Korea South

3DV.2.25 Enhancing Minority-Carrier Lifetime and Cell Performance of Si Nanostructure/Organic Hybrid Solar Cells through Surface Modified Nanostructures
H.-J. Syu, T. Subramani, J.-J. Chao, C.-C. Hsueh, C.-T. Liu, S.-T. Yang, S.-C. Shiu & C.-F. Lin
NTU, Taipei, Taiwan

3DV.2.26 Attaining 46% Utilization of the AM1.5G Photons Impinging on a 400nm Thick nc-Si Cell per Area Using Nanoelement-Array Light Trapping Structures
W.J. Nam, Z. Gray, S. Waggoner, A.O. Cakmak & S.J. Fonash
Pennsylvania State University, University Park, United States
J.-C. Dornstetter & P. Roca i Cabarrocas
CNRS, Palaiseau, France
D. Neidich
Solarity, State College, United States

3DV.2.27 Backreflectors in Thin Film Solar Cells: Influence of the Fabrication Procedure on the Performances Numerical Prediction
A. Micco, A. Ricciardi, M. Pisco & A. Cusano
University of Sannio, Benevento, Italy
V. La Ferrara, I. Usatii, L.V. Mercaldo & P. Delli Veneri
ENEA, Portici, Italy

3DV.2.28 Optimisation of Plasmonic Back Reflectors for Ultra-Thin Crystalline Silicon Photovoltaics
Y. Chang, D.N.R. Payne, M.E. Pollard & D.M. Bagnall
UNSW, Sydney, Australia

3DV.2.29 Structural, Optical, Properties of CZTS Layers Deposited by Spray Pyrolysis Technique
R. Tala-Ighil, D. Haouanoh, F. Bensouici & A. Slimani
Boumerdes University, Algeria
A. Samantilleke
University of Minho, Braga, Portugal

NOTES

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VISUAL PRESENTATIONS 3DV.3

15:15 - 16:45 CdTe, CIS and Related Thin Film Devices II

3DV.3.1 Plasma-Assisted Selenization of Stacked Elemental Layers
J. Ohland, I. Riedel, T. Madena, U. Mikolajczak & J. Parisi
University of Oldenburg, Germany
F. Stahr
FAP, Dresden, Germany
J. Anderson, K. Dybek, K. Schade & J. Hartung
VON ARDENNE, Dresden, Germany
M. Fürfanger & A. Jahnke
AVANCIS, Torgau, Germany

3DV.3.2 Investigation of Small Grain Region at Back Contact in Solution Processed Cu(InxGa1-x)Se2 Photovoltaic Devices
Z. Liu, S. Stubbs, C. Allen, S. Whitelegg, P. Kirkham, S. Garimella & A. Whiteside
Nanoco Technologies, Manchester, United Kingdom

3DV.3.3 Cu-Sn-(S,Se) System for Thin Films Photovoltaic Applications: Cu/Sn Ratio Impact on Structural and Vibrational Properties
T. Jawhari, X. Alcobé, L. Calvo-Barrio & A. Perez-Rodriguez
University of Barcelona, Spain
X. Fontané, E. Saucedo & V. Izquierdo-Roca
IREC, Barcelona, Spain
A. Fairbrother
EMPA, Dübendorf, Switzerland

3DV.3.4 Development of Insulated Steel Substrate for PV Applications Using Roll-to-Roll Deposition Lines
L. Samain, M.-S. Colla, J.-B. Richir, A. Lafort, C. Kempeneers, E. Volon & L. Fourdrinier
CRM Group, Liège, Belgium
R. Vignal
Arcelor Mittal, Maizières-lès-Metz, France

3DV.3.6 Improvement of Elemental Vapor Distribution Systems in CIGS Sulfo-Selenization Furnaces
H. Myers, P. van den Heuvel & P. Diepens
Smit Ovens, Son, Netherlands
S.S. Schmidt, C. Wolf, H. Rodríguez-Alvarez, C.A. Kaufmann & R. Schlatmann
HZB, Berlin, Germany
S. Villain, A. Weber, S. Bodnar, C. Guillou & C. Broussillou
NEXCIS, Rousset, France

3DV.3.7 Structure and Chemical Composition of Sputtered MoOx Layers in Back Contact of CdTe Solar Cells in Substrate Configuration
H. Morgner, E. Schwuchow, O. Zywitzki, T. Modes,
L. Decker & C. Metzner
Fraunhofer FEP, Dresden, Germany

3DV.3.8 Electrodeposition of Nanostructured Zinc Oxide for Solar Cell Applications
L. Atourki, H. Ihalane, H. Kirou, A. Ihlal & K. Bouabid
University of Agadir, Morocco

3DV.3.9 Investigation of Electrical Properties of Cu-Ag–In–Se Thin Films Deposited by Thermal Evaporation Method
H.H. Güllü, E. Coskun, O. Bayrakli,
M. Parlak & A.C. Erçelebi
METU, Ankara, Turkey

3DV.3.10 Optimization of Metallic Precursor Thickness Ratio for CIGS Solar Cell Prepared by Magnetron Sputtering Process
S. Gulkowski, E. Krawczak & J.M. Olchowik
Lublin University of Technology, Poland

3DV.3.11 Effects of Na on Structural Properties and Surface Potential of Cu2ZnSnSe4 Thin Film Absorbers
T.T.T. Nguyen, H.-Y. Shin, H. Moon, G. Kim,
W. Jo & S. Yoon
Ewha Womans University, Seoul, Korea South

3DV.3.12 Fabrication of CdTe Ultra Thin Film Solar Cell with Wide Bandgap Window Layer of CdS:O by Magnetron Sputtering
M.A. Islam, M. Akhtaruzzaman, K. Sopian & N. Amin
National University of Malaysia, Bangi, Malaysia
M.M. Alam & Z.A. Al-Othman
King Saud University, Riyadh, Saudi Arabia

3DV.3.13 Effect of Substrate Temperature on ZnxCd1-xS Thin Film Growth by RF Magnetron Sputtering
T. Hossain, A. Islam, T.M. Razykov & N. Amin
National University of Malaysia, Bangi, Malaysia
M. Alam & Z.A. Al-Othman
King Saud University, Riyadh, Saudi Arabia

3DV.3.14 On the Influence of Elemental Composition on the Electrical Quality of Crystalline CISe2 Thin Film Absorbers
F. Werner, D. Regesch, G. Rey,
M. Melchiorre & S. Siebentritt
University of Luxembourg, Belvaux, Luxembourg

3DV.3.15 Voltage-Bias-Induced Migration of Elements in CIGS Solar Cells
O. Kiowski, A. Lämmle & O. Salomon
ZSW, Stuttgart, Germany
T. Ott & T. Walter
Ulm University of Applied Sciences, Germany

3DV.3.16 Development of Large Area Production Machines for Atmospheric Spatial Atomic Layer Deposition of Zn(O,S) Buffer Layers for CIGS Solar Cells on Glass Substrates
C.I.M.A. Spee, M.D. Bijker & R.S.R. Archer
Smit Ovens, Son, Netherlands

3DV.3.17 Comparative Study on Thermally-Annealed and Laser-Annealed CdTe Thin Films Grown by RF Magnetron
N.A. Khan, K.S. Rahman, M.N. Imamzai, M.A. Islam,
M. Akhtaruzzaman, K. Sopian & N. Amin
National University of Malaysia, Bangi, Malaysia
M.M. Alam & Z.A. Al-Othman
King Saud University, Riyadh, Saudi Arabia

3DV.3.19 High Efficiency of CZTSe Solar Cells Prepared by Electrodeposited Cu/Sn/Zn Precursors Followed by Three-Step Selenization at Low Se Pressure
L. Yao, J.-P. Ao, J. Bi, S. Gao, G. Sun & Y. Sun
Nankai University, Tianjin, China
M.-J. Jeng & L.-B. Chang
Chang Gung University, Kweishan, Taiwan
Y. Tang
SUSTC, Guangzhou, China
H. Zeng
Yangjiang Henergy Industrial, Guangdong, China

3DV.3.20 Influence of Ga Doping Profile on Electrical Properties of Flexible CIGS Solar Cells
N. Severino, N. Bednar & N. Adamovic
Vienna University of Technology, Austria
R. Mereu, S. Binetti & M. Acciarri
University of Milan, Italy
A. Gasparotto
University of Padua, Padova, Italy

3DV.3.21 Substrate Configuration CdTe Minimodules by Monolithic Interconnection
J. Perrenoud, C. Gretener, L. Kranz,
S. Buecheler & A.N. Tiwari
EMPA, Dübendorf, Switzerland
R. Ziltener
Flisom, Dübendorf, Switzerland

3DV.3.22 Analysis of SnS Growth and Post Deposition Treatment by Congruent Physical Vapor Deposition
S. Di Mare, A. Salavei, F. Piccinelli & A. Romeo
University of Verona, Italy

3DV.3.23 Cu2ZnSnS4 Thin Film Solar Cells Produced via Sol Gel without Sulfurization and Optimization the Annealing Temperature
A. El Kissani, L. Nkhaili, K. El Assali & A. Outzourhit
Cadi Ayyad University, Marrakech, Morocco

3DV.3.24 Flexible CdTe Solar Cell on Polyimide and Flexible Glass Substrates
A. Salavei, F. Piccinelli, S. Di Mare & A. Romeo
University of Verona, Italy
E. Artegiani, D. Menossi, A. Bosio & N. Romeo
University of Parma, Italy

3DV.3.25 CIGS Solar Cells Fabricated on Mo Back-Contacts/SLG with Varied Mo Surface Conditions
Y. Kamikawa-Shimizu, J. Nishinaga, A. Yamada,
H. Shibata & S. Niki
AIST, Tsukuba, Japan

3DV.3.26 Cu(In,Ga)Se2 Thin Film Solar Cells Prepared by Sputtering the Precursors from InSe, GaSe and Cu Targets on Metallic Thin Layers
A. Bosio, D. Menossi, G. Rosa & N. Romeo
University of Parma, Italy
A. Salavei & A. Romeo
University of Verona, Italy

3DV.3.27 Fast Reactive Feedback Process Control Using a Selenium Pulsed Cracker Effusion Valve for Industrial CIGS Deposition
I. Fernandez-Martínez & A. Wennberg
Nano4Energy, Madrid, Spain
V. Bellido-Gonzalez, B. Daniel, J. Brindley & D. Monaghan
Gencoa, Liverpool, United Kingdom

3DV.3.28 Ultrashort Laser Patterning and Electrical Shunt Evaluation of CIGS and CZTSe Thin Film Solar Cells
E. Markauskas, P. Gecys & G. Raciukaitis
Center for Physical Sciences and Technology, Vilnius, Lithuania

3DV.3.29 Temperature Dependent Raman Scattering of CuS, ZnS, SnxSy, CuxSnSy and Cu2ZnSnS4 for In-Situ Process Control
S. van Duren, J. Just & T. Unold
HZB, Berlin, Germany
Y. Ren & J. Scragg
Uppsala University, Sweden

3DV.3.30 Surface Photovoltage in Thin Films of Cu2ZnSn(SxSe1-x)4 Prepared by Spray Pyrolysis
T. Dittrich, G. Gurieva, S. Schorr,
M.C. Lux-Steiner & M. Rusu
HZB, Berlin, Germany
L.I. Bruc, L. Dermenji, N. Curmei, M.S. Guc, D.A. Sherban,
A.V. Simashkevich & E.K. Arushanov
Academy of Sciences of Moldova, Chisinau, Moldova
S. Vatavu
Moldova State University, Chisinau, Moldova

3DV.3.32 SIMS Study of Na Distributions in CIGS
L. Wang & G. Mount
Evans Analytical, Sunnyvale, United States

3DV.3.33 The Ga Distribution of CIGS Thin Films Prepared by Three-Step Selenization of Electrodeposited Cu/Ga/In Precursors with Solid-State Selenium Sources
J. Bi, J.-P. Ao, L. Yao, S. Gao, G. Sun & Y. Sun
Nankai University, Tianjin, China
M.-J. Jeng & L.-B. Chang
Chang Gung University, Kweishan, Taiwan
Y. Tang
SCUT, Guangzhou, China
H. Zeng
Yangjiang Henergy Industrial, Guangdong, China

3DV.3.34 Chemical Bath Deposited Zinc Oxide as Transparent Conductive Contact for Electrodeposition Based CIGS Cells and Mini-Modules
J. Steinhauser, P. Fuchs, H. Hagendorfer,
Y.E. Romanyuk & A.N. Tiwari
EMPA, Dübendorf, Switzerland
P.P. Grand, A. Sorba & C. Broussillou
NEXCIS, Rousset, France

3DV.3.35 Plasma Treatment Nanostructuring of Cu(in,Ga)Se2 Films Grown by Selenization and Pulsed Laser Deposition
S.P. Zimin, E.S. Gorlachev & D.A. Mokrov
Yaroslav State University, Yaroslavl, Russia
I.I. Amirov & V.V. Naumov
RAS, Yaroslavl, Russia
V.F. Gremenok
NASB, Minsk, Belarus

3DV.3.36 Na2Se4 Post Deposition Treatment Integrating Na Incorporation and Selenization of Printed CuInS2 Absorber
A. Alsaggaf, E. Ahmed, B. Davaasuren & A. Rothenberger
KAUST, Thuwal, Saudi Arabia

3DV.3.38 Roll-to-Roll Manufacturing of High Efficiency and Low Cost Flexible CIGS Solar Modules

P.J. Bolt, A. Illiberi & C. Frijters
TNO, Eindhoven, Netherlands
A.N. Tiwari, S. Buecheler, P. Reinhard & J. Löckinger
EMPA, Dübendorf, Switzerland
D. Brémaud, A. Meeder, M. Ruth & R. Ziltener
Flisom, Dübendorf, Switzerland
B. Dimmler
Manz, Reutlingen, Germany
R. Wächter
Manz, Schwäbisch Hall, Germany
F. Kessler, R. Würz & S. Spiering
ZSW, Stuttgart, Germany
A. Smith, D. Bird & S. Edge
Centre for Process Innovation, Sedgefield, United Kingdom
W. Krumlacher & H. Muckenhuber
ISOVOLTAIC, Lebring, Austria
P. Merilaïnen & M. Söderlund
Beneq, Vantaa, Finland
A. Apraiz, J. Aguerre & I. Iturbe Gomez
Mondragon Assembly, Aretxabaleta, Spain
R. Tacken & R. Knaapen
VDL ETG, Eindhoven, Netherlands

3DV.3.39 Structural and Optical Properties of RF-Sputtered Zn(S,O) Thin Films

O.M. Chaikh, L. Nkhaili, A. El Kissani,
M. Chaik & A. Outzourhit
Cadi Ayyad University, Marrakech, Morocco
M. Aggour
Ibn Tofail University, Kenitra, Morocco

3DV.3.40 Comparative Technology Assessment and Diagnostics of CdTe and CIS PV Devises Using Variable Illumination Measurements (VIM)

J. Merten, G. Razongles & L. Sicot
CEA, Le Bourget du Lac, France

3DV.3.41 Characterisation of Electrodeposition Based Cu(In,Ga)(S,Se)2 Absorbers for High Efficiency Solar Cells: Impact of Surface Absorber Composition on Absorber/Buffer Conduction Band Discontinuity and Device Properties

C. Insignares-Cuello, F. Oliva, M. Neuschitzer, X. Fontané,
E. Saucedo & V. Izquierdo-Roca
IREC, Barcelona, Spain
C. Broussillou & T. Goislard de Monsabert
NEXCIS, Rousset, France
C.M. Ruiz Herrero
IM2NP - CNRS, Marseille, France
A. Perez-Rodriguez
University of Barcelona, Spain

PROGRAMME

3DV.3.42 Prospects of SnS Back Surface Field Layer in CdTe Thin Film Solar Cells from Numerical Analysis

S. Benabbas, Z. Rouabah, H. Heriche & N.-E. Chelali
University of Bordj Bou Arreridj, El-Anasser, Algeria

3DV.3.43 Effect of Ethyl Cellulose on the Growth and Photovoltaic Performance of Cu2ZnSnS4 (CZTS) Thin Films

S. Cetinkaya, S. Kahraman, S. Yasar,
H.A. Cetinkara & H.S. Güder
Mustafa Kemal University, Hatay, Turkey
I. Bilican
Aksaray University, Turkey
M. Podlogar & S. Bernik
Jozef Stefan Institute, Ljubljana, Slovenia

3DV.3.44 Nonstoichiometric Composition Shift in Physical Vapor Deposition of CdTe Thin Films

Z. Cheng, K.K. Chin & A.E. Delahoy
NJIT, Newark, United States
S. Peng, C. Wang & J. Pan
Triumph International Engineering, Shanghai, China

3DV.3.45 The RF-Sputtered Rutile-TiO2 Thin Films as Buffer Layer in CdS/CdTe Based Solar Cells

J.L. Peña, E. Hernández-Rodríguez,
R. Mis-Fernández & V. Rejón
CINVESTAV, Merida, Mexico
I. Riech
Autonomous University of Yucatan, Merida, Mexico

3DV.3.46 Impurities in Chalcopyrite Photovoltaics: Changing the Perception from an Absolute to a Relative and Cost Efficiency Perspective

V. Handke, V. Hinrichs, L. Chikhaoui,
T. Köhler & M.C. Lux-Steiner
HZB, Berlin, Germany

3DV.3.47 Quickly Synthesized Flower Shaped Cu2ZnSnS4 Nanoparticles by Microwave Irradiation for Solar Cell Application

M.Z. Ansari & N. Khare
IIT Delhi, New Delhi, India

3DV.3.48 CdTe/CdS Solar Cell Activated with MgCl2

V. Rejón, R. Mis-Fernández, I. Rimmaudo,
E. Hernández-Rodríguez & J.L. Peña
CINVESTAV, Merida, Mexico
I. Riech
University of Yucatan, Merida, Mexico

3DV.3.49 Investigation of Interface and Bulk Defects of the CdS/CdTe Solar Cell by DLTS Method
Y.M. Ding, Z. Cheng, D. Misra, A.E. Delahoy, G.E. Georghiou & K.K. Chin
NJIT, Newark, United States
S. Peng
Triumph International Engineering, Shanghai, China

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M. Heinemann, R. Mainz, H. Rodríguez-Alvarez, D. Greiner, C.A. Kaufmann & T. Unold
HZB, Berlin, Germany

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Y. Feng, G. Cheng, Z. Li, H. Luo, C. Yang & Z. Liu
CAS, Shenzhen, China
T. Lau, X. Lu & X. Xiao
CUHK, Hong Kong, Hong Kong

3DV.3.52 Enhanced SnS Phase Purity of Films Produced by Rapid Thermal Processing of SnS2-x Precursors
M.G. Sousa, A.F. da Cunha & P.A. Fernandes
University Aveiro, Portugal

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A.R. Uhl & H.W. Hillhouse
University of Washington, Seattle, United States

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B. O'Donnell & P. Jouy
Heliocentric Solutions, Berlin, Germany

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H. Camilo
Siemens Brazil, Jundiai, Brazil
U. Miguel Edgar Morales, A.L. Gimenes & J.A.B. Grimoni
University of Sao Paulo, Brazil

7DV.4.4 Evaluation of the Aging Behavious of Stationary Lithium Ion Battery Storage Systems for Different Photovoltaic Driven Applications in the Distribution Grid
M. Müller, A. Zeh, H. Hesse & A. Jossen
Munich University of Technology, Germany
S. Rohr, R. Witzmann & M. Lienkamp
Munich University of Technology, Garching, Germany

7DV.4.5 Battery Energy Storage and Advanced Forecast Integration in Large Scale PV Plant Enabling Active RES Integration in the Grid
L. Lanuzza, F. Bizzarri & C. Pregagnoli
ENEL Green Power, Rome, Italy

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P. Westacott & C. Candelise
Imperial College London, United Kingdom

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A.P. Carvalho, R.C.R. Pereira, W. Uturbey, T.F. Araújo, B.M. Lopes & E.N. Cardoso
UFMG, Belo Horizonte, Brazil

7DV.4.8 Island-Grid-Study Hamburg-Wilhelmsburg
A.K. Lutzenberger
ALRENE, Kasseburg, Germany
S. Peter
ALRENE, Munich, Germany

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F. Baena, J. Terrados, G. Almonacid & P. Gómez Vidal
University of Jaén, Spain
P. Gómez-Bueno
REE, Madrid, Spain
P. Valera & L. Almonacid
Astrom, Madrid, Spain

7DV.4.10 Impact of PV Production on Wholesale Electricity Prices
G. Masson & S. Orlandi
Becquerel Institute, Brussels, Belgium
N. Gourvitch & H. Gouzerh
Green Graffe Energy, Paris, France

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I. Babic & Z. Durisic
University of Belgrade, Serbia

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D. Premm, B. Engel, A. Unru & G. Bettenwort
SMA Solar Technology, Niestetal, Germany
B. Osterkamp & J. Seidel
TU Braunschweig, Germany
S. Poehling
GEWI, Hannover, Germany

7DV.4.13 How to Stimulate the South African Rooftop PV Market without Putting Electricity Distributors' Financial Stability at Risk

K.T. Roro & T. Bischof-Niemz
CSIR, Pretoria, South Africa

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A.D. Owen, X. Liu, A. Finenko,
K. Soundararajan & K.-H. Yuen
National University of Singapore, Singapore

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S. Krauter
University of Paderborn, Germany

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S. Caneva, I. Weiss, S. Betz & S. Arancón
WIP - Renewable Energies, Munich, Germany

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S. Betz, S. Caneva & I. Weiss
WIP - Renewable Energies, Munich, Germany
P. Rowley
Loughborough University, United Kingdom
G. Lettner
Vienna University of Technology, Austria

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T. Bischof-Niemz & K. Roro
CSIR, Pretoria, South Africa

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M. Dershowitz
ModSolar, Philadelphia, United States

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I.T. Theologitis
SolarPower Europe, Brussels, Belgium
G. Masson
Becquerel Institute, Brussels, Belgium

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J. Mittell
Actis, London, United Kingdom

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G. Wahl
Flextronics, Filderstadt, Germany
T. Gopalarathnam
Flextronics, San Jose, United States

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S. Tselepis
CRES, Pikermi, Greece

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S. Orlandi & A. El Gammal
Becquerel Institute, Brussels, Belgium

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S. Shimura, R. Silva Simplicio, R. Herrero Alonso, C. Biasi de Moura, M. Knorich Zuffo & R. de Deus Lopes
University of São Paulo, Brazil
J.A.B. Grimoni
University of Sao Paulo, São Paulo, Brazil

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B.B. Kausika & W.G.J.H.M. van Sark
Utrecht University, Netherlands
W. Folkerts
ECN, Eindhoven, Netherlands
B. Siebenga
I-Real, Terborg, Netherlands
P. Hermans
Aurum, Hoofddorp, Netherlands

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A.D. Owen, X. Liu, A. Finenko,
K. Soundararajan & K.-H. Yuen
National University of Singapore, Singapore

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I. Mauleón
URJC, Vicálvaro, Spain

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S. Edalati
Graduate University of Advanced Technology, Kerman, Iran
M. Ameri
Shahid Bahonar University of Kerman, Iran

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S. AlYahya & M. Irfan
Qassim University, Buraidah, Saudi Arabia

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M.R. Regmi & B. Pokharel
Civil society, Kathmandu, Nepal

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S. Szabó, K. Bódis, V. Motola & I. Kougias
European Commission DG JRC, Ispra, Italy

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S. Valentim Oliveira, G. Pereira Távora & J.A. Almeida Silva
University of Lisbon, Portugal
S. Mendonça
ISCTE, Lisbon, Portugal

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U. Muntwyler, T. Schott, M. Jost & E. Schüpbach
BUAS, Burgdorf, Switzerland

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T. Inoue
JST, Chiyoda-ku, Japan
K. Yamada
University of Tokyo, Japan

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ENEA, Portici, Italy
I. Lauermann
HZB, Berlin, Germany

I. Anton Hernandez
UPM, Madrid, Spain
Y.B. Assoa, F. Bergeron, J. Merten & P. Malbranche
CEA, Le Bourget du Lac, France
S.A. Gevorgyan
RISOE National Laboratory, Roskilde, Denmark
J. Hüpkes
Forschungszentrum Jülich, Germany
M. Köhl, M.C. Schubert & G. Siefer
Fraunhofer ISE, Freiburg, Germany
J.M. Kroon
ECN, Petten, Netherlands
T. Pettersen
SINTEF, Trondheim, Norway
I.T. Theologitis
SolarPower Europe, Brussels, Belgium

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M. Yamaguchi
TTI, Nagoya, Japan
H. Yamada
NEDO, Kawasaki, Japan
Y. Katsumata
JST, Chiyoda-ku, Japan

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F. Roca & D. Casaburi
ENEA, Portici, Italy
K. Bittkau
Forschungszentrum Jülich, Germany
M.C. Lux-Steiner & I. Lauermann
HZB, Berlin, Germany
S.A. Gevorgyan
RISOE National Laboratory, Roskilde, Denmark
P. Malbranche & O.N. Aguila
CEA, Le Bourget du Lac, France
T. Rachow
Fraunhofer ISE, Freiburg, Germany
G. Sánchez-Plaza
UPV, Valencia, Spain
P.M. Sommeling & J.M. Kroon
ECN, Petten, Netherlands
N. Taylor
European Commission DG JRC, Ispra, Italy

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M. Biancardo
Plougmann & Vingtoft, Copenhagen, Denmark

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A. Visentin
European Patent Office, Berlin, Germany
M. Boero & C. Königstein
European Patent Office, Rijswijk, Netherlands

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N.J. Sheikh
State University of New York, Incheon, Korea South

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

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P. Leicester, C.I. Goodier & P. Rowley
Loughborough university, United Kingdom

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U. Blieske, N. Reiners, R. Gecke, A. Maixner, P. Schorpp, N. Schwarze, N. Wolf, D. Korber & J. Muenzberg
Cologne University of Applied Sciences, Germany

7DV.4.57 International Strategy and Policy Statement of Certified PV Module Registration and Management in Taiwan
C.-C. Chou & H.-C. Ma
ITRI, Hsinchu, Taiwan

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D.-C. Wu, Y.-T. Chen, S.-I. Chen, C.-P. Hsu, H. Lee, Y.-T. Chang, H.-H. Chiang & F.-M. Lin
ITRI, Hsinchu, Taiwan

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S. Kumar
PTB, New Delhi, India
M. Brinkschröder & N. Ferdinand
PTB, Braunschweig, Germany
O.S. Sastry
NISE, Gurgaon, India
G. Kumar
MERI, Bahadurgarh, India

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M. Metayer & C. Breyer
Lappeenranta University of Technology, Finland

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K. Komoto
Mizuho IR Institute, Tokyo, Japan
T. Ehara
E-KONZAL, Kyoto, Japan
C. Breyer
Lappeenranta University of Technology, Finland
S. Wang
Energy Research Institute, NDRC, Beijing, China
E. Cunow
LSPV Consulting, Gröbenzell, Germany
D. Faiman
BGU, Beer-Sheva, Israel
P. Sinha
First Solar, Tempe, United States
N. Enebish
National Renewable Energy Center, Ulaanbaatar, Mongolia

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A. Lagaaij
SucceSun, Breukelen, Netherlands

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T. Li & W. Wang
CAS, Beijing, China

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PARALLEL EVENTS

PARALLEL EVENTS

The EU PVSEC Parallel Events are open to all registered Conference Participants of the EU PVSEC 2015.

For detailed information and programme please visit www.photovoltaic-conference.com/parallel-events.

Monday,14 September 2015

13:30 - 17:00

Competitiveness, Soft Costs and New Business Cases for PV

jointly with the International Energy Agency Photovoltaic Power Systems Programme (IEA PVPS) - IEA PVPS Task 1

Tuesday, 15 September 2015

08:30 - 12:30

Reaching out for opportunities in BIPV – market, policies and BIPV development drivers

jointly with the International Energy Agency Photovoltaic Power Systems Programme - IEA PVPS Task 15 and linked to the EU PV Technology Platform

13:30 - 18:30

Reaching out for opportunities in BIPV – technology and industry developments

jointly with the European Photovoltaic Technology Platform and the International Energy Agency Photovoltaic Power Systems Programme – IEA PVPS Task 15

Wednesday, 16 September 2015

08:30 - 12:30

For solar PV, the future is here today: But where will future cost reductions come from?

jointly with IRENA – International Renewable Energy Agency

14:00 - 18:00

PHOTOVOLTAICS | FORMS | LANDSCAPES: Beauty and power of designed Photovoltaics

jointly with EC-JRC, ENEA and ETA-Florence Renewable Energies

Thursday, 17 September 2015

13:20 - 18:30

PV CROPS: Novel solutions for a high PV penetration in EU electrical networks with lower LCOE

jointly with PVCROPS consortium

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jointly with:

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COMPETITIVENESS, SOFT COSTS AND NEW BUSINESS CASES FOR PV

jointly with the International Energy Agency Photovoltaic Power Systems Programme (IEA PVPS) - IEA PVPS Task 1

Day: **Monday, 14 September 2015**
Time: **13:30 - 17:00**
Site: **2nd floor, Auditorium Hall D**
Access: **Open to all registered Conference participants of the EU PVSEC 2015**

PV system costs dropped significantly over the last years, making PV electricity competitive in some market segments and some countries. However, will it be sufficient to ensure a stable and steady market development in the coming years? This workshop will summarize the state of the PV competitiveness, with a focus on how soft costs could be the next area of progress in PV LCOE reduction. Which are the business models that will exploit these low PV system prices and how will innovative financing help to (re)develop the PV market where the feed-in tariffs have been phased out?

Programme Outline

13:30 - 13:40
Welcome Speech & the Role of the IEA PVPS Programme
- Stefan Nowak, IEA-PVPS Chairman

13:40 - 15:00
Session 1
PV Competitiveness and Soft Costs
- Moderator: Gaëtan Masson, IEA-PVPS Task 1

This session will explore the questions of competitiveness of PV through its main aspects: The declining PV system prices through learning curve analysis, the impact of new PV and storage system, especially in mini grids, the evolution of LCOE in the coming years and its drivers, the soft costs including administrative hurdles, the need for reduced cost of capital, innovative financing in emerging countries and the question of quality and reliability. BIPV will be explored as well as an option to further reduce the cost of PV systems and LCOE.

- Christian Breyer (LUT) - PV Competitiveness in a Complex Transition
- Eva Hauser (IZES) – Storage and Electricity Markets
- Eero Vartianen (Fortum) – From the Learning Curve to Competitiveness
- Christof Bucher (Basler & Hofmann) - Soft Costs in Switzerland
- Izumi Kaizuka (RTS Corporation) - Soft Costs and Competitiveness in the Booming Japanese Market

15:00 - 15:15 **Coffee Break**

15:15 - 16:40
Session 2
Best Practices of Business Models for Competitive PV in Europe
- Moderator: Gaëtan Masson, IEA-PVPS Task 1

This session will explore how new business models already deployed in Europe and in other regions of the world, can unlock the PV market globally, at distributed and centralized levels. The question of grid services and the evolution of PV systems with regard to limitation of grid impacts will be discussed as well. Finally, the relevance of large-scale PV with regard to electricity market will be discussed.

- Gian Carle (EWZ) – Utilities Business Models in Switzerland
- Uta Hoffmann (Econeers) - Crowdfunding for Solar PV Plants
- Kristian Petrick (IEA-RETD) – Prosumers in the commercial sector.
- Daniel Mugnier (IEA-SHC) – PV for Heating and Cooling
- David Wedepohl (BSW) – The Emergence of New Business Models in Germany

16:40 - 17:00
Closing Speech
- Stefan Nowak, IEA PVPS Chairman

PARALLEL EVENTS

REACHING OUT FOR OPPORTUNITIES IN BIPV – MARKET, POLICIES AND BIPV DEVELOPMENT DRIVERS

jointly with the International Energy Agency Photovoltaic Power Systems Programme - IEA PVPS Task 15 and linked to the EU PV Technology Platform

Day: **Tuesday, 15 September 2015**
Time: **08:30 - 12:30**
Site: **2nd floor, Auditorium Hall D**
Access: **Open to all registered Conference participants of the EU PVSEC 2015**

Integration of PV in the Built Environment (BIPV) has the potential to become a major player in the PV market. It generates necessary energy close to the consumer while at the same time being part of the built environment and creating an aesthetic valued solution. Although exact numbers are not consistent, approximately between 1% and 3% of all PV installed is Building Integrated (BIPV), resulting in a niche market for BIPV products. There are more than 100 prototypes of market-ready BIPV products worldwide. However, only a small amount seems to be able to cross the valley of death between product and prototype development and successful large-scale market penetration. This workshop will explore the challenges ahead for the acceleration of BIPV, related to the recently started IEA PVPS Task 15 on BIPV. During this interactive workshop, the different subtasks of the Task will be discussed and input from the audience used for further refinement of future activities.

Programme Outline

08:30 - 08:50

Introduction and welcome

- Michiel Ritzen, IEA-PVPS Task 15 OA, Zuyd University of Applied Sciences, BIHTS
- Marko Topic, chair of the EU PV Technology Platform

08:50 - 09:15

BIPV projects mapping and tools – what are the necessary elements in a BIPV database to fulfil market demands?

- Tjerk Reijenga, BEAR-iD architects

09:15 - 09:35

The BIPV market – how to develop successful BIPV projects and business cases.

- Maider Machado, Tecnalia

09:35 – 10:00

BIPV market development in infrastructural projects

- Menno van den Donker, SEAC

10:00 – 10:30 **Coffee Break**

10:15 - 10:45

What are the developments in BIPV evaluation, certification and regulation policies to open up larger market potentials?

- Tilmann Kuhn, Fraunhofer / Francesco Frontini, SUPSI

10:45 - 11:15

What are the environmental benefits of BIPV and how can they contribute to a larger market penetration?

- T.b.d.

11:15 - 11:45

What are the relevant indicators in a framework for demonstration of different PV techniques and applications?

- Simon Boddaert, CSTB

11:45 - 12:30

Discussion / panel discussion

- Moderator: Michiel Ritzen

- Marko Topic, chair of the EU PV Technology Platform
- Zeger Vroon, professor New Energy in the Built Environment, senior researcher new energy at TNO
- Tjerk Reijenga, founder BEAR-ID
- Maider Machado, Tecnalia
- Menno van den Donker, SEAC
- Tilmann Kuhn, Fraunhofer
- Simon Boddaert, CSTB

REACHING OUT FOR OPPORTUNITIES IN BIPV – TECHNOLOGY AND INDUSTRY DEVELOPMENTS

jointly with the European Photovoltaic Technology Platform and linked to the International Energy Agency Photovoltaic Power Systems Programme – IEA PVPS Task 15

Day: **Tuesday, 15 September 2015**
Time: **13:30 – 18:30**
Site: **2nd floor, Auditorium Hall D**
Access: **Open to all registered Conference participants of the EU PVSEC 2015**

Programme Outline

SESSION I: BIPV: Expectations and visions from Architects and Building industry
Chair: Marko Topic, Chair of EU PV Technology Platform

13:30 - 13:45
Introduction
Marko Topic, Chair of EU PV Technology Platform

13:45 - 14:00
Welcome/ Key-note speech by EC representative
Paul Verhoef, Head of New and Renewable Energy Sources Unit, Directorate General for Research and Innovation, European Commission

14:00 - 14:15
The visions from the European Photovoltaic Technology Platform
Silke Krawietz & Jef Poortmans, Leaders of the BIPV working group of EU PV Technology Platform

14:15 - 14:30
Expectations from the building sector
Stefano Carosio, E2BA coordinator

14:30 - 14:45
BIPV and challenges of Building Energy Management Systems
Christian Trodella, Siemens Building Technologies Division, Global Head Performance Contracting PPA

14:45 - 15:00 **Questions & Answers**

15:00 - 15:15 **Coffee Break**

SESSION II: Research, development and demonstration of innovative BIPV products
Chair: W. Sinke, Co-Chair of EU PV Technology Platform

15:15 - 15:30
R&D support for development of BIPV products
Philippe Malbranche, Director CEA-INES

15:30 - 15:45
Products and system design for making PV a natural component of the building envelope
Pierre-Jean Alet, CSEM

15:45 - 16:00
What are the needs of the PV industry to further enable the developments
Laurent Quittre, ISSOL CEO (tbc)

16:00 - 16:15
Innovative approaches to regain dimensional freedom for BIPV models
Jef Poortmans, IMEC

16:15 - 16:30
Advanced material research for BIPV products with high aesthetic attractiveness
David Müller, Merck, Global Head of Strategic Marketing PV

16:30 - 16:45 **Questions & Answers**

16:45 - 17:00 **Coffee Break**

SESSION III: Panel discussion

17:00 - 18:15

Mobilize investment for innovative and competitive BIPV products manufactured in Europe for Nearly Zero Energy Buildings and Positive Energy Buildings

- Moderator: Gaetan Masson, Becquerel Institute

- Paul Hodson, Head of Energy Efficiency & Intelligent Energy Unit, Directorate General for Energy, European Commission
- Georg Menzen, Federal Ministry for Economic Affairs and Energy, Germany (tbc)
- Laurent Quittre, ISSOL CEO (tbc)
- Eric Peeters, Dow Corning, chairman of EMIRI (tbc)
- Emiliano Perezagua, SC Member of the EU PV Technology Platform

18:15 - 18:30

Concluding Remarks & Closing by

- Marko Topic, Chair of EU PV Technology Platform
- Michiel Ritzen, IEA PVPS Task 15 Operating Agent

FOR SOLAR PV, THE FUTURE IS HERE TODAY: BUT WHERE WILL FUTURE COST REDUCTIONS COME FROM?

jointly with IRENA – International Renewable Energy Agency

Day:	**Wednesday, 16 September 2015**
Time:	**8:30 - 12:30**
Site:	**2nd floor, Auditorium Hall D**
Access:	**Open to all registered Conference participants of the EU PVSEC 2015**

Since the end of 2009 solar PV modules prices have fallen by three-quarters or more, while the global weighted average levelised cost of electricity (LCOE) from solar PV has fallen by half between 2010 and 2014.

Solar PV is now a mainstream and mature technology, which is beginning to compete-head-to-head with incumbent technologies at a utility-scale where excellent solar resources exist and competitive cost structures are achievable. In OECD countries, the total installed costs of solar PV at the utility-scale are now lower than nuclear and, typically, lower than coal-fired plants. This is a remarkable transformation, given that in the fourth quarter of 2009 solar PV module prices alone averaged USD 2 646/kW.

With solar PV module prices at historically low levels, module prices will not necessarily drive absolute future cost reduction potentials anymore. Although percentage cost reductions will likely continue along the learning curve, these will have modest impacts on absolute total installed costs. As solar PV deployment grows, these cost reductions may also start to come more slowly as solar PV growth slows in percentage terms, even if deployment in GW terms grows slowly.

In this new era of low module prices, where will future cost reduction opportunities come from? Will they be as large as in the past? How can we gain a better understanding of the cost reduction opportunities in order to manage stakeholder expectations about what are realistic cost reduction targets in order to maintain the political and public support for solar PV deployment?

Fortunately, excellent opportunities still exist to continue to drive down solar PV costs and improve performance. However, it will increasingly be balance of project costs, performance and financing costs that are likely to yield the largest contributions to future cost reductions. The good news is that in many cases the policy levers exist to unlock these potentials, the challenge is that they now need to address much more closely the entire solar PV project value chain.

Yet with wide variations in total installed costs of solar PV projects, not only between countries but also often within countries the potential to drive down average costs remains excellent.

IRENA has undertaken analysis of future cost reductions for solar PV in order to support the G20 and their efforts to continuously improve the investment climate for renewables in order to meet their members energy security, diversification, economic and environmental goals. Yet the challenges remain significant and unlocking solar PV's true potential will require an integrated effort addressing today's challenges and anticipating future, emerging challenges to the large-scale deployment of solar PV throughout the world.

Join us at this event to discuss three of the critical components in the effort to increase solar PV deployment by ensuring the competitiveness of solar PV continues to improve:

Today's costs and distribution: Understanding the reasons for the wide variations in costs within a country and between countries for installed solar PV costs is critical to identifying efficient cost levels. In many cases represents narrowing or eliminating these cost differentials where possible represent the largest cost reduction opportunity.

Future technology and performance cost reduction opportunities: For the most efficient solar PV markets, the largest cost reduction opportunities will still come from technology improvements that lower module costs and improve performance, while opportunities to reduce other hardware and soft costs remain. But where are these opportunities, is a step-change in thinking required to unlock the future cost reductions.

How to grow markets to efficient cost levels rapidly and reduce perceived risk and financing costs: With solar PV deployment still far too narrow compared to the resource potential, a handful of countries still dominate solar PV deployment. How do we accelerate new markets as rapidly as possible to efficient cost levels that provide proof to policy makers that support policies work and are efficient? Hand-in-hand with this growth, how do we ensure that perceived risks and financing constraints don't result in high costs of capital which render the projects LCOE prohibitively expensive.

The joint IRENA / EU PVSEC Parallel Event to hear about recent research and work by IRENA and others into these critical issues facing the continued accelerated deployment of solar PV.

Programme Outline

IRENA
International Renewable Energy Agency

08:30 - 08:45

Welcome and Introduction

Dolf Gielen, Director of IRENA Innovation and Technology Centre, IRENA

08:45 - 09:10

The current Global PV Landcscape

Gaetan Masson, Becquerel Institute/IEA PVPS

09:10 - 10:25

The rapidly growing competitiveness of Solar PV

09:10 - 09:35

Renewable power generation costs, solar PV and fossil fuel costs: The new age of PV competitiveness

Michael Taylor, Senior Analyst, IRENA

09:35 - 10:00

The latest cost trends and cost distributions in the United States

Dan Getman, NREL (invited)

10:00 – 10:25

Cost variations in Italy by market segment

Riccardo Toxiri/Luca Benedetti, GSE, Italy

10:25 - 11:15

Future technology performance improvements and cost reduction opportunities

10:25 – 10:50

Solar PV costs in Africa and cost reduction opportunities: Our best hope for widespread electrification

Eun Young So, Analyst, IRENA Innovation and Technology Centre

10:50 - 11:15

The long-term outlook for solar PV costs

Christopher Kost, ISE Fraunhofer, Germany

11:15 - 12:05

How to grow markets to efficient cost levels rapidly and reduce perceived risk and financing costs

11:15 – 11:40

A virtual marketplace for RE projects: A project facilitation platform

Henning Wuester, Director, IRENA

11:40 - 12:05

The role of the Government in developing markets

Representative from West Africa or South Africa (tbc)

12:05 - 12:30

Panel Discussion

Are we really on track to broaden and deepen solar PV markets?

Moderation:
Dolf Gielen, Director of IRENA Innovation and Technology Centre, IRENA

Panellists: All speakers

PHOTOVOLTAICS | FORMS | LANDSCAPES

Beauty and power of designed Photovoltaics

jointly with the European Commission, DG JRC, ENEA and ETA-Florence Renewable Energies

Day: **Wednesday, 16 September 2015**
Time: **14:00 - 18:00**
Site: **2nd floor, Auditorium Hall D**
Access: **Open to all registered Conference participants of the EU PVSEC 2015**

The fifth edition of the Special Session Photovoltaics | Forms | Landscapes will take place on Wednesday, 16 September 2015 within the framework of 31st European Photovoltaic Solar Energy Conference and Exhibition in Hamburg, Germany.

This Conference is the largest event in the world addressing science, technology, engineering and policies of photovoltaic solar energy.

The target audience present at this conference, about 4000 scientists, engineers, entrepreneurs, financing organisations and political decision makers, is not readily aware of the opportunities and specific features photovoltaics offers. This new energy system continuously becomes more visible in our daily life and can easily be reinforced by design.

In the upcoming 5th edition, the organizers of the event want to extend the visions presented towards the opportunity of demonstrating the “Beauty and Power of Designed photovoltaics ”. Internationally-renowned researchers, producers, architects and landscape designers present their concepts for making photovoltaic systems a new cultural experience which enhances the relationship between the citizens and the energy environment.

etaflorence renewableenergies

With the rising number of photovoltaic installations used on building roofs and as integrated systems in the urban environment or as large fields, the acceptance by the citizens becomes an increasing issue and in the case of larger installations, also an issue with authorities.

Emphasis is also given to designs which foster further cost reduction and which add value to the systems such as:

- double function of photovoltaic modules (such as isolation or heat recovery);
- building integration (such as modules as building material, integral part of the building construction)
- visibility and “vivibility” of urban spaces (shading, weather protection)
- upgrade of open spaces and landscape (higher agricultural yield, reduction of soil degradation, water collection, industrial or transport infrastructures)

The event is co-organised by the European Commission, Joint Research Centre (JRC), ENEA, the Italian National Agency for New Technologies, Energy and Sustainable Economic Development and ETA-Florence Renewable Energies.

www.pv-landscapes.com

PV CROPS: NOVEL SOLUTIONS FOR A HIGH PV PENETRATION IN EU ELECTRICAL NETWORKS WITH LOWER LCOE

Beauty and power of designed Photovoltaics

jointly with PVCROPS consortium

Day: **Thursday, 17 September 2015**
Time: **13:20 – 18:30**
Site: **2nd floor, Auditorium Hall D**
Access: **Open to all registered Conference participants of the EU PVSEC 2015**

PVCROPS is a European funded project (Seventh framework program).

The acronym means: PhotoVoltaic Cost r€duction, Reliability,Operational performance, Prediction and Simulation.

The 2 main objectives of the project are:

- Reduction of 30% the LCoE of PV generation to achieve 0.14 – 0.07 €/kWh by 2020 and 0.20 – 0.09 €/kWh by 2015 and increase of 9% of the performance ratio of PV systems
- Enhancement of the grid integration of PV by mitigating PV power fluctuations and integrating energy management and storage to allow 30% of PV penetration by 2020

PVCROPS has 5 different fields of work:

- Modelisation, design optimization and simulation (early steps of PV system)
- Prediction of systems output regarding local weather and system behavior
- Integration of energy management and storage strategies
- Monitoring, real-time follow-up and advanced diagnoses of performance
- Hardware, software and contractual solutions for field and laboratory testing

www.pvcrops.eu

Programme Outline

13:20
Welcome
Prof. Luis Narvarte (UPM) – Coordinator of the PVCROPS project

13:30 - 14:20

Prediction of photovoltaic power
- **Prediction of PV energy production**
- **Prediction of PV power fluctuations**
- **PROPHET - Open toolbox for PV prediction: demonstration**

Prof. Luis Narvarte (UPM), Javier Marcos (UPNA)

14:20 - 15:00

Integration of batteries for the management of PV energy (I) Energy management strategies and sizing of batteries

Dr. Iñigo de la Parra (UPNA)

15:00 - 15:15 **Coffee break**

15:15 - 16:00

Integration of batteries for the management of PV energy (II)
- **Demonstrators of Li-ion and Vanadium Redox Batteries**
- **New hardware for the PV energy management**

Tomás Fartaria and Luis Fialho (U. Evora), Roberto González (INGETEAM)

16:00 - 16:45

Tools for the automatic detection of performance failures

- **Detection of performance failures**
  - **Analysis of the performance of BIPV in Europe**
  - **Novel solutions for the automatic detection of performance failures**
  - **Demonstration of Web services for the detection of performance failures**
- **Accurate low cost solar irradiation data**
  - **BIPV as solar irradiation sensors**
  - **SOWEDA - A free real-time irradiation map for Europe**
- **RTONE: services of monitoring and performance analysis of PV systems**

Jonathan Leloux (WEBPV) and Adrien Desportes (RTONE)

16:45 - 17:00 **Coffee break**

17:00 - 18:30

Quality control procedures for the bankability of PV plants: Software and Hardware solutions
- **Quality control procedures for contractual frameworks: reducing the uncertainty and assigning responsibilities.**
- **Acceptance criteria for quality issues such as hot spots.**
- **SISIFO - Open-source tool for the simulation of PV systems: demonstration and links with quality control procedures**
- **Hardware for field testing**
  - **Irradiance and cell temperature sensors for reducing the uncertainty**
  - **Real Sun testing of PV modules**
  - **2 MW capacity charge**
  - **Open-Drones for hot spots**

Prof Eduardo Lorenzo (UPM), Francisco Martínez (UPM) and Nikolay Tyutyundzhiev (CLSENES)

18.30 **Closure**

GENERAL INFORMATION

For more information please refer to
www.photovoltaic-conference.com/general-information

GENERAL INFORMATION

VENUE OF EU PVSEC 2015

CCH – Congress Centre and International Fair Hamburg
Am Dammtor / Marseiller Straße
20357 Hamburg
Germany

Telephone : +49 40 3569-0
Web: www.cch.de

For detailed Travel and Transport Information please visit
www.photovoltaic-conference.com/general-information

Find here a general overview of the EU PVSEC 2015 ticketing categories and registration benefits:

EU PVSEC 2015 Registration Benefits

Registration Category	Conference Sessions	Parallel Events	Exhibition	Information Material	Proceedings	EU PVSEC Dinner	Networking Lunch	Welcome Reception
Full Conference week	✓	✓	✓	✓	✓			✓
One Day Admission *	✓	✓	✓	✓	✓			✓
Two Days Admission *	✓	✓	✓	✓	✓			✓
Students	✓	✓	✓	✓	✓			✓
Networking Lunch (from Mon - Thu)							✓	
EU PVSEC Dinner (Wednesday)						✓		
Exhibition Visitor Tickets			✓					✓

* on registered day/s only

ACCESS

EU PVSEC Conference

Upon arrival at CCH Hamburg, Conference participants should proceed to the Conference Registration Desk at the main entrance to check in and pick up their badge.

Opening hours of the Conference Registration Desk:

Sun	13 Sept 2015	16:00 – 18:00
Mon	14 Sept 2015	07:30 – 19:00
Tue – Thu	15 - 17 Sept 2015	08:00 – 19:00
Fri	18 Sept 2015	08:00 – 09:30

Conference Badge

Your personalised Conference badge authorises you to visit:

- all EU PVSEC Conference Sessions
- all EU PVSEC Parallel Events
- the EU PVSEC Industry Exhibition

on day/s registered.

Kindly note, that your badge is not transferable to another person. We ask for your understanding that your personalised admission might be controlled by our staff. In case of loss or find a badge, please inform our staff immediately. Kindly note that lost badges cannot be replaced.

EU PVSEC Industry Exhibition

The Exhibition is open to Conference Delegates, on day/s registered.

Opening hours are from:

Tue – Thu	15 – 17 Sept 2015	09:00 to 18:00

EU PVSEC Parallel Events

All EU PVSEC Parallel Events are open to Conference Delegates on day/s registered.

For further information about the EU PVSEC Parallel Events see page 277)

CONFERENCE PROCEEDINGS

The EU PVSEC 2015 Proceedings contain all scientific papers presented at the EU PVSEC 2015 and submitted for publication.

They constitute a comprehensive source of state-of-the-art information and vital point of reference for researchers, technologists, decision-makers, entrepreneurs and all involved in the global PV sector.

The EU PVSEC 2015 Proceedings include full presented papers, slides presentations and poster presentations (if available).

A digital identifier (DOI code) has been assigned to each paper to ensure unequivocal and permanent identification and citation capability of the online publication. This identification system is administered by the German National Library of Science and Technology.

Conference participants will have immediate and free access to the EU PVSEC 2015 Proceedings right after publication.

The EU PVSEC Proceedings are available on www.eupvsec-proceedings.com.

Authors are requested to submit their manuscript for publication in the Conference Proceedings (see page 310)

COOPERATION WITH 'PROGRESS IN PHOTOVOLTAICS'

After a peer review process, a selected number of the highest ranked papers from every Conference subject will be published - in addition to the EU PVSEC Proceedings 2015 - on the website and in a digital special issue of the renowned scientific journal 'Progress in Photovoltaics'.

GENERAL INFORMATION

PRIZES & AWARDS

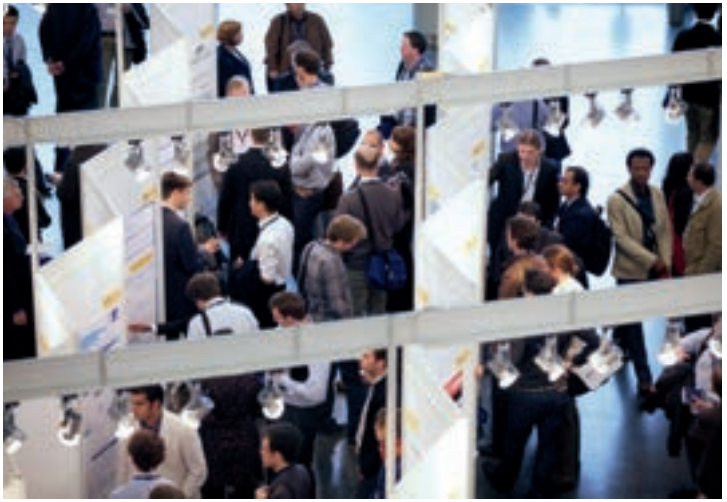
European Becquerel Prize for Outstanding Merits in Photovoltaics

The European Becquerel Prize for Outstanding Merits in Photovoltaics will be awarded during the Conference. This prize was established by the European Commission in 1989 to mark the 150th anniversary of Alexandre-Edmond Becquerel's discovery of the photovoltaic effect in 1839, which laid the foundation of both, photovoltaics and photography. The Becquerel Prize will be awarded on Monday, 14 Sept. 2015 during the Opening Ceremony in the Main Auditorium Hall 3.

Awards for Outstanding Visual Presentations

This award is one of the highlights of the Closing Session: The most outstanding Visual Presentations of each topic (Topic 1 to 7) will be awarded.

A jury of experts judges the quality of the contents reported and the quality of the presentation. The awards will be announced and delivered as part of the Conference Closing on Friday, 18 September 2015. The winners will be invited on stage and the winning posters will be projected in the Auditorium.



INFORMATION

EU PVSEC Student Awards

Following the success of previous years and to encourage high-quality work among young researchers, the EU PVSEC Student Awards will be delivered in recognition of the most remarkable and outstanding research work in the field of PV on the occasion of the EU PVSEC 2015.

37 applications for the EU PVSEC Student Awards have been received. They have been reviewed and scored by the international Scientific Committee, made up of more than 200 leading research and industry experts from the global PV community.

The prizes will be awarded during the Conference Closing Session on Friday, 18 September 2015.

Take the chance to attend the presentation of their outstanding work in the following Oral sessions:

Monday, 14th September 2015, 15:15

1AO.2.3 Fast Current Mapping of Photovoltaic Devices Using Compressive Sampling
G. Koutsourakis, X. Wu, M. Bliss, T.R. Betts & R. Gottschalg
Loughborough University, United Kingdom
M. Cashmore & S.R. Hall
National Physics Laboratory, London, United Kingdom

3AO.5.4 10.1% Efficiency Cu2ZnSnSe4 Solar Cells through a Novel Absorber Engineering with Ge Optimizing the Open Circuit Voltage
S. Giraldo, M. Neuschitzer, S. López-Marino, Y. Sánchez, M. Colina, M. Placidi, P. Pistor, V. Izquierdo-Roca, A. Perez-Rodriguez & E. Saucedo
IREC, Barcelona, Spain

Tuesday, 15th September 2015, 13:30

3BO.6.1 Kelvin Probe Force Microscopy Study of Electric Field Homogeneity in Epitaxial Silicon Solar Cells Cross-Section under Illumination and Voltage Bias
P. Narchi & P. Prod'homme
TOTAL, Paris la Defense, France
G. Picardi, R. Cariou, M. Foldyna & P. Roca i Cabarrocas
CNRS, Palaiseau, France

4BO.10.6 Simulated and Experimental Performance of High Efficiency GaInNAsSb Solar Cells
A. Aho, A. Tukiainen, V. Polojärvi, T. Aho, M. Raappana, R. Isoaho & M. Guina
Tampere University of Technology, Finland

Wednesday, 16th September 2015, 08:30

5CO.13.4 Evaluation of Uncertainty in Electroluminescence Imaging of PV Devices due to Optical and Perspective Distortions
K. Bedrich, M. Bliss, T.R. Betts & R. Gottschalg
Loughborough University, United Kingdom

Thursday, 17th September 2015, 13:30

2DO.2.2 Optimized Metal Free Back Reflectors for High Efficiency Open Rear c-Si Solar Cells
A. Ingenito, O. Isabella & M. Zeman
Delft University of Technology, Netherlands
S. Luxembourg, P. Spinelli & A.W. Weeber
ECN, Petten, Netherlands

7DO.14.2 Case Study of a Low-Voltage Distribution Grid with High PV Penetration in Germany and Simulation Analyses of Cost-Effective Measures
F. Carigiet & F. Baumgartner
Zurich University of Applied Sciences, Winterthur, Switzerland
M. Niedrist & C. Scheuermann
EKS, Schaffhausen, Switzerland

Thursday, 17th September 2015, 15:15

6DO.7.2 The Role of Solar PV in the Long-Term Sustainability of the Finnish Energy System
M. Child & C. Breyer
Lappeenranta University of Technology, Finland
T. Haukkala
Aalto University, Finland

* EU PVSEC Student Award Winner
Above programme may be subject to adaptation.

NETWORKING

Coffee Breaks (for Conference Delegates)

Coffee Breaks are included in the Conference fee. Coffee, tea, water and pastries will be served in the Conference breaks in front of the Main Auditorium Hall 3.

Catering / Restaurants

A special dedicated Networking Lunch could be booked prior to the event. Tickets are not available on-site. The Networking Lunch will be served in Felini Restaurant in the Radisson Hotel. For those who did not include Networking Lunch tickets in their registration, there is a wide range of cafés and restaurants around CCH and numerous snack bars in the Exhibition Hall H.

Welcome Reception

On Tuesday, 15 September, there will be a Welcome Reception for all Conference and Exhibition participants, from 18:30 in the exhibition hall H. Come and meet your colleagues of the PV community and celebrate the EU PVSEC 2015 as a major networking platform for the global PV Solar sector.

EU PVSEC Dinner

Wednesday, 16 September 2015, 19:30 - 22:30

Without any doubt – the most famous part of the City of Hamburg is its harbor. The most famous part of the harbor is the historical ware-house district.

This year's EU PVSEC Dinner will take place in an extraordinary loft within this fascinating area.

Enjoy an excellent dinner and fine drinks together with PV experts from all over the world. Enjoy the ambience of the historic Hamburg, while having excellent networking opportunities or just having a good time at a one of its kind location.

GENERAL INFORMATION

Networking Lunch

A networking lunch will be available for interested delegates from Monday to Thursday, 14 - 17 September, in the Felini Restaurant in the Radisson Hotel, which is directly adjoint to the CCH. This avoids queueing up in lunch periods and provides a networking environment. The networking lunch will be served in buffet style, and is convenient for both meat lovers and vegetarians. Tickets were available until 31 August 2015 (subject to availability). Tickets will not be sold on-site. Access to the networking lunch in Felini Restaurant will be granted upon presentation of a lunch voucher which you will receive at the registration desk on-site along with your registration documents. Lost tickets will not be replaced..

INFORMATION

SERVICES

EU PVSEC Personal Programme Planner

We recommend using the EU PVSEC Personal Programme Planner in order to most successfully schedule your EU PVSEC week.

The EU PVSEC Personal Programme Planner provides a quick and detailed general synopsis of all events, sessions and presentations of the EU PVSEC 2015. It provides targeted search e.g. by speakers, organisations, topics, product categories, keywords, time and location.

Create your personal, clearly laid out agenda. See at a glance where and when your chosen presentations / sessions take place and get detailed information about the respective topics. You may save and modify your agenda at any time.

Please use the online version at www.eupvsec-planner.com, or the mobile version at www.mobile.eupvsec-planner.com.

The mobile version is web-based and can be used by all kinds of smartphones. All you need is your smartphone's browser and internet connection.

Jobs4PV – EU PVSEC Job Platform 2015

Recruiting new talents is crucial for the PV Industry. Jobs4PV is a service organised by EU PVSEC within the EU PVSEC 2015 and is addressed to Conference delegates, exhibitors and visitors in order to help potential employers and employees to meet and to exchange relevant information.

Jobs4PV is accessible on www.photovoltaic-conference.com and showcases job offers from exhibitors of the EU PVSEC 2015.

You will also find Jobs4PV represented at the Exhibition site, where job offers will be posted on the job wall. Please feel free to pin up your printed job offers onto the on-site Jobs4PV job wall.

Press Centre

A fully-equipped press centre is at the disposal of press and media representatives throughout the event. Computers, free internet access, background information and press kits are available. The Press Centre is located in room 36 right next to the registration desks.

The official Press Conference is scheduled to take place on Monday, 14 September at 12:45.

INSTRUCTIONS FOR AUTHORS AND PRESENTERS

Plenary / Oral Presentations

Speakers of Plenary and Oral presentations **hand in their presentation/s at the Presenters' Desk** (room 18/19 next to registration desks). A technician will control the correct functionality and transfer the presentation to the respective auditorium. Further details regarding Plenary/Oral Presentations can be found in the *Notes for Authors* available on the EU PVSEC website.

Opening hours of Presenters' Desk
(room 18/19 next to registration desks)

Sun	14 Sept 2015	14:00 – 18:30
Mon	15 Sept 2015	07:30 – 18:30
Tue – Thu	16 – 17 Sept 2015	08:00 – 18:30
Fri	18 Sept 2015	08:00 – 12:00

Speakers and Chairpersons of Plenary and Oral sessions **meet 15 minutes prior to the start of their session** in the respective auditorium in order to be briefed and to become acquainted with audio-visual aids.

Visual Presentations

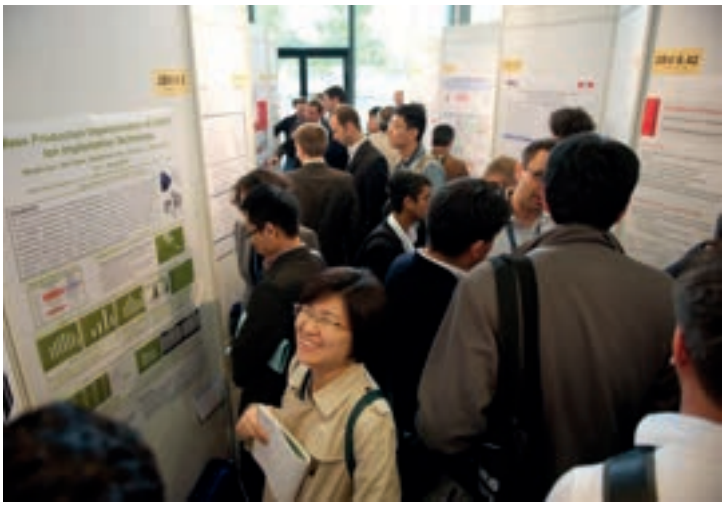
Authors of Visual presentations are requested to **set up their posters** on the allotted boards as early as possible on **Monday morning, 14 September** and to take them down on **Thursday, 17 September, after the last session at 18:30**. All Visual presentations should be presented through the full 4 days from Monday to Thursday in the Poster Area. Please find all detailed guidelines in the *Notes for Authors of Visual Presentations*.

Authors of posters are requested t**o be in situ at their posters at the session time** indicated in the Programme Brochure, in order to present their paper to the audience and to create a Q&A session.

In order to be **published in the EU PVSEC 2015 Proceedings**, authors need to **deliver their manuscript at the Delivery of Manuscripts Desk** (room 18/19). If the manuscript is not delivered during the Conference, your paper cannot be published in the Proceedings. The *Instructions for Preparation of Papers* are available for download on the EU PVSEC website.

Opening hours of the Delivery of Manuscripts Desk
(room 18/19):

Sun	13 Sept 2015	14:00 – 18:30
Mon – Thu	14 – 17 Sept 2015	08:00 – 18:30



INSURANCE

The organiser cannot be held responsible for injury to Conference attendees or for damage to or loss of their personal belongings, regardless of cause.

Attendees are advised to make their own insurance arrangements.

ACKNOWLEDGEMENTS

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ACKNOWLEDGEMENTS

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ACKNOWLEDGEMENTS

INSTITUTIONAL SUPPORT

With the support of UNESCO's Natural Sciences Sector

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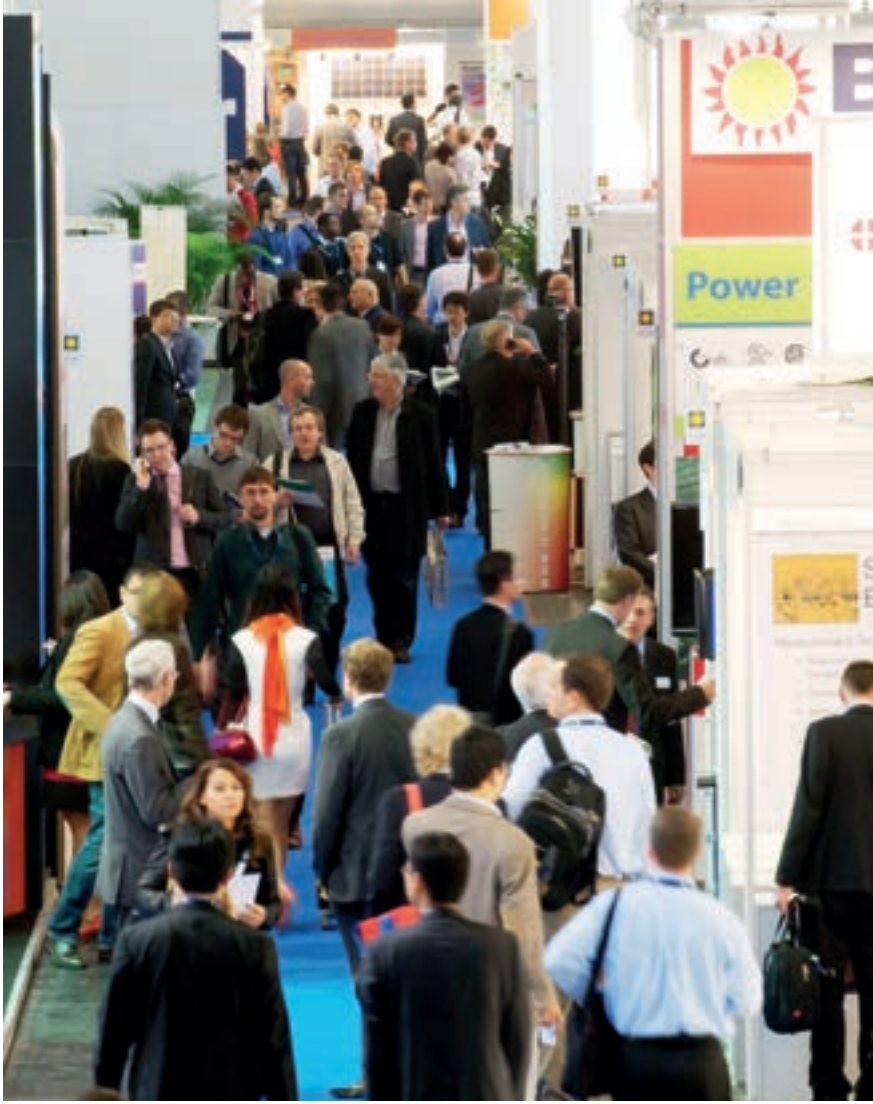

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Jonas & Redmann is an automation specialist with extensive expertise in the fields of handling technology, factory automation, measurement systems and process chain integration. With a focus on enabling the most reliable production processes, JR has implemented a wide variety of customer-specific solutions over the past decades. Successful projects with major solar and battery cell manufacturers across the world have led to the development of groundbreaking automation and production technologies.

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Highly accurate measurement of solar irradiance is very important in Photovoltaics. It is a key input to monitor the efficiency and performance of an installed PV system. Kipp & Zonen is the world-wide specialist in the measurement of solar irradiance and offers a range of instruments for the measurement of global, diffuse and direct solar radiation. From the world class CMP 22 pyranometer to the smart range with Modbus® interface, we offer a solution for every requirement.

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LayTec is a major provider of integrated metrology for thin-film deposition and other high value generating processes. LayTec's equipment is used in a broad range of applications like optoelectronics, electronics, PV, displays, optics and photonics, SEMI and flash memory production, automotive industry and others.

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G. LUFFT Mess- und Regeltechnik has been dealing with the production of climatological measuring equipment since its foundation by Gotthilf Lufft in 1881. Their innovative products are used world widely. Besides measuring atmospheric pressure, temperature, relative humidity and other factors, several all-in-one weather sensors perfect for photovoltaic plant monitoring are offered in different quality levels, such as Secondary Standard. Furthermore we are certified according to DIN EN ISO 900.

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Luvata is a world leader in metal solutions manufacturing and related engineering services. Luvata's solutions are used in industries such as renewable energy, power generation, automotive, medicine, air-conditioning, industrial refrigeration, and consumer products. The company's continued success is attributed to its longevity, technological excellence and strategy of building partnerships beyond metals. Employing over 6,300 staff in 18 countries, Luvata works in partnership with customers.

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M10 Industries develops and manufactures facilities for photovoltaic automation, which are characterised by maximum efficiency and performance. For the latest Stringer generation KUBUS the company once again consistently relies on German manufacturing. The high-performance Stringer achieved a productivity of 5,000 cells per hour and thus aligns soldering technology for crystalline solar cells with major industrial standards for the first time.

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Meco is a world leading manufacturer of equipment for plating equipment for semiconductor and PV industry. Our plating equipment is used for Cu plating (metallization) of high efficiency silicon solar cells (Back Contact IBC, heterojunction, bifacial, n-type and p-type cells). For thin film CIS and CIGS cells we provide plating equipment for low-cost deposition of Copper-Indium or Copper-Indium-Gallium layers.

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SolarPower Europe, the new EPIA (European Photovoltaic Industry Association), is a member-led association representing organisations active along the whole value chain. Our aim is to shape the regulatory environment and enhance business opportunities for solar power in Europe.

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SoLayTec is a spin-off company of the Dutch research organisation TNO and established in 2010. The company develops, delivers and services machines for atomic layer deposition (ALD) on solar cells worldwide. The SoLayTec ALD machines are designed for mass production in the solar market. In the field of solar cell ALD equipment, SoLayTec has a leading position.

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Solliance is a partnership of R&D organizations from the Netherlands, Belgium and Germany working in thin film photovoltaic solar energy, including 250 researchers from ECN, imec, TNO, Holst Centre, TU/e, Forschungszentrum Jülich, University Hasselt and Delft University. Various laboratories and pilot production lines are jointly used in cooperation with the industry. Solliance offers participation in its research programs and opens up its lab facilities to industry and research organizations.

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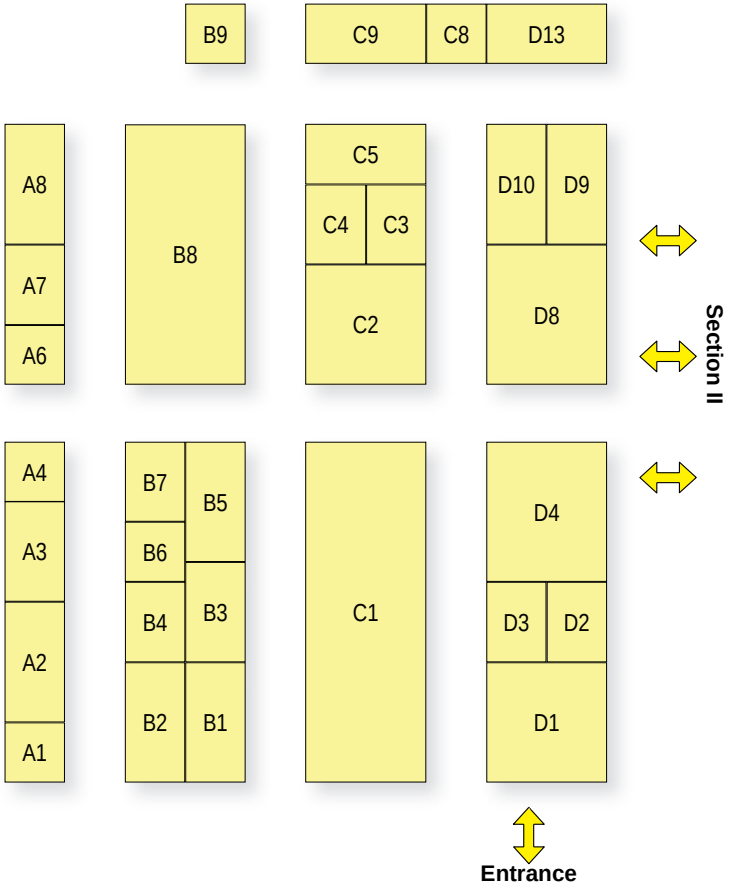

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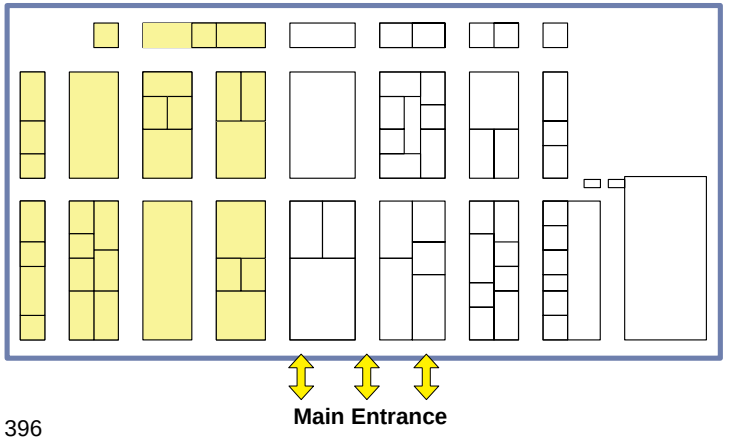
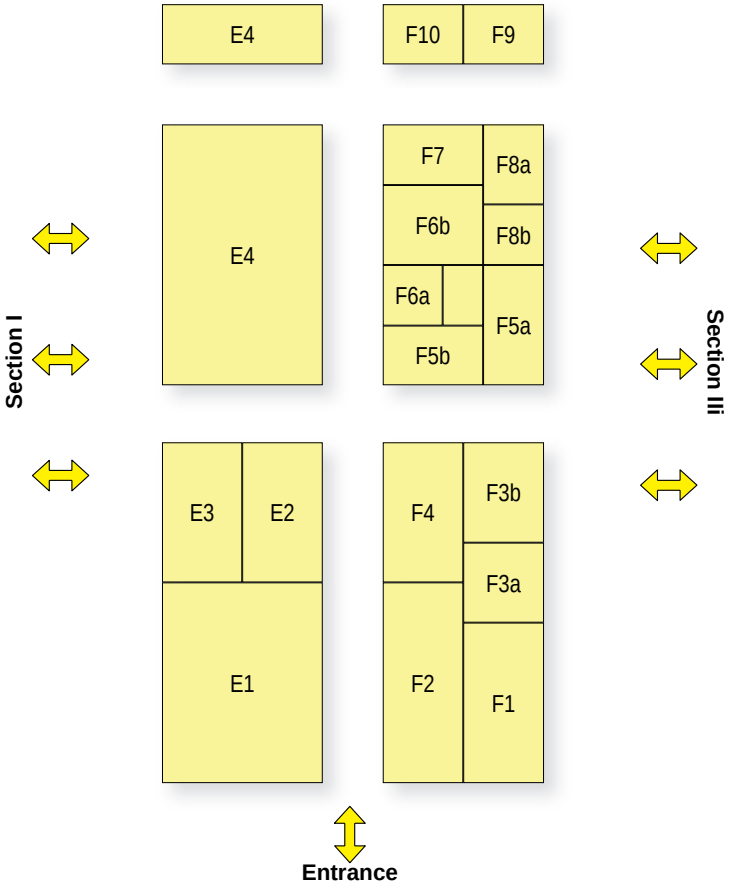


A1	Evans Analytical Group
A2	Institute for Energy Technology
A3	Ming Hwei Energy Co., Ltd.
A4	pv-tools GmbH
A6	Lamers High Tech Systems
A7	M10 Industries AG
A8	NGK Insulators
B1	centrotherm photovoltaics AG
B2	Engineered Materials Systems, Inc.
B3	pv magazine group
B4	Solarbe.com & Shine Magazine
B5	h.a.l.m. elektronik
B6	EUREC
B7	Endeas Oy
B8	Berlin-Brandenburg Energy Network e.V.
B8	Envaris GmbH
B8	greateyes GmbH
B8	Helmholtz-Zentrum Berlin für Materialien und Energie
B8	SOLARC Innovative Solarprodukte GmbH
B8	Valentin Software GmbH
B9	IHT
C1	InnoLas Solutions GmbH
C1	Jonas & Redmann Group GmbH
C1	LayTec
C1	Meyer Burger Global Ltd.
C1	SOLARUNITED
C2	SoLayTec
C2	Tempress Systems
C3	Photovoltaics International / PV-Tech
C4	Wiley
C5	Aescusoft GmbH Automation
C8	Solarthemen - Guido Bröer & Andreas Witt GbR
C9	LPKF SolarQuipment GmbH
D1	BERGER Lichttechnik GmbH & Co. KG
D2	Bentham Instruments Ltd.
D3	EKO Instruments Europe B.V.
D4	PHOENIX CONTACT Deutschland GmbH
D8	ASYS GmbH
D9	RENA Technologies GmbH
D10	EDWARDS
D13	Spitzenberger & Spies GmbH & Co. KG

Hall H, Section II



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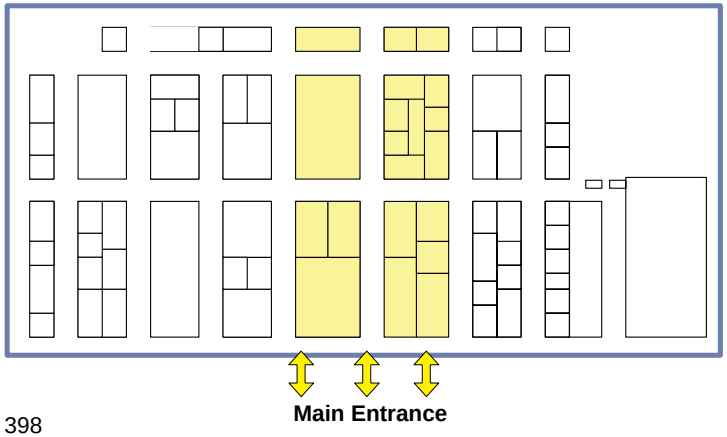
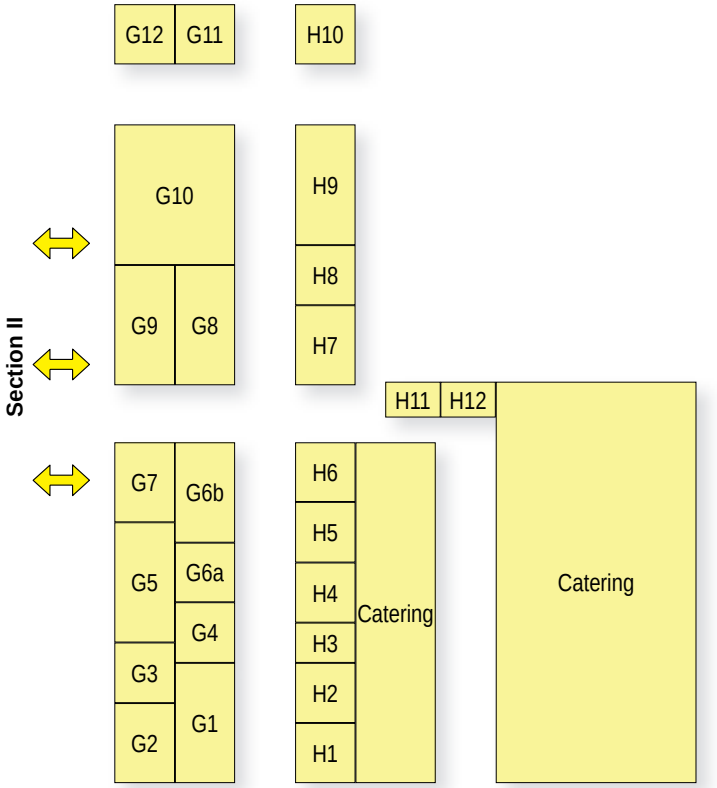


E1	SINGULUS TECHNOLOGIES AG
E2	Rehm Thermal Systems GmbH
E3	ECN Solar Energy
E3	imec
E3	Solliance
E4	3D-Micromac AG
E4	AIS Automation Dresden GmbH
E4	Freiberg Instruments
E4	Loser Chemie GmbH
E4	PIBAS SERVICE GmbH
E4	SENTECH
E4	SiC Processing Deutschland GmbH
E4	Solarvalley Mitteldeutschland e.V.
E4	SURAGUS GmbH
E4	Wirtschaftsförderung Sachsen GmbH
F1	ISC Konstanz e.V.
F2	European Commission, DG JRC Joint Research Centre
F3a	Bruker-Spaleck GmbH
F3b	ISRA VISION / GP SOLAR
F4	Heraeus Photovoltaics Business Unit
F5a	MacDermid Photovoltaics Solutions
F5b	VON ARDENNE GmbH
F6a	Aristotle University - LAB LTFN
F6a	Organic Electronic Technologies P.C. (OET)
F6b	ETA - Florence Renewable Energies
F6b	WIP Renewable Energies
F7	Ecoprogetti S.r.l.
F8a	Zhejiang Kingdom Solar Energy Technic Co.,Ltd.
F8b	Kyoshin Electric (KOPEL) Co., Ltd.
F9	Newport Spectra-Physics GmbH
F10	Optosolar GmbH

Hall H, Section III



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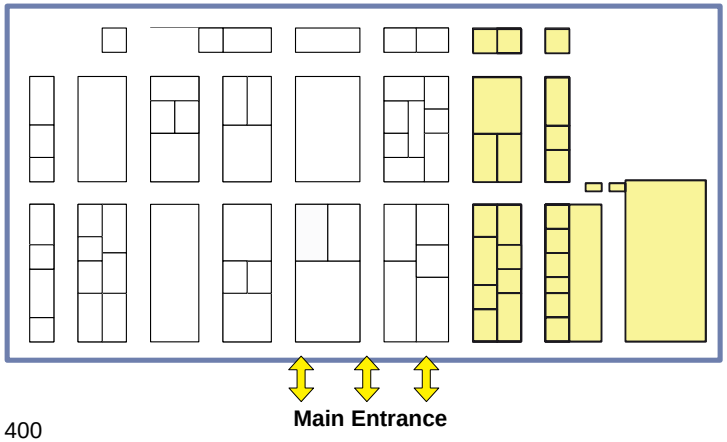


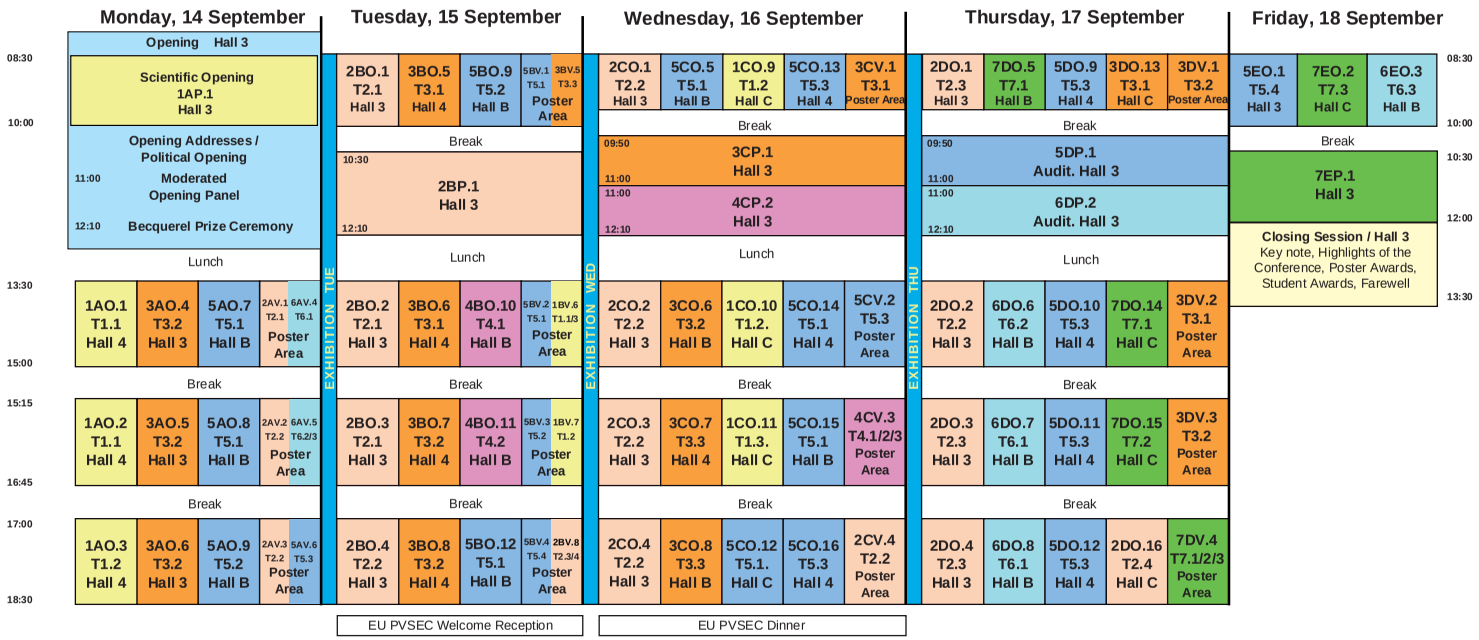
G1	Sinton Instruments
G2	OAI
G3	Kipp & Zonen
G4	African Renewable Energy Alliance - AREA
G5	Sun & Wind Energy
G6a	Shaoxing City Solarcom Solar Equipment Co., Ltd.
G6b	Ulbrich Solar Technologies Inc.
G7	ZSW Zentrum für Sonnenenergie- und Wasserstoff- Forschung Baden-Württemberg
G8	Meco Equipment Engineers B.V.
G9	Sika AG
G10	SolarPower Europe
G11	Abet Technologies, Inc.
G12	Lufft Mess- und Regeltechnik GmbH
H1	EBARA Precision Machinery Europe GmbH
H2	Luvata
H3	WEP
H4	SUPSI ISAAC
H5	Hukseflux Thermal Sensors
H6	IEA PVPS International Energy Agency Photovoltaic Power Systems Programme
H7	InfraTec GmbH Infrarotsensorik und Messtechnik
H8	HBL Germany GmbH
H9	SEMILAB Semiconductor Physics Laboratory Co., Ltd.
H10	Standa Ltd.
H11	PHOTON Publishing GmbH
H12	Jobs4PV

PLENARY SESSIONS **Page**

ORAL SESSIONS . . . . . Page

VISUAL SESSION **Page**

Conference Programme Outline



Topics / Subtopics

1 New Materials and Concepts for Solar Cells and Modules
- T1.1 Fundamental Material Studies
- T1.2 New Materials and Concepts for Cells
- T1.3 New Materials and Concepts for Modules

2 Wafer-Based Silicon Solar Cells and Materials Technology
- T2.1 Silicon Feedstock, Crystallisation and Wafering
- T2.2 Silicon Solar Cell Improvements
- T2.3 Silicon Solar Cell Characterisation and Modelling
- T2.4 Manufacturing Issues and Processing

3 Thin Film Solar Cells and Modules
- T3.1 Silicon-based Thin Film and Silicon-Heterojunction Solar Cells and Modules
- T3.2 CdTe, CIS and Related Ternary and Quaternary Thin Film Solar Cells and Modules
- T3.3 Perovskites, Organic PV and hybrid devices

4 Solar Cells / Assemblies / Modules for Terrestrial Concentrator Systems and for Space Solar Generators
- T4.1 III-V-based Multi-junction Solar Cells, Concentrator Solar Cells and Space Solar Cells
- T4.2 Terrestrial Concentrator Systems
- T4.3 Solar Generators for Space Missions

5 Operations, Performance and Reliability of Photovoltaics (from Cells to Systems)
- T5.1 Operation of PV Systems and Plants
- T5.2 Balance of System Components
- T5.3 PV Modules
- T5.4 Quality and Sustainability in Manufacturing and Recycling

6 PV Applications
- T6.1 PV as Part of the Energy System
- T6.2 PV in Architecture and as Building Material
- T6.3 PV Applications Without a Centralised Grid

7 PV - A Major Electricity Source
- T7.1 PV in the Electricity Markets
- T7.2 PV Business Opportunities
- T7.3 PV Globalisation, Policies and Administrative Issues

Session Code

1 A P .1

Day Codes	Session Type	Session Number
A Monday, 14 September	P Plenary Session	
B Tuesday, 15 September	O Oral Session	
C Wednesday, 16 September	V Visual Session	
D Thursday, 17 September		
E Friday, 18 September		

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