EU PVSEC 2016

32nd European Photovoltaic Solar Energy Conference and Exhibition

The Innovation Platform for the global PV Solar Sector

Programme

20 - 24 JUNE 2016
MUNICH, GERMANY
ICM - International Congress Center Munich

Co-located with inter solar EUROPE

www.photovoltaic-conference.com

INSTITUTIONAL SUPPORT

European Commission

With the support of UNESCO's Natural Sciences Sector

United Nations Educational, Scientific and Cultural Organization

WCRE – World Council for Renewable Energy

COORDINATION OF THE TECHNICAL PROGRAMME

JOINT RESEARCH CENTRE
The European Commission's in-house science service

INSTITUTIONAL PV INDUSTRY COOPERATION

SOLARUNITED
GLOBAL SOLAR BUSINESS & TECHNOLOGY ASSOCIATION

SolarPower Europe

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The content represents the status as of 7 June 2016

CHAIRMAN'S MESSAGE

Key role of PV forecasted in all major future energy scenarios

The EU PVSEC 2016, the 32nd edition of the European Photovoltaic Energy Conference and Exhibition, offers you an excellent opportunity to absorb, update and discuss the most recent and relevant developments in photovoltaics. We are honoured to host this world class event this year in Munich, Germany, from 20-24 June, 2016, co-located with Intersolar Europe.

Of course it is not just about great conference location and facilities. All major future energy scenarios forecast a key role for photovoltaic solar energy. Further, the COP21's overarching goal from Paris last year to reduce greenhouse gas emissions and to limit the global temperature increase clearly showed that expectations and projections for PV are high. PV has a huge European and global potential, making it an important building block for cost-competitive, secure and sustainable energy systems. PV has just reached 1% of global annual electricity supply but has harnessed only a small fraction of its vast potential. PV deployment could be accelerated by further enhancing light-to-power conversion efficiency, and reducing module and system prices as well as grid-integration bottlenecks. After a difficult period in the PV sector over the past few years, we may expect a strong revival in the coming period. The sense of urgency for innovation is felt more than ever and global market conditions are improving. This also implies a huge challenge for the photovoltaic community.

Once again, the EU PVSEC 2016 continues to be the platform for a unique event to share the latest scientific, technical, financial, policy and market insights and developments. Have a close look to an impressive programme that offers each of you a variety of interesting topics and an opportunity to intensively learn, discuss and network.

I am very pleased to welcome you in Munich. I am sure the 32nd EU PVSEC will energize and inspire you in many ways.

Marko Topič
Chairman of European Technology & Innovation Platform Photovoltaics,
Conference General Chairman

MESSAGE FROM THE TECHNICAL PROGRAMME CHAIR

A very warm welcome to EU PVSEC 2016! Again this year we've had a great response from the PV research community, with over 1200 abstracts submitted. Thanks to you all, and to my colleagues on 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.

We're also pleased to host the award ceremony for the Becquerel prize, given in recognition of an outstanding contribution to the field of photovoltaics and supported by the European Commission.

Photovoltaic solar electricity has emerged as one of the few renewable technologies that can really impact our energy system and help meet the challenge to mitigate climate change. Moreover one of the exciting things about this field is how much technological potential still exists – we have pathways to improve performance and sustainability in all areas, as well as a technology mix that can be developed to meet a broad range consumer requirement and applications.

Against this background, the EU PVSEC programme aims to provide you with insights into cutting edge research both on existing photovoltaic technologies as well as on innovative concepts. I look forward to a stimulating week and count on your active participation to presentations and discussions.

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

WELCOME

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, 20 June 2016

CONFERENCE OPENING

08:30 - 10:00 Scientific Opening

PLENARY SESSION 1AP.1

08:30 - 09:30 New Materials and Concepts for Solar Cells and Modules

Welcome:

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

Chairpersons:

A.W. Bett
Fraunhofer ISE, Germany

M. Rusu
HZB, Germany

1AP.1.1 ***Keynote Presentation***
37% Efficient One-Sun Minimodule and over 40% Efficient Concentrator Submodules
M.A. Green, M.J. Keevers, B. Concha-Ramon & J. Jiang
UNSW, Sydney, Australia
P.J. Verlinden, Y. Yang & X. Zhang
Trina Solar, Changzhou, China

1AP.1.2 ***Keynote Presentation:***
Innovative Approaches to Interconnect Back-Contact Cells
J. Govaerts, T. Borgers, E. Voroshazi, S. Jambaldinni, B. O'Sullivan, S. Singh, M. Debucquoy, J. Szlufcik & J. Poortmans
imec, Leuven, Belgium

1AP.1.3 **Decarbonisation in the Light of Paris COP 21 – Consequences and urgent first steps**
H. Lehmann
Federal Environment Agency of Germany, Dessau, Germany

PROGRAMME

10:00 - 11:00 Opening Addresses

- Professor Marko Topič
  Conference General Chairman
  Chairman European Technology & Innovation Platform Photovoltaics
- Message from the European Commission
- Claude Turmes, Member of the European Parliament; ITRE Committee and EUFORES President, Luxembourg
- Osman Benchikh
  Head of UNESCO's Renewable Energy Programme
  UNESCO Coordinator and Focal Point for UN-Energy

11:00 - 12:15 Moderated Opening Panel

Topic:

- Technology and Market Innovations for PV after Paris COP 21.

Moderator

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

Panelists:

- Marko Topic
  Chairman European Technology & Innovation Platform Photovoltaics
- Claude Turmes
  Member of the European Parliament; ITRE Committee and EUFORES President, Luxembourg
- Giovanni De Santi
  Director Institute for Energy and Transport JRC, European Commission
- Oliver Schäfer
  President SolarPower Europe, Board member Global Solar Council
- Eicke Weber
  Director Fraunhofer Institute for Solar Energy Systems, President EUREC - Association of European Renewable Energy Research Centres
- Patrick Hofer-Noser *(i)*
  CTO, Meyer Burger Technology, Switzerland

12:15 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, 20 JUNE 2016

PROGRAMME

ORAL PRESENTATIONS 1AO.1

13:30 - 15:00 Fundamental Characterisation, Theoretical and Modelling Studies

Chairpersons:

invited

invited

1AO.1.1 Fast Qualification Method for Thin Film Absorber Materials
L.W. Veldhuizen, Y. Kuang, D. Koushik & R.E.I. Schropp
Eindhoven University of Technology, The Netherlands
G. Adhyaksa & E. Garnett
FOM Institute AMOLF, Amsterdam, The Netherlands

1AO.1.2 Transient I-V Measurement Set-Up of Photovoltaic Laser Power Converters under Monochromatic Irradiance
S.K. Reichmuth, D. Vahle, M. de Boer, M. Mundus,
G. Siefer, A.W. Bett & H. Helmers
Fraunhofer ISE, Freiburg, Germany
C.E. Garza
Nanoscribe, Eggenstein-Leopoldshafen, Germany

1AO.1.3 Imaging of Terahertz Emission from Individual Subcells in Multi-Junction Solar Cells
S. Hamauchi, Y. Sakai, T. Umegaki, I. Kawayama,
H. Murakami & M. Tonouchi
Osaka University, Japan
A. Ito & H. Nakanishi
SCREEN, Kyoto, Japan

1AO.1.4 Simulation-Based Optimization for Solar Cells and Modules with Novel Silver Nanowire Transparent Electrodes
S. Altazin, R. Hiestand & M. Fontenlos
Fluxim, Winterthur, Switzerland
F. Pschenitzka
Cambrios Technologies, Sunnyvale, United States
B. Ruhstaller
ZHAW, Winterthur, Switzerland

1AO.1.5 EU PVSEC Student Award Winner Presentation
Different Electron and Hole Thermodynamics from Hot Carrier Solar Cell Modeling
F. Gibelli & J.-F. Guillemoles
CNRS, Chatou, France

1AO.1.6 Hot Carrier Solar Cell as Thermoelectric Device
I. Konovalov & V. Emelianov
University of Applied Sciences Jena, Germany

ORAL PRESENTATIONS 3AO.4

13:30 - 15:00 Special Session on CdTe and Kesterites

Chairpersons:

invited

A. Romeo
University of Verona, Italy

3AO.4.1 An Approach to High Efficient CdTe Solar Cells with Wide Spectral Response
L. Wu, L. Feng, J. Zhang, W. Wang, W. Li, H. Xu, C. Liu,
B. Li & G. Zeng
Sichuan University, Chengdu, China

3AO.4.2 The Impact of Oxygen Inlet during Close-Spaced Sublimation Process on the as-Deposited and Chlorine Treated Microstructure of CdTe Layers
D. Hirsch, O. Zywitzki, T. Modes, H. Morgner & C. Metzner
Fraunhofer FEP, Dresden, Germany
B. Späth & B. Siepchen
CTF Solar, Dresden, Germany

3AO.4.3 Sodium Induced Microstructural Changes in MOCVD Grown CdTe Thin Films
A. Amirkhalil, V. Barrioz, N.S. Beattie & G. Zoppi
Northumbria University, Newcastle upon Tyne, United Kingdom
S.J.C. Irvine
Glyndwr University, St Asaph, United Kingdom

3AO.4.4 Effects of Surface Etching, Sodium Incorporation and Solar Cell Post-Annealing Treatment on Cu2ZnSnS4 Solar Cells
G. Altamura, S. Temgoua, N. Naghavi & R. Bodeux
IPVF, Antony, France

3AO.4.5 Na and Ge Doping Effect on CZTS Absorber Cells Fabricated by Ink-Jet Printing, Study and Comparison with PVD
E. Bailo Bobi, B. Medina-Rodríguez, M. Blanes &
F.M. Ramos
FAE, Barcelona, Spain
M. Colina Brito, I. Becerril-Romero, L. Acebo, M. Placidi &
E. Saucedo
IREC, Barcelona, Spain
A. Cirera & A. Perez-Rodriguez
University of Barcelona, Spain

3AO.4.6 Improved Cu2ZnSnSe4 Solar Cell Properties by Bi-Directional Crystallization Strategy Assisted with Back/ Front Ge Nanolayers

S. Giraldo, M. Neuschitzer, M. Espindola-Rodriguez, P. Pistor, F. Oliva, V. Izquierdo-Roca, A. Perez-Rodriguez & E. Saucedo
IREC, Sant Adrià de Besòs, Spain
T. Thersleff & K. Leifer
Uppsala University, Sweden

ORAL PRESENTATIONS 5AO.7

13:30 - 15:00 Solar Resource Assessment

Chairpersons:

S. Tselepis
CRES, Greece

J. Remund
Meteotest, Switzerland

5AO.7.1 Performance Assessment of PV Power Plants by Satellite-Derived Solar Radiation and Modelled Meteorological Data

M. Suri, T. Cebecauer, A. Skoczek, B. Schnierer & N. Suriova
GeoModel Solar, Bratislava, Slovakia

5AO.7.2 Classifying 1 Minute Temporal Variability in Global and Direct Normal Irradiances within Each Hour from Ground-Based Measurements

M. Schroedter-Homscheidt, S. Jung & M. Kosmale
German Aerospace Center, Wessling, Germany

5AO.7.3 High Resolution Solar Radiation Database. Solar Atlas for South Africa

A. Gracia Amillo & T. Huld
European Commission, Ispra, Italy
L. Ntsangwane
South African Weather Service, Pretoria, South Africa
J. Trentmann
German Meteorological Service, Offenbach, Germany

5AO.7.4 Fast All-Sky Radiation Model for Solar Applications (FARMS): Mechanisms, Performance, and Applications

Y. Xie & M. Sengupta
NREL, Golden, United States

5AO.7.5 Preliminary Results of the Fifth International Spectroradiometer Comparison for Improved Solar Spectral Irradiance Measurements

R. Galleano & W. Zaaiman
European Commission DG JRC, Ispra, Italy
D. Alonso-Álvarez
Imperial College London, United Kingdom
A. Minuto
RSE, Milan, Italy
N. Ferretti
PI Berlin, Germany
R. Fucci
ENEA, Portici, Italy
M. Marzoli & L. Manni
SUPSI, Canobbio, Switzerland
M. Halwachs
AIT, Vienna, Austria
M. Friederichs
PV Lab Germany, Potsdam, Germany
F. Plag & D. Friedrich
PTB, Braunschweig, Germany
E.J. Haverkamp
Radboud University, Nijmegen, France

5AO.7.6 The Quality of Satellite-Based Irradiation Data for Operations and Asset Management

A. Woyte, K. de Brabandere, B. Sarr & M. Richter
3E, Brussels, Belgium

VISUAL PRESENTATIONS 2AV.1

13:30 - 15:00 Silicon Solar Cell Improvements and Innovation (I)

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

VISUAL PRESENTATIONS 6AV.4

13:30 - 15:00 Grid and Energy System Integration

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

ORAL PRESENTATIONS 1AO.2

15:15 - 16:45 Fundamental Materials Studies, their Characterization and Modelling

Chairpersons:

J.A.M. Van Roosmalen
ECN, The Netherlands

H. Shirai
Saitama University, Japan

1AO.2.1 Optical Evaluation of Multi-Wire Modules
K.R. McIntosh & M.D. Abbott
PV Lighthouse, Coledale, Australia
M. Edwards
UNSW, Sydney, Australia
R. Evans
Solinno, Sydney, Australia
Y. Yao
Meyer Burger, Gwatt, Switzerland

1AO.2.2 Influence of Efficient Back Reflectors on the Quantum Efficiency of Solar Cells
D.N. Micha
CEFET-RJ, Petrópolis, Brazil
A. Walker, G. Siefer, A.W. Bett & F. Dimroth
Fraunhofer ISE, Freiburg, Germany

1AO.2.3 Impact of Improved Thin Film PV Front Contact and Interconnect Dead-Zone
J. van Deelen & M. Barink
TNO, Eindhoven, The Netherlands

1AO.2.4 Efficient Luminescent Solar Concentrators Based on Self-Absorption Free, Tm2+ Doped Halides
O.M. ten Kate, M. De Jong, O.M. ten Kate & E. van der Kolk
Delft University of Technology, The Netherlands
K.W. Krämer
University of Berne, Switzerland

1AO.2.5 A Three Dimensional Phantom Node Method to Study Complex Crack Patterns in Photovoltaic Solar Cells
P.R. Budarapu & M. Paggi
IMT School of Advanced Studies, Lucca, Italy
J. Reinoso
University of Seville, Spain

1AO.2.6 Probing Stress Evolution and Fracture Mechanisms during Solar PV Module Integration/Assembly Using Synchrotron X-Ray Microdiffraction – Enabling Thin Silicon Technologies for Next Generation Solar PV Systems
A.S. Budiman, S.K. Tippabhottla, I. Radchenko & K.R. Narayanan
Singapore University of Technology & Design, Singapore
G. Illya & V. Handara
Surya University, Tangerang, Indonesia
M. Kunz & N. Tamura
ALS, Berkley, United States

ORAL PRESENTATIONS 3AO.5

15:15 - 16:45 Buffer and Contacts for Thin Film Devices

Chairpersons:

T. Walter
Ulm University of Applied Sciences, Germany

I. Lauermann
HZB, Germany

3AO.5.1 Electrical Passivation of Thin Film Solar Cell Interfaces
B. Vermang & I. Gordon
imec, Leuven, Belgium
R. Kotipalli & D. Flandre
Catholic University of Louvain, Louvain-la-Neuve, Belgium
M. Edoff
Uppsala University, Sweden

3AO.5.2 Chemical Bath Deposited Zinc Oxide as Transparent Conductive Contact for CIGS Cells
J. Steinhauser, P. Fuchs, Y.E. Romanyuk & A.N. Tiwari
EMPA, Dübendorf, Switzerland
D. Hariskos & W. Wischmann
ZSW, Stuttgart, Germany
D. Brémaud
Flisom, Dübendorf, Switzerland

3AO.5.3 Characterization of the Back Contact of CIGS Solar Cell as the Origin of "Rollover" Effect
T. Kato, K. Kitani, K.F. Tai, R. Kamada, H. Hiroi & H. Sugimoto
Solar Frontier, Atsugi, Japan

3AO.5.4 Atmospheric Roll-to-Roll Atomic-Layer-Deposition of Zn(O,S) Buffer Layers for Flexible CIGS PV Modules

P.J. Bolt, C. Frijters, P. Poodt & A. Illiberi
TNO, Eindhoven, The Netherlands
D. Brémaud & M. Ruth
Flisom, Dübendorf, Switzerland
J. Van den Brink & R. Knaapen
VDL Enabling Technologies, Eindhoven, The Netherlands

3AO.5.5 Revealing the Beneficial Effects of Ge Doping on Cu2ZnSnSe4 Thin Film Solar Cells

M. Neuschitzer, M. Espindola-Rodriguez, M. Guc,
S. Giraldo, A. Perez-Rodriguez & E. Saucedo
IREC, Sant Adrià de Besòs, Spain
J. Marquez & I. Forbes
Northumbria University, Newcastle upon Tyne,
United Kingdom
T. Olar & I. Lauermann
HZB, Berlin, Germany

ORAL PRESENTATIONS 5AO.8

15:15 - 16:45 Solar Forecasting

Chairpersons:

W.G.J.H.M. Van Sark
Utrecht University, The The Netherlands

C. Protogeropoulos
Phoenix Solar, Greece

55AO.8.1 Multi-Model Ensemble for Day Ahead PV Power Forecasting Improvement

M. Pierro, F. Bucci & C. Cornaro
University of Rome, Italy
M. De Felice
ENEA, Rome, Italy
E. Maggioni, A. Perotto & F. Spada
IDEAM, Cinisello, Italy
D. Moser
EURAC, Bolzano, Italy

5AO.8.2 Dependence of Peer-to-Peer Solar Forecast Skill on Irradiance Variability

B. Elsinga & W.G.J.H.M. van Sark
Utrecht University, The The Netherlands

5AO.8.3 Optimal Selection of Training Datasets for Solar Nowcasting Models

A. Sanfilippo & L. Pomares
Qatar Foundation, Doha, Qatar
D. Perez Astudillo, N. Mohandes & D. Bachour
Qatar Environment and Energy Research Institute, Doha, Qatar

5AO.8.4 Mathematical Parametrisation of Irradiance Transitions Caused by Moving Clouds for PV System Analysis

K. Lappalainen & S. Valkealahti
Tampere University of Technology, Finland

5AO.8.5 Shortest Term Forecasting of DNI for Concentrated Solar Technologies

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

5AO.8.6 Application of Whole Sky Imagers for Data Selection for Radiometer Calibration

S. Wilbert, B. Nouri & C. Prahl
German Aerospace Center, Tabernas, Spain
G. Garcia
CIEMAT, Tabernas, Spain
L. Ramirez, L. Zarzalejo, R. Valenzuela & F. Ferrera
CIEMAT, Madrid, Spain
N. Kozonek
German Aerospace Center, Almeria, Spain

VISUAL PRESENTATIONS 2AV.2

15:15 - 16:45 Silicon Solar Cell Improvements and Innovation (II)

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

VISUAL PRESENTATIONS 6AV.5

15:15 - 16:45 PV in Buildings and the Environment

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

ORAL PRESENTATIONS 1AO.3

17:00 - 18:30 New Materials and Concepts: Nanostructures

Chairpersons:

A. Martí Vega
UPM, Spain

invited

1AO.3.1 Fabrication of Strain-Compensated Heterojunction Ge/Si1-xCx Quantum Dots Solar Cells
K. Gotoh
Tokyo Institute of Technology, Yokohama, Japan
R. Oshima, T. Tayagaki, T. Sugaya & K. Matsubara
AIST, Tsukuba, Japan
M. Kondo
AIST, Fukushima, Japan

1AO.3.2 Extended Electron Lifetime in Intermediate-Band Solar Cells Using Dot-in-Well Structure
S. Asahi
Kobe Univesity, Japan
H. Teranishi, S. Watanabe, T. Takada, T. Kaizu & T. Kita
Kobe University, Japan

1AO.3.3 *EU PVSEC Student Award Winner Presentation*
Thin GaAsSb Capping Layers for Improved Performance of InAs/GaAs Quantum Dot Solar Cells
A.D. Utrilla, A. Gonzalo, I. Artacho, Z. Gacevic, A. Guzmán, A. Hierro & J.M. Ulloa
UPM, Madrid, Spain
D. Fernández Reyes, T. Ben & D. González
UCA, Puerto Real, Spain
J.M. Llorens
IMM - CSIC, Tres Cantos, Spain

1AO.3.4 Influence of the Quantum Dot Capping Procedure on the Density of Defects of InAs/GaAs Quantum Dot Intermediate Band Solar Cells
D.N. Micha
CEFET/RJ, Petrópolis, Brazil
E. Weiner, L.D. Pinto & P.L. Souza
DISSE, Rio de Janeiro, Brazil
R. Jakomin
UFRJ, Duque de Caxias, Brazil
M.P. Pires
UFRJ, Rio de Janeiro, Brazil

1AO.3.5 Development of Absorber and Energy Selective Contacts for the Hot Carrier Solar Cell
S. Shrestha, S. Chung, Y. Liao, W. Cao, H. Xia, N. Gupta, X. Wen & G.J. Conibeer
UNSW Australia, Sydney, Australia

1AO.3.6 Optimal Utilization of the Optical Field Distribution in RCE a-Ge:H Nanoabsorber Solar Cells
V. Steenhoff, M. Vehse & C. Agert
Next Energy, Oldenburg, Germany

ORAL PRESENTATIONS 3AO.6

17:00 - 18:30 Interfaces for Thin Film Devices

Chairpersons:

invited

M.C. Lux-Steiner
HZB, Germany

3AO.6.1 Potassium Fluoride Ex-Situ Treatment for Cu-Rich CuInSe2 Thin Film Solar Cells
H. ElAnzeery, F. Babbe, M. Melchiorre & S. Siebentritt
University of Luxembourg, Belvaux, Luxembourg

3AO.6.2 Effects of Thermal Annealing and KF Post Deposition on Photovoltaic Property of CIGS Solar Cell
Y. Kamikawa-Shimizu, J. Nishinaga, S. Ishizuka, H. Shibata & S. Niki
AIST, Tsukuba, Japan

3AO.6.3 Punch-Through Effect in CIGS Thin Film Solar Cells
T. Ott & H.-J. Fecht
University of Ulm, Germany
T. Walter
Ulm University of Applied Sciences, Germany
R. Schäffler
Manz, Schwäbisch Hall, Germany

3AO.6.4 Nano-Scale Insight into CdS/Cu(In,Ga)Se2 Interface of Alkali Incorporated Solar Cells
A. Stokes & A.-J. Mowafak
NREL, Golden, United States
B. Gorman
Colorado School of Mines, Golden, United States

3AO.6.5 p-n Junction Quality Improvement of Cu2ZnSn(S,Se)4/ CdS Solar Cells: Surface Passivation with Group III-S Compounds by Wet Chemical Treatments

H. Xie, Y. Sánchez, M. Espindola-Rodriguez,
S. López-Marino & E. Saucedo
IREC, Sant Adrià de Besòs - Barcelona, Spain
L. Calvo-Barrio & A. Perez-Rodriguez
University of Barcelona, Spain

ORAL PRESENTATIONS 5AO.9

17:00 - 18:30 Balance of System Components

Chairpersons:

G. Graditi
ENEA, Italy

N.M. Pearsall
Northumbria University, United Kingdom

5AO.9.1 Safe PV Plants with Panel Level Electronics?

J. Laschinski, G. Bettenwort, M. Hopf & H. Knopf
SMA Solar Technology, Niestetal, Germany

5AO.9.2 A MPPT Algorithm for Partial Shading Conditions Employing Curve Fitting

E. Batzelis, G. Kampitsis & S. Papathanassiou
NTUA, Athens, Greece

5AO.9.3 Deviations of Results for Energy Yield from Efficiency Rankings of Micro-Inverters

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

5AO.9.4 Performance of Recent Inverter Systems under Partial Shading Conditions

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

5AO.9.5 Performance Evaluation of Household Li-Ion Battery Storage Systems

N. Munzke & J. Barry
KIT, Eggenstein-Leopoldshafen, Germany

5AO.9.6 Photovoltaic Emulator for High-Performance Multi-Substring Simulations

T.-D. Mai, K. Baert & J. Driesen
KU Leuven, Heverlee, Belgium
S. De Breucker & P. van Tichelen
VITO, Mol, Belgium

VISUAL PRESENTATIONS 2AV.3

17:00 - 18:30 Silicon Solar Cell Improvements and Innovation (III)

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

VISUAL PRESENTATIONS 6AV.6

17:00 - 18:30 Utility-Scale PV / PV Applications without a Centralised Grid

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

NOTES

Tuesday, 21 June 2016

ORAL PRESENTATIONS 2BO.1

08:30 - 10:00 Silicon Crystallisation

Chairpersons:

J. Friedrich
Fraunhofer IISB, Germany

K. Tanahashi *(i)*
AIST, Japan

2BO.1.1 CRYSTALMAX Silicon for High Efficiency/ Low-Cost Solar Cells
R. Cabal & S. Dubois
CEA, Le Bourget du Lac, France
G. Fortin & L. Bounaas
ECM Greentech, Grenoble, France

2BO.1.2 The Effect of Seed Arrangements on the Ingot Quality of n-Type Mono-Like Silicon Grown by Directional Solidification
Y.C. Wu, A. Lan, C.-F. Yang & C.-W. Lan
NTU, Taipei, Taiwan
C. Hsu
SAS, Hsinchu, Taiwan
J.-M. Lu & A. Yang
Solartech Energy, Hsinchu, Taiwan

2BO.1.3 Optimized Grain Size of Seed Plates for High Performance Multicrystalline Silicon
P. Krenckel, S. Riepe, F. Schindler & T. Strauch
Fraunhofer ISE, Freiburg, Germany

2BO.1.4 Influence of Temperature Distribution on the Performance of High-Performance Multi-Crystalline Silicon
Q. Wang & W. Chen
Jinko Solar, Shangrao, China

2BO.1.5 Influence of Extraordinary Long Ingot Heights on the Wafer Quality of High Performance Multi-Crystalline Silicon for PV Application
T. Lehmann & I. Kupka
Fraunhofer THM, Freiberg, Germany
M. Trempa, M. Beier, C. Reimann & J. Friedrich
Fraunhofer IISB, Erlangen, Germany
D. Oriwol, F. Kropfgans & L. Sylla
SolarWorld Innovations, Freiberg, Germany

2BO.1.6 Electromagnetic Casting at Emix : a High Rate Purification Process Driven by Numerical Simulations
J. Givernaud & F. Boulle
EMIX, Saint Maurice la Souterraine, France

ORAL PRESENTATIONS 3BO.5

08:30 - 10:00 Amorphous Silicon-Based Thin-Film PV Devices

Chairpersons:

S. Gall
HZB, Germany

I. Gordon
imec, Belgium

3BO.5.1 Monolithic Interconnection of Micromorph Tandem Thin Film Solar Cells on Flexible and Opaque Substrates Using Laser Ablation
K. Borzutzki, S. Geißendörfer, O. Siepmann, O. Sergeev, M. Vehse & C. Agert
Next Energy, Oldenburg, Germany
J. Ohland
University of Oldenburg, Germany

3BO.5.2 High Quality p-a-SiOxCy:H Films Using Additional Trimethylboron for Amorphous Silicon Based Top Cells
D.-W. Kang
Cheongju University, Korea South
P. Sichanugrist & M.A. Khan
MEXT/FUTURE-PV, Fukushima, Japan
C. Niikura
NIMS, Ibaraki, Japan
M. Konagai
Tokyo City University, Japan

3BO.5.3 Transfer of a Highly Efficient Thin-Film Photovoltaic Device from Its Growth Substrate to a Flexible Plastic Sheet
S.K. Ram, F. Lyckegaard, B.R. Jeppesen, P.B. Jensen, J. Chevallier, A. Nylandsted Larsen & P. Balling
Aarhus University, Denmark
R. Rizzoli & M. Bellettato
CNR, Bologna, Italy
D. Desta
University of Aveiro, Portugal

3BO.5.4 Development and Validation of a New Model for Degradation and Annealing of a-Si:H Solar Cells under Dynamically Varying Conditions
M. Görig & B.E. Pieters
Forschungszentrum Jülich, Germany

3BO.5.5 Color Control for a-Si:H Thin Film Solar Cells with Ultrathin Transparent Electrodes
G. Kim, J.-W. Lim & S.J. Yun
ETRI, Daejeon, Korea South
M. Shin
Korea Aerospace University, Goyang-City, Korea South

3BO.5.6 Integration of Graphene as Transparent Conductive Electrode for a-Si:H Solar Cells
F. Roux, F. Emieux, H. Szambolics, P. Faucherand, V. Muffato & E. Quesnel
CEA, Grenoble, France
A. Centeno & A. Zurutuza
Graphenea, San Sebastian, Spain

ORAL PRESENTATIONS 2BO.9

08:30 - 10:00 Industrial Production of High Efficiency c-Si Cells

Chairpersons:

P. Wohlfart
Singulus Technologies, Germany

D.L. Bätzner
Meyer Burger Research, Switzerland

2BO.9.1 Silicon Heterojunction Solar Cells in Meyer Burger's Demo Line: Results of Pilot Production on Mass Production Tools
J. Zhao, D. Sontag, M. König, A. Wissen, V. Breus, D. Decker, M. Fritzsche, M. Schorch, M. Richter, H.J. Nonnenmacher, M. Leonhardt, J. Hausmann, A. Waltinger, D. Landgraf, S. Burkhardt, K. Walther, S. Frigge, H. Mehlich & E. Vetter
Meyer Burger, Hohenstein-Ernstthal, Germany
Y. Yao, T. Söderström, A. Richter & S. Leu
Meyer Burger, Gwatt, Switzerland
W. Stein
Stein Engineering & Consulting, Dresden, Germany
R. Varache, P. Jeronimo & C. Roux
CEA, Le Bourget du Lac, France

2BO.9.2 How to Deal with Thin Wafers in a Heterojunction Solar Cells Industrial Pilot Line: First Analysis of the Integration of Cells Down to 70µm Thick in Production Mode
S. Harrison, O. Nos, A. Danel, D. Muñoz, J.P. Rakotoniaina, C. Roux & P.J. Ribeyron
CEA-LITEN, Le Bourget du Lac, France

2BO.9.3 **Mass Production of High Efficiency Silicon Heterojunction Solar Cells: a Low-Cost Approach by Upgrading Gen8.5 Thin Film Solar Line**

L. Li, L. Zhang, Z. Xu, X. Fang, G. Zhao, S. Gu, X. Tian, B. Li, R. Yang, Y. Meng & T. Guo
ENN Solar Energy, Langfang, China

2BO.9.4 **PERC Solar Cells and Its Road to Industry**

J. Wu, X.-S. Wang & G. Xing
Canadian Solar, Suzhou, China

2BO.9.5 **Cu-Plated Electrodes with Green Nano-Laser Opening Metal Contact on n-Type Silicon Solar Cells**

K.-C. Lai, S.-Y. Liu, Y.L. Lee, M.-S. Lin, Y.-K. Tsao, C.-C. Chuang, C.-C. Li & C.-C. Wang
Motech Industries, Tainan, Taiwan

2BO.9.6 **40 kHz PECVD of AlOx/SiNx Stacks Demonstrated in Industrial High Efficiency PERC Production**

T. Pernau, J.-U. Fuchs, V.X. Nguyen, A. Nickel, U. Walk & W. Jooß
Centrotherm Photovoltaics, Blaubeuren, Germany
K. Hsu, J. Chen & S. Wiebecke
Centrotherm Photovoltaics Asia, Zhubei, Taiwan
H.-H. Wu, K.-H. Hung, K.-C. Lin & W.K.W. Huang
Gintech Energy, Miaoli, Taiwan

VISUAL PRESENTATIONS 5BV.1

08:30 - 10:00 PV Cells and Modules (I)

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

PLENARY SESSION 2BP.1

10:30 - 12:00 Wafer-Based Silicon Technology

Chairpersons:

R. Brendel
ISFH, Germany

P.J. Verlinden
Trina Solar Energy, China

2BP.1.1 ***Keynote Presentation:***
Current Status of High-Efficiency Q.Antum Technology with New World Record Module Efficiency of 19.5%

M. Scherff, P. Kowalzik, C. Gerber, K. Duncker, M. Junghänel, C. Fahrland, S. Kunath, S. Hörnlein, M. Schütze, L. Niebergall, B. Klöter & J.W. Müller
Hanwha Q CELLS, Bitterfeld-Wolfen, Germany

2BP.1.2 **New Monosilane Fluid Bed Decomposition Technology for the Production of Solar Quality Silicon Feedstock**

M. Dassel
SiTec, Augsburg, Germany

2BP.1.3 ***EU PVSEC Student Award Winner Presentation***
Calcium Contacts to n-Type Crystalline Silicon Solar Cells

T.G. Allen, P. Zheng, Y. Wan, C. Samundsett, J. Bullock & A. Cuevas
ANU, Canberra, Australia
B. Vaughan & M. Barr
University of Newcastle, Callaghan, Australia

2BP.1.4 **Impact of Solar Cell Architecture on the Temperature Dependency of Electrical Performance**

J.P. Seif, J. Haschke, J. Cattin & S. De Wolf
EPFL, Neuchâtel, Switzerland
L. Tous, P. Choulat, M. Aleman, E. Cornagliotti, A. Uruena de Castro, R. Russell, F. Duerinckx & J. Szlufcik
imec, Leuven, Belgium
L. Barraud, J. Champliaud, J. Levrat, M. Despeisse & C. Ballif
CSEM, Neuchâtel, Switzerland
A.A. Abdallah, B. Aissa, M.-M. Kivambe & N. Tabet
Qatar Foundation, Doha, Qatar

ORAL PRESENTATIONS 2BO.2

13:30 - 15:00 Silicon Feedstock and Wafer Technologies

Chairpersons:

K. Hesse
Wacker Chemie, Germany

B.Y. Jang
KIER, Korea South

2BO.2.1 Capture of Agglomerates by Beads in an Experimental System That Simulates a Fluidized Bed Reactor for the Production of Polysilicon
M. Vazquez Pufleau & M. Yamane
Washington University in St. Louis, United States

2BO.2.2 Investigations of Thermal Decomposition of Monosilane in a Free Space Reactor
G.M. Wyller, T.J. Preston, H. Klette, O. Nordseth, T.T. Mongstad & E.S. Marstein
IFE, Kjeller, Norway
W.O. Filtvedt
Dynatec Engineering, Askim, Norway

2BO.2.3 On the Parameters That Impact the Performance of Diamond Wire in the Production of Silicon Wafers
K. Sunder & O. Anspach
PV Crystalox Solar, Erfurt, Germany

2BO.2.4 The Influence of Surface Quality on Diamond Wire Sawn Multi-Crystalline Silicon Wafer
T.Y. Wang & W.-J. Lih
ITRI, Hsinchu, Taiwan
C.-Y. Cheng, C.-Y. Liu & W.-H. Lin
Green Energy Technology, Taoyuan, Taiwan

2BO.2.5 3 Dimensional Direct Wafer Product with Locally-Controlled Thickness
A. Lorenz, J. Hofstetter, H. Malkasian, L. Sanderson & F. van Mierlo
1366 Technologies, Bedford, United States

2BO.2.6 Multiple Reuse of the Silicon Substrate in a Porous Silicon Based Layer Transfer Process
A. Hajijafarassar, K. Van Nieuwenhuysen, I. Sharlandzhiev, V. Depauw, H. Sivaramakrishnan Radhakrishnan, T. Bearda, I. Gordon, J. Szlufcik & J. Poortmans
imec, Leuven, Belgium
Y. Abdulraheem
Kuwait University, Safat, Kuwait
L. Magagnin
Polytechnic University of Milan, Italy

ORAL PRESENTATIONS 3BO.6

13:30 - 15:00 Silicon-Based Thin-Film Materials and Devices

Chairpersons:

P. Delli Veneri
ENEA, Italy

J. Meier
PV Consultant, Switzerland

3BO.6.1 External Quantum Efficiency as Function of Applied Voltage of Multi-Junction Hydrogenated Amorphous Si Based Cell: Performance Optimization After Stabilization
A. Canino, G. Condorelli & A. Battaglia
3Sun, Catania, Italy
C. Gerardi
Enel Green Power, Catania, Italy

3BO.6.2 Annealing Effects in Amorphous Silicon Solar Cells Deposited at Low Temperatures for Transparent Flexible Plastic Substrates
K. Wilken, S. Wang, F. Finger & V. Smirnov
Forschungszentrum Jülich, Germany

3BO.6.3 Bifacial Multicrystalline Silicon Thin Film Solar Cells
G. Jia, A. Gawlik, J. Plentz, M. Vetter & G. Andrä
IPHT, Jena, Germany

3BO.6.4 1-µm-Thin Crystalline Silicon Solar Cells with Pseudo-Ordered Nanotextures
V. Depauw, T. Bearda, I. Gordon & J. Poortmans
imec, Leuven, Belgium
I. Massiot & A. Dmitriev
Chalmers University of Technology, Goteborg, Sweden
W. Chen & P. Roca i Cabarrocas
CNRS, Palaiseau, France
C. Trompoukis
KU Leuven, Heverlee, Belgium

3BO.6.5 Passivation at the Interface between Liquid-Phase Crystallized Silicon and Silicon Oxynitride in Thin Film Solar Cells
N. Preissler, J.A. Töfflinger, O. Gabriel, D. Amkreutz, B. Stannowski, R. Schlatmann & B. Rech
HZB, Berlin, Germany

3BO.6.6 Analysis of Carrier Lifetime in Liquid-Phase Crystallized Silicon on Glass
M. Vetter, A. Gawlik, J. Plentz & G. Andrä
IPHT, Jena, Germany

ORAL PRESENTATIONS 5BO.10

13:30 - 15:00 Backsheet and Encapsulant Materials

Chairpersons:

C. Monokroussos
TÜV Rheinland, China

R. Gottschalg
Loughborough University, United Kingdom

5BO.10.1 Yellowing of PV Backsheets in Accelerated Tests Can Be Used as a Realistic Indication of Possible Field Failures – Fact or Fiction?
E. Parnham, A. Seaman, A. Whitehead, W. Brennan & M. Peevor
DuPont Teijin Films, Redcar, United Kingdom

5BO.10.2 Acetic Acid Permeation through PV-Backsheets: Dependence of the Composition on the Permeation Rate
G. Oreski & A. Mihaljevic
PCCL, Leoben, Austria
Y. Voronko & G.C. Eder
OFI, Vienna, Austria

5BO.10.3 Method to Measure Light Recovery Factor Enabling 20.2% Module Efficiency with Passivated Emitter and Rear Solar Cells
M. Köntges, H. Schulte-Huxel, S. Blankemeyer, M.R. Vogt, R. Witteck, S. Spätlich, D. Hinken, H. Holst, U. Sonntag, T. Brendemühl, I. Ahrens, T. Neubert, K. Bothe & R. Brendel
ISFH, Emmerthal, Germany

5BO.10.4 Development of Adhesive and Cohesive Failures in EVA-Backsheet Structures in Environmental Testing
J. Zhu, D. Montiel-Chicharro, T.R. Betts & R. Gottschalg
Loughborough University, United Kingdom

5BO.10.5 Investigation of the EVA Degradation Mechanism and Prediction of Reliability by the Raman Spectroscopy
M.A. Islam, K. Noguchi & Y. Ishikawa
NAIST, Ikoma, Japan
H. Nakahama
Nisshinbo Mechatronics, Tsukuba, Japan

5BO.10.6 Direct Evidence for Hot-Cell-Induced Modifications in PV Module Encapsulants
C. Camus, C. Buerhop-Lutz, S. Wrana, J. Adams, T. Pickel, H. Scheuerpflug & J. Hauch
ZAE Bayern, Erlangen, Germany
C. Zetzmann
Rauschert, Pressig, Germany
E. Malguth
LayTec in-line, Berlin, Germany
C.J. Brabec
University of Erlangen, Germany

VISUAL PRESENTATIONS 5BV.2

13:30 - 15:00 Operation of PV Systems

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

VISUAL PRESENTATIONS 1BV.5

13:30 - 15:00 Fundamental Studies / 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 Heterojunction Solar Cell Concepts

Chairpersons:

P.J. Ribeyron
CEA, France

C. Ballif
EPFL&CSEM, Switzerland

2BO.3.1 Impact of High-Temperature Processes on Bulk Carrier Lifetime of n-Type Cz Silicon
S. Werner, A. Wolf, S. Mack & E. Lohmüller
Fraunhofer ISE, Freiburg, Germany
R.C.G. Naber
Tempress, Vaassen, The Netherlands

2BO.3.2 Implementation of n+ and p+ Poly-Si/c-Si Junctions on Front and Rear Side of Double-Side Contacted Industrial Silicon Solar Cells

R. Peibst, Y. Larionova, S. Reiter, M. Turcu & R. Brendel
ISFH, Emmerthal, Germany
D. Tetzlaff, J. Krügener & T. Wietler
Leibniz University Hannover, Germany
U. Höhne & J.-D. Kähler
centrotherm, Hannover, Germany
H. Mehlich & S. Frigge
Meyer Burger, Hohenstein-Ernstthal, Germany

2BO.3.3 Process Development of Silicon Heterojunction Interdigitated Back-Contacted (SHJ-IBC) Solar Cells Bonded to Glass

M. Xu, T. Bearda, H. Sivaramakrishnan Radhakrishnan, S. Kiran Jonnak, V. Depauw, K. Van Nieuwenhuysen, M. Filipic, I. Gordon, J. Szlufcik & J. Poortmans
imec, Leuven, Belgium
Y. Abdulraheem
Kuwait University, Safat, Kuwait

2BO.3.4 Enhancing the Efficiency of Silicon Heterojunction Solar Cells Using Effectively Transparent Contacts

R. Saive, A.M. Borsuk, H.S. Emmer, C. Bukowsky, J.V. Lloyd, S. Yalamanchili & H.A. Atwater
Caltech, Pasadena, United States

2BO.3.5 Silicon Heterojunction Solar Cells Using Aluminum Doped Zinc Oxide as Back Contact: Sputtering and ALD

G. Christmann, D. Sacchetto, L. Sansonnens, L. Barraud, A. Descoeudres, B. Paviet-Salomon, N. Badel, M. Despeisse, S. Nicolay & C. Ballif
CSEM, Neuchâtel, Switzerland
L.A.A. Duval, M. Creatore & W.M.M. Kessels
Eindhoven University of Technology, The Netherlands
G. Wahli & B. Strahm
Meyer Burger Research, Hauterive, Switzerland

2BO.3.6 Status of the EU FP7 HERCULES Project: What Is the Potential of n-Type Silicon Solar Cells in Europe?

D. Muñoz, P.J. Ribeyron & S. Harrison
CEA, Le Bourget du Lac, France
C. Allebé, A. Descoeudres & M. Despeisse
CSEM, Neuchâtel, Switzerland
C. Reichel & S.W. Glunz
Fraunhofer ISE, Freiburg, Germany
R. Peibst & A. Merkle
ISFH, Emmerthal, Germany
O. Nielsen
NorSun, Oslo, Norway
I. Martín
UPC, Barcelona, Spain

PROGRAMME

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EDF R&D - IRDEP, Chatou, France
E. Macron
Alma Consulting Group, Lyon, France
B. de Gier
Eurotron, Bleskensgraaf, The Netherlands
M. Tallián & F. Korsós
Semilab, Budapest, Hungary
L. Korte
HZB, Berlin, Germany

ORAL PRESENTATIONS 3BO.7

15:15 - 16:45 Perovskite Solar Cells and Modules: Performance

Chairpersons:

R. Gehlhaar
imec, Belgium

S. Berson
CEA, France

3BO.7.1 Air-Blade Deposition of Large Area Perovskite Modules with Efficiency Exceeding 9%

S. Razza, L. Cinà, M. Dianetti, S. Casaluci, A. Agresti, F. Matteocci, A. d'Epifanio, S. Licoccia, A. Reale, F. Brunetti & A. di Carlo
University of Rome, Italy

3BO.7.2 Flexible Perovskite/Cu(In, Ga)Se2 Tandem Thin Film Solar Cell

S. Pisoni, F. Fu, T. Feurer, S. Buecheler & A.N. Tiwari
EMPA, Dübendorf, Switzerland

3BO.7.3 Spatially Resolved Current Generation in the Sub-Cells of Monolithic Perovskite/Silicon Tandem Solar Cells
Z. Song, A.B. Phillips, R.J. Ellingson & M.J. Heben
University of Toledo, United States
J. Werner, S. De Wolf & B. Niesen
EPFL, Neuchâtel, Switzerland
C. Ballif
CSEM, Neuchâtel, Switzerland

3BO.7.4 Interface Architecture between TiO2/Perovskite, Perovskite/Hole Transport Layer, and Perovskite Grain Boundary
D. Hirotani, M. Moriya, Y. Ogomi & S. Hayase
Institute of Technology, Kitakyushu, Japan
Q. Shen & T. Toyoda
University of Electro-Communication, Chofu, Japan
K. Yoshino
University of Miyazaki, Japan

3BO.7.5 Tin(IV)-Based Iodide Perovskite Materials for Photovoltaic Application
Y. Chen, T. Krishnamoorthy, T. Baikie, N. Mathews,
L.H. Wong & S.G. Mhaisalkar
Nanyang Technological University, Singapore, Singapore

3BO.7.6 Dependence of the Transport Length in CH3NH3PbI3 Powders on Light Soaking: a Surface Photovoltage Study
T. Dittrich, O. Shargaieva, F. Lang, N.H. Nickel,
B. Rech & J. Rappich
HZB, Berlin, Germany

ORAL PRESENTATIONS 5BO.11

15:15 - 16:45 Potential Induced Degradation (PID), Soiling and Glass of PV Modules

Chairpersons:

H. Nagel
Germany

A.R. Lagunas
CENER, Spain

5BO.11.1 Regeneration of Potential Induced Degradation Affected Modules
C. Hinz, S. Koch & J. Berghold
PI Berlin, Germany

5BO.11.2 Modeling the Lifetime and Performance Prediction of PV Solar Plants: the Role of PID and Moisture Ingress in Crystalline Modules
E. Annigoni, F. Galliano & F. Sculati-Meillaud
EPFL, Neuchâtel, Switzerland
M. Jankovec & M. Topic
University of Ljubljana, Slovenia
H.Y. Li, L.-E. Perret-Aebi & C. Ballif
CSEM, Neuchâtel, Switzerland

5BO.11.3 Potential-Induced Degradation: an Improved Understanding of Mechanism and Influence Factors
C. Taubitz & M.B. Köntopp
Hanwha Q CELLS, Bitterfeld-Wolfen, Germany
A. Schulze
Rosenheim University of Applied Sciences, Germany

5BO.11.4 PV Module Test for Arid Climates Including Sand Storm and Dust Testing
G. Mathiak, M. Hansen, M. Schweiger, L. Rimmelspacher,
W. Herrmann, F. Reil & J. Althaus
TÜV Rheinland, Cologne, Germany

5BO.11.5 Advances in the Development of "AtaMo": Solar Modules Adapted for the Climate Conditions of the Atacama Desert in Chile- the Impact of Soiling and Abrasion
E. Cabrera, A. Schneider, E. Wefringhaus,
D. Thaller & R. Kopecek
ISC Konstanz, Germany
J. Rabanal-Arabach
ISC Konstanz, Antofagasta, Chile
P. Ferrada, F. Araya, A. Marzo, M. Trigo,
D. Olivares & E. Fuentealba
University of Antofagasta, Chile
J. Haas
University of Santiago de Chile, Chile

5BO.11.6 Investigation of Damp Heat Aging on Soda-Lime Glass for Photovoltaic Applications
V. Guiheneuf, F. Delaleux, O. Riou, P.-O. Logerais &
J.-F. Durastanti
University of Paris-Est, Lieusaint, France

VISUAL PRESENTATIONS 5BV.3

15:15 - 16:45 Balance of System Components

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

VISUAL PRESENTATIONS 1BV.6

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 p-Type PERC Solar Cell Concepts and Surface Passivation

Chairpersons:

R. Preu
Fraunhofer ISE, Germany

J. John
imec, Belgium

2BO.4.1 Emitter Saturation Currents of 22 fA/cm2 Applied to Industrial PERC Cells Approaching 22% Conversion Efficiency
T. Dullweber, H. Hannebauer, S. Dorn, S. Schimanke, A. Merkle, C. Hampe & R. Brendel
ISFH, Emmerthal, Germany

2BO.4.2 Recent 22% Efficient Fully Screen Printed Industrial PERC Silicon Solar Cells – the Q.ANTUM Technology Platform Applied to Mono Cz p-Type to Maintain Constant Efficiency Increase per Year in Production Environment
M. Schaper, J. Cieslak, K. Duncker, C. Fahrland, S. Geissler, S. Hörnlein, C. Klenke, R. Lantzsch, A. Mohr, L. Niebergall, A. Schönmann, M. Schütze, J.W. Müller & D.J.W. Jeong
Hanwha Q CELLS, Bitterfeld-Wolfen, Germany

2BO.4.3 Towards a 300wp p-Type HIP-MWT-Module – Simulation, Experimental Results and Costs
A. Spribille, A. Kraft, D. Eberlein, M. Ebert & F. Clement
Fraunhofer ISE, Freiburg, Germany
T. Savisalo & H. Pantsar
Valoe, Mikkeli, Finland

2BO.4.4 Plasma Process Analysis of ICP-PECVD of AlOx Layers for c-Si Surface Passivation
M. Hofmann & M. Jäcklein
Fraunhofer ISE, Freiburg, Germany

B. Cord
Singulus Technologies, Kahl am Main, Germany
T. Schütte
Plasus, Mering, Germany
M. Siemers
Fraunhofer IST, Braunschweig, Germany

2BO.4.5 Al2O3 Passivation for Cu Plated 15.6x15.6 cm2 IBC Cells
S. Jambaldinni, B. O'Sullivan, S. Singh, E. Cornagliotti, B. Zielinski, M. Debucquoy, J. Szlufcik & J. Poortmans
imec, Leuven, Belgium
M. Kyuzo
Kyocera, Shiga, Japan

2BO.4.6 Formation and Evolution of the SiOxFy Masking Layer Caused by Plasma Texturing
M. Gaudig, J. Hirsch & N. Bernhard
Anhalt University of Applied Sciences, Köthen, Germany
V. Naumann, C. Hagendorf & D. Lausch
Fraunhofer CSP, Halle, Germany

ORAL PRESENTATIONS 3BO.8

17:00 - 18:30 CIGS Manufacturing

Chairpersons:

M. Powalla
ZSW, Germany

A.N. Tiwari
EMPA, Switzerland

3BO.8.1 Improved CIGS Modules by KF Post Deposition Treatment and Reduced Cell-to-Module Losses
N. Kaihovirta, O. Lundberg, E. Wallin, V. Gusak, S. Södergren, S. Chen, S. Lotfi, F. Chalvet, U. Malm, J. Joel, M. Skupinski, P. Lindberg, T. Jarmar, J. Lundberg, J. Mathiasson & L. Stolt
Solibro Research, Uppsala, Sweden
P. Mende, G. Jaschke & P. Kratzert
Solibro, Bitterfeld-Wolfen, Germany

3BO.8.2 Efficiency Improvement of CIGSSe/Cd-Free Solar Module by Optimized Cell and Interconnect Design
P. Eraerds, C. Schubbert, T. Kwast, M. Grave, F. Braun, M. Algasinger, R. Lechner, T. Dalibor & J. Palm
AVANCIS, Munich, Germany

3BO.8.3 High Efficiency Solution Coated Cu(In,Ga)(Se,S)2 Thin Film Solar Cells
T. Aramoto & Y. Kawaguchi
Solar Frontier, Atsugi, Japan
Y.-C. Liao, Y. Kikuchi, T. Ohashi, H. Iida & A. Nakamura
Tokyo Ohka Kogyo, Koza-Gun, Japan

3BO.8.4 Recrystallization of Printed Cu(In,Ga)S Nanoparticle Absorber Layers
S.K. Stubbs, C.G. Allen, P. Kirkham, Z. Liu, A. Whiteside, C. Newman, O. Masala & S. Whitelegg
Nanoco Technologies, Manchester, United Kingdom
A. Abbas, A. Eeles, J. Bowers & M. Walls
Loughborough University, United Kingdom

3BO.8.5 Revealing Laser-Induced Damages in CIGSe Based Solar Cells by Means of Photoluminescence and Thermography
G. Farias, C. Schultz & B. Stegemann
Berlin University of Applied Sciences, Germany
C. Wolf, C.A. Kaufmann, B. Rau & R. Schlatmann
HZB, Berlin, Germany

ORAL PRESENTATIONS 1BO.12

17:00 - 18:30 Advanced Concepts for Modules

Chairpersons:

U. Eitner
Fraunhofer ISE, Germany

G. Beaucarne
Dow Corning, Belgium

1BO.12.1 Universal External Light Trap for Photovoltaic Modules
L. van Dijk & M. Di Vece
Utrecht University, The Netherlands
J. van de Groep & A. Polman
AMOLF, Amsterdam, The Netherlands
R.E.I. Schropp
Eindhoven University of Technology, The Netherlands

1BO.12.2 White Bifacial Modules – Improved STC Performance Combined with Bifacial Energy Yield
B.B. Van Aken, L.A.G. Okel, J. Liu & J.A.M. Van Roosmalen
ECN, Petten, The Netherlands

1BO.12.3 Enabling Solderability of PVD Al Rear Contacts on High-Efficiency Crystalline Silicon Solar Cells by Wet Chemical Treatment
H. Nagel, M. Kamp, D. Eberlein, J. Bartsch, M. Glatthaar & S.W. Glunz
Fraunhofer ISE, Freiburg, Germany

1BO.12.4 Results on Module Integration of IBC Solar Cells Based on the Conductive Backsheet Approach
A. Halm, A. Schneider, V.D. Mihailetchi, L.J. Koduvelikulathu, G. Galbiati, H. Chu, R. Roescu, J. Libal & R. Kopecek
ISC Konstanz, Germany
B. de Gier & N. van Ommen
Eurotron, Bleskensgraaf, The Netherlands

1BO.12.5 Small Unit Compound Modules: a New Approach for Light Weight PV Modules
H. Nussbaumer, M. Klenk & N. Keller
Zurich University of Applied Sciences, Winterthur, Switzerland

1BO.12.6 Reconfigurable Topologies for Smarter PV Modules: Simulation, Evaluation and Implementation
P. Bauwens & J. Doutreloigne
Ghent University, Belgium
J. Govaerts, F. Catthoor, H. Goverde & J. Poortmans
imec, Leuven, Belgium
M. Baka & D. Anagnostos
NTUA, Athens, Greece
K. Baert & G. Vandenbroeck
KU Leuven, Heverlee, Belgium

VISUAL PRESENTATIONS 5BV.4

17:00 - 18:30 PV Cells and Modules (II)

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

VISUAL PRESENTATIONS 2BV.7

17:00 - 18:30 Silicon Solar Cell Characterisation and Modelling / Manufacturing and Processing

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

NOTES

Wednesday, 22 June 2016

ORAL PRESENTATIONS 2CO.1

08:30 - 09:30 Silicon Material Characterisation and Treatment

Chairpersons:

K. Petter *(i)*
Hanwha Q CELLS, Germany

invited

2CO.1.1 Measurement of Residual Stresses in Large Silicon Samples Using the Dissection Method
T. Bähr & H. Behnken
Access, Aachen, Germany
K. Dadzis, F. Kropfgans, L. Sylla & T. Richter
SolarWorld Innovations, Freiberg, Germany

2CO.1.2 Material Limits of Silicon from State-of-the-Art Photoluminescence Imaging Techniques
F. Schindler, J. Giesecke, B. Michl, W. Warta & M.C. Schubert
Fraunhofer ISE, Freiburg, Germany

2CO.1.3 Laser Hydrogenation of Laser Doped and Grooved Solar Cells
S. Wang, L. Mai, A. Wenham, Z. Hameiri, C. Chan,
B. Hallam, A. Sugianto, C.M. Chong, J. Ji,
Z. Shi & S. Wenham
UNSW Australia, Sydney, Australia
S.R. Wenham
UNSW Australia, Kensington, Australia

2CO.1.4 High Efficiency, Industrially-Relevant n-Cz Si PV via Process-Tolerant Wafers and Tunneling Passivated Contacts
B.G. Lee, V. LaSalvia, W. Nemeth, M.R. Page,
A.G. Norman, D.L. Young & P. Stradins
NREL, Golden, United States

ORAL PRESENTATIONS 3CO.5

08:30 - 09:30 Characterisation and Simulation for Thin Film Devices

Chairpersons:

J.R. Sites
Colorado State University, United States

P. Pistor
IREC, Spain

3CO.5.1 **Spatially Resolved Determination of the Absolute Collected Photocurrent from Solar Cells Using Electro-Modulated Luminescence**
V. Huhn, A. Gerber, B.E. Pieters, Y. Augarten & U. Rau
Forschungszentrum Jülich, Germany

3CO.5.2 **EU PVSEC Student Award Winner Presentation**

Quantitative Mapping of Interface Defects in Cu(In,Ga)Se2 Solar Cells Using Photoluminescence-Based Methods
G. El Hajje, D. Ory, J.F. Guillemoles & L. Lombez
CNRS, Chatou, France

3CO.5.3 **Reverse-Bias Induced Shunt Formation in Cu(In,Ga)Se2 Thin Film Solar Cells: an Approach with Three-Dimensional Electro-Thermal Simulations**
M. Richter, J. Neerken & J. Parisi
University of Oldenburg, Germany

3CO.5.4 **Chalcogenides CIGS Thin Films: a Novel Cross Strategy Approach of Surface and Volume Characterizations**
A. Loubat, M. Bouttemy, D. Aureau, J. Vigneron & A. Etcheberry
CNRS, Versailles, France
F. Mollica, N. Naghavi & D. Lincot
CNRS, Chatou, France
C. Eypert
HORIBA, Palaiseau, France
S. Gaiaschi & P. Chapon
HORIBA, Longjumeau, France
M. Jubault & F. Donsanti
EDF, Chatou, France

ORAL PRESENTATIONS 1CO.9

08:30 - 09:30 New Light Management Concepts

Chairpersons:

invited

I. Konovalov
Ernst Abbe University of Applied Science Jena, Germany

1CO.9.1 **Enhanced Solar Cell Current and Voltage by Nanostructuring**
D. van Dam, Y. Cui, N.J.J. van Hoof, R.P.J. van Veldhoven, E.P.A.M. Bakkers & J.E.M. Haverkort
Eindhoven University of Technology, The Netherlands
S.A. Mann & E.C. Garnett
AMOLF, Amsterdam, The Netherlands

1CO.9.2 **Photovoltaic-Performance-Enhancing Patch with Combined Light Trapping and Spectral Upconverting Effect**
D. Desta
University of Aveiro, Portugal
E. Eriksen, B.R. Jeppesen, P.B. Jensen, S.P. Madsen, A. Nylandsted Larsen, P. Balling & S.K. Ram
Aarhus University, Denmark
M. Bellettato, R. Rizzoli & C. Summonte
CNR, Bologna, Italy

1CO.9.3 **Electrical and Optical Performances of Silicon Solar Cells Modulated by Plasmonics Scattering of Silver and Indium Nanoparticles**
S.-H. Weng, W.-J. Ho, Y.-Y. Lee, C.-H. Hu, W.-L. Wang & Y.-J. Deng
NTUT, Taipei, Taiwan
H.-P. Shiao
Win Semiconductor, Taoyuan, Taiwan

1CO.9.4 **Graphene Quantum Dot Layers with Down-Conversion Effect on Crystalline Silicon Solar Cells**
K.D. Lee, D.-Y. Kim, S.M. Kim, S. Kim, H. Kim, H. Park, H.-S. Lee, Y. Kang, S.S. Yoon & D. Kim
Korea University, Seoul, Korea South
M.J. Park & B.H. Hong
Seoul National University, Korea South

ORAL PRESENTATIONS 5CO.13

08:30 - 09:30 Interconnects and Cell Cracking

Chairpersons:

M. Köntges
ISFH, Germany

D. Jordan *(i)*
NREL, USA

5CO.13.1 Impact of Ribbon Specification and Handling during PV Module Manufacturing to Module Reliability
A. Schneider, R. Fernada, J. Schmauder & R. Harney
ISC Konstanz, Germany
T. Link
SI Module, Freiburg, Germany

5CO.13.2 Fatigue Analysis of Solar Cell Interconnectors due to Cyclic Mechanical Loading
M. Pander, R. Meier, S. Dietrich & M. Ebert
Fraunhofer CSP, Halle (Saale), Germany

5CO.13.3 Extended Thermal Cycling Lifetime Testing on Crystalline Silicon Solar Modules with Artificially Introduced Defects
J. Schmauder, K. Kurz & A. Schneider
ISC Konstanz, Germany

5CO.13.4 Reliability of Low Temperature Conductive Film Interconnection Process for PV Modules
S. Zhang, Y. Xie, H. Jiao, J. Xu, Z. Feng & P.J. Verlinden
Trina Solar Energy, Changzhou, China

VISUAL PRESENTATIONS 4CV.1

08:30 - 09:30 III-V-based Devices for Terrestrial and Space Applications / Concentrator and Space Systems

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

PLENARY SESSION 3CP.1 / 4CP.2

09:50 - 12:10 Thin Film Solar Cells and Modules // Concentrator and Space Applications

Chairpersons:

J. Cárabe
CIEMAT, Spain

C. Signorini
ESA-ESTEC, The Netherlands

3CP.1.1 Advanced Si Epi-Foil-Based PV Devices
J. Poortmans
imec, Leuven, Belgium

3CP.1.2 Progress on Making Perovskite Solar Cells Viable Products
A. Hagfeldt
Uppsala University, Sweden

3CP.1.3 Advances and Opportunities in CIGS Thin Film Photovoltaics R&D
A.N. Tiwari
EMPA, Dübendorf, Switzerland

3CP.1.4 Delivering on the Promise of Thin-Film PV
D. Weiss
First Solar, Santa Clara, USA

3CP.1.5 The Future of CIGS Technology: Production Standardization and Product Differentiation
J. Palm
AVANCIS, Munich, Germany

4CP.2.1 invited

ORAL PRESENTATIONS 2CO.2

13:30 - 15:00 Metallisation Technologies for Si Solar Cells

Chairpersons:

J. Horzel
CSEM - Centre Suisse d'Electronique et de Microtechnique SA, Switzerland

J. Libal
ISC Konstanz, Germany

2CO.2.1 22.77% Efficient n-Type PERT Solar Cell with Plating Metallization Process
W. Duan, S. Yuan, Y. Sheng, W. Cai, Z. Zhang, Y. Chen, Y. Yang, P.P. Altermatt, P.J. Verlinden & Z. Feng
Trina Solar Energy, Changzhou, China

2CO.2.2 High Speed Dispensing – a High-Throughput Metallization Technology for >21% PERC Type Solar Cells
M. Pospischil, M. Klawitter, M. Kuchler, M. Linse, S. Gutscher, A. Brand, F. Clement & D. Biro
Fraunhofer ISE, Freiburg, Germany
M. König
Heraeus, Hanau, Germany
L. Wende
ASYS, Dornstadt, Germany

2CO.2.3 Flip-Flop Cell Interconnection Enabled by an Extremely High Bifaciality of Screen-Printed Ion Implanted n-PERT Si Solar Cells
H. Schulte-Huxel, F. Kiefer, S. Blankemeyer, R. Witteck, M. Vogt, M. Köntges, R. Brendel & R. Peibst
ISFH, Emmerthal, Germany
J. Krügener
Leibniz University, Hanover, Germany

2CO.2.4 High-Throughput Front Side Metallization of Busbarless Solar Cells Using Rotational Flexographic Printing
A. Lorenz, C. Gredy & F. Clement
Fraunhofer ISE, Freiburg, Germany
S. Beyer & J. Ufheil
SOMONT, Umkirch, Germany
Y. Yao
Meyer Burger Technology, Gwatt, Switzerland
A. Senne
ContiTech, Northeim, Germany
H. Reinecke
University of Freiburg, Germany

2CO.2.5 Bifacial n-PERT Cells (BiPERT) with Plated Contacts for Smart-Wire Interconnection
E. Cornagliotti, L. Tous, A. Uruena de Castro, R. Russell, M. Aleman, P. Choulat, A. Sharma, J. John, F. Duerinckx & J. Szlufcik
imec, Leuven, Belgium

2CO.2.6 Laser Formed Anchor Points for Copper Plating Adhesion on Al-BSF and PERC Cells
A. Wenham, C.M. Chong, S. Wang, J. Ji, Z. Shi, L. Mai, A. Sugianto, S. Wenham, A. Barnett & M. Green
UNSW Australia, Sydney, Australia

ORAL PRESENTATIONS 4CO.6

13:30 - 15:00 III-V-based Devices for Terrestrial and Space Applications / Concentrator and Space Systems

Chairpersons:

M.C. Casale
CESI, Italy

A.D. Johnson
IQE, United Kingdom

4CO.6.1 III-V Multi-Junction Metal-Wrap-through (MWT) Concentrator Solar Cells
E. Oliva, H. Helmers, M. Steiner, M. Schachtner, V. Klinger & F. Dimroth
Fraunhofer ISE, Freiburg, Germany
T. Salvetat, C. Jany, R. Thibon & J.-S. Moulet
CEA, Le Bourget du Lac, France

4CO.6.2 Group-V in-Diffusion and Si(100) Surface Preparation for Single-Domain III/V-on-Si Tandem Absorbers
A. Paszuk, O. Supplie, S. Brückner, A. Dobrich, M.M. May, C. Koppka, M. Duda, A. Nägelein, P. Kleinschmidt & T. Hannappel
Ilmenau University of Technology, Germany

4CO.6.3 Improved Performance of III-V Multi-Junction Solar Cells Fabricated with Indium-Tin-Oxide Electrodes
R.-H. Horng, Y.-C. Kao, F.-L. Wu & S.-H. Shi
NCTU, Taichung, Taiwan
S.-L. Ou
Da-Yeh University, Changhua, Taiwan

4CO.6.4 Luminescent Solar Noise Barrier – Large Scale Testing and Modeling
L.H. Slooff
ECN, Petten, The Netherlands
S. Verkuilen
Heijmans Wegen, Rosmalen, The Netherlands
M.M. de Jong & M.N. van den Donker
SEAC, Eindhoven, The Netherlands
M. Kanellis & M.G. Debije
Eindhoven University of Technology, The Netherlands

4CO.6.5 Developing a Low Concentration Module Using PV Assembly Processes and Suitable for Both Terrestrial and Space Applications
C. Weick, P. García-Linares, P. Voarino & M. Baudrit
CEA, Le Bourget Du Lac, France

4CO.6.6 Performance Analysis of Ecosole HCPV System
C. Cancro, G. Graditi, G. Ciniglio, G. Leanza, A. Borriello, A. Merola, S. Ferlito & F. Pascarella
ENEA, Portici, Italy
M. Carpanelli, G. Borelli, D. Verdilio, D. De Nardis & V. Gilioli
Becar, Monteveglio, Italy

ORAL PRESENTATIONS 1CO.10

13:30 - 15:00 New Solar Cell Concepts

Chairpersons:

invited

invited

1CO.10.1 Al-Back Surface Field-Type Crystalline Si-Based Smart Stack Triple-Junction (InGaP/GaAs/Si) Cells
H. Mizuno, K. Makita, T. Tayagaki, T. Mochizuki, Y. Kida, T. Sugaya & H. Takato
AIST, Koriyama, Japan

1CO.10.2 Photoresponse Properties of BaSi2 Film Grown on Si (100) by Vacuum Evaporation
C.T. Trinh, Y. Nakagawa & N. Usami
Nagoya University, Japan
K.O. Hara
University of Yamanashi, Japan
R. Takabe & T. Suemasu
University of Tsukuba, Japan

1CO.10.3 Organometallic Halide Perovskite / Barium Di-Silicide Thin-Film Double-Junction Solar Cells
O. Isabella, R. Vismara & M. Zeman
Delft University of Technology, The Netherlands

1CO.10.4 Solar Grade III-V Substrates for Cost Effective High Efficiency Photovoltaics
Y.-T. Sun, G. Omanakuttan, C. Reuterskiöld Hedlund, M. Hammar & S. Lourdudoss
KTH Royal Institute of Technology, Kista, Sweden

1CO.10.5 Back-Contacted Thin-Film GaAs Solar Cells
C.-Y. Hong, Y.-C. Lin, K.-Y. Ho, J.-L. Tsai, T.-C. Zhan, Y.-R. Wu, A. Lin, W.-Y. Uen, G.-C. Chi & P. Yu
NCTU, Hsinchu, Taiwan

1CO.10.6 Recent Advances in Polymer/Silicon Heterojunction Solar Cells
J. Schmidt, D. Zielke & R. Gogolin
ISFH, Emmerthal, Germany
R. Sauer & W. Lövenich
Heraeus Deutschland, Leverkusen, Germany

ORAL PRESENTATIONS 5CO.14

13:30 - 15:00 Bifacial Performance and Yield Measurement

Chairpersons:

K. Peter
ISC Konstanz, Germany

M. Grottke
WIP - Renewable Energies, Germany

5CO.14.1 Geographical Mapping of the Performance of Vertically Installed Bifacial Modules
M. Ito
Waseda University, Tokyo, Japan
E. Gerritsen
CEA, Le Bourget du Lac, France

5CO.14.2 Modelling of Single-Axis Tracking Gain for Bifacial PV Systems
A. Lindsay, M. Chiodetti, D. Binesti & P. Dupeyrat
EDF R&D, Moret-sur-Loing, France
S. Mousel, E. Lutun & K. Radouane
EDF EN, Paris, France

5CO.14.3 Performance Analysis of PV Green Roof Systems
T. Baumann, D. Schär, F. Carigiet & F. Baumgartner
Zurich University of Applied Sciences, Winterthur, Switzerland
A. Dreisiebner
Solarspar, Sissach, Switzerland

5CO.14.4 Performance Monitoring of Different Module Technologies and Design Configurations of PV Systems in South Africa
T. Serameng, K. Cunden & S. Myeni
Eskom, Johannesburg, South Africa
K.T. Roro, M.B. Ayanna & S. Koopman
CSIR, Pretoria, South Africa

5CO.14.5 The Need of Frameless Mounting Structures for Vertical Mounting of Bifacial PV Modules
J. Rabanal-Arabach, A. Schneider & R. Kopecek
ISC Konstanz, Germany
M. Mrcarica
DSM Innovation Center, Sittard, The Netherlands

5CO.14.6 Performance Analysis of Photovoltaics Systems Installed at Different Sites in the Atacama Desert
F. Araya, P. Ferrada, A. Marzo & E. Fuentealba
University of Antofagasta, Chile
J. Rabanal-Arabach
ISC Konstanz, Germany

VISUAL PRESENTATIONS 3CV.2

13:30 - 15:00 CdTe, CIS and Related Thin Film Solar Cells and Modules (I)

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

ORAL PRESENTATIONS 2CO.3

15:15 - 16:45 n-Type PERT Solar Cell Concepts

Chairpersons:

A.W. Weeber
ECN, The Netherlands

J. Bagdahn
Fraunhofer CSP, Germany

2CO.3.1 Oxygen Vacancies in Tungsten Oxide and Their Influence on Tungsten Oxide/Silicon Heterojunction Solar Cells
M. Mews, L. Korte & B. Rech
HZB, Berlin, Germany

2CO.3.2 n-PERT Solar Cells with Passivated Contact Technology Based on LPCVD Polysilicon and Fire-through Contact Metallization
R.C.G. Naber, M. Lenes, A.H.G. Vlooswijk & J.R.M. Luchies
Tempress, Vaassen, The Netherlands
Z. Qian, F. Zheng, J. Lin & Z. Zhang
Shanghai ShenZhou New Energy Development, China

2CO.3.3 20% n-PERT Solar Device in Only 7 Steps: the Solenna(3) Concept
R. Cabal, B. Grange, R. Monna, Y. Veschetti & S. Dubois
CEA, Le Bourget du Lac, France

2CO.3.4 21.3% Large Area n-PERT Silicon Solar Cells Using Screen-Printed Aluminium with Open Circuit Voltage above 680mV
J. Chen, F. Duerinckx, E. Cornagliotti, A. Uruena de Castro, L. Tous, M. Aleman, R. Russell, P. Choulat, S. Singh, J. Cho, J. John, I. Kuzma Filipek, M. Haslinger, I. Gordon, J. Poortmans & J. Szlufcik
imec, Leuven, Belgium

2CO.3.5 n-PERC c-Si Solar Cell Architecture with Front and Rear Ion-Implanted Carrier-Selective Contacts
A. Ingenito, H. Dijkslag, G. Yang, O. Isabella & M. Zeman
Delft University of Technology, The Netherlands

2CO.3.6 Industrial n-Type Bifacial Co-Diffused Rear Emitter Solar Cells with Boron Silicate Glass as Diffusion Source and Passivation
N. Wehmeier, S. Kajari-Schröder, T. Brendemühl, A. Nowack, R. Brendel & T. Dullweber
ISFH, Emmerthal, Germany

ORAL PRESENTATIONS 3CO.7

15:15 - 16:45 Perovskite Solar Cells and Modules: Processing

Chairpersons:

Y. Chen
Nanyang Technological University, Singapore

S. Hayase
Institute of Technology, Japan

3CO.7.1 ***Special Introductory Presentation***
Towards Roll-to-Roll Manufacturing of Perovskite Based PV Modules
R. Andriessen & P. Poodt
TNO, Eindhoven, The Netherlands
T. Aernouts
imec, Leuven, Belgium
S. Veenstra
ECN, Eindhoven, The Netherlands
R. Janssen & A. Createore
TU/e, Eindhoven, The Netherlands
D. Vanderzande
University of Hasselt, Diepenbeek, Belgium
T. Kirchartz
Forschungszentrum Jülich, Germany

3CO.7.2 **High-Efficiency Planar-Structure Perovskite Solar Cells from Low Temperature Proximity Evaporation Technique**
S.-P. Lin, H.-C. Lee, P.-T. Guo & C.-F. Lin
NTU, Taipei, Taiwan

3CO.7.3 **Perovskite-Based Solar Cells: towards Large & Flexible Devices**
L. Wagner, M. Manceau, F. Ardiaca & S. Berson
CEA, Le Bourget du Lac, France

3CO.7.4 **A Fast Spray Deposition Approach for High Efficient Planar Heterojunction Solar Cells**
Z. Bi, Z. Liang, X. Xu, J. Li & G. Xu
Chinese Academy of Science, Guangzhou, China
N. Yuan & J. Ding
Changzhou University, Jiangsu, China

3CO.7.5 **Loss Analysis and Optimization for High Efficiency Perovskite Photovoltaic Modules**
R. Gehlhaar, T. Merckx, C. Masse de la Huerta,
L. Rakocevic, W. Qiu & M. Jaysankar
imec, Leuven, Belgium

ORAL PRESENTATIONS 1CO.11

15:15 - 16:45 New Materials for Modules

Chairpersons:

J. Poortmans
imec, Belgium

B.B. Van Aken
ECN, The Netherlands

1CO.11.1 **Back in the PV Galaxy: the Return of the Silicone Module**
G. Beaucarne
Dow Corning, Seneffe, Belgium
S. Wang, X. Sun, Y. Wu & Y. Huang
BYD, Shenzhen, China
N. Shephard
Dow Corning, Midland, United States

1CO.11.2 **Investigation of Thermomechanical Stress in Solar Cells with Multi Busbar Interconnection by Finite Element Modeling**
L.C. Rendler, A. Kraft & U. Eitner
Fraunhofer ISE, Freiburg, Germany
C. Ebert
Gebr. Schmid, Freudenstadt, Germany
S. Wiese
Saarland University, Saarbrücken, Germany

1CO.11.3 **Production of Cheap Back Contact Based PV Modules**
M.J.A.A. Goris, A. Biesbroek, B.W.J. Kikkert & J.M. Kroon
ECN, Petten, The Netherlands
K. Rozema
Dycomet Europe, Akkrum, The Netherlands
I.J. Bennett
DSM Innovation Center, Sittard, The Netherlands
J. Verlaak
DSM Coating Resins, Zwolle, The Netherlands

1CO.11.4 **Novel Conductive Adhesive Concept for Solar Module Manufacturing**
S. Helland, T. Helland & E. Kalland
Mosaic Solutions, Skjetten, Norway
H. Kristiansen & K. Redford
Conpart, Skjetten, Norway

1CO.11.5 **DSM Light Trapping Technology for Bifacial PV Modules**
P. Pasmans
DSM, Geleen, The Netherlands
M. Mrcarica & K. Du-Mong
DSM, Sittard, The Netherlands
A. Schneider & J. Rabanal-Arabach
ISC Konstanz, Germany

1CO.11.6 Novel High Performance, Highly Durable, Anti-Reflective Coating for Photovoltaic Glass

B. Brophy, S. Maghsoodi & P. Gonsalves
Enki Technology, San Jose, United States
M. Terry, J. Dee & C. Alcantara
DuPont, Sunnyvale, United States
Y. Wang, J. Qi & D. Hu
Lerri Solar Technology, Xi'an, China

ORAL PRESENTATIONS 5CO.15

15:15 - 16:45 MPP, Inverter and Grid Services

Chairpersons:

C. Wittwer
Fraunhofer ISE, Germany

H. Te Heesen
Tier University of Applied Science, Germany

5CO.15.1 Low Cost Maximum Power Point Tracker Replaces Bypass-Diode

T. Czarnecki, A. Schneck & R. Merz
University of Applied Sciences Karlsruhe, Germany

5CO.15.2 Power Balance Control for a Two-Stage Solar Inverter with Low Voltage Ride through Capability

G. Kampitsis, E. Batzelis & S. Papathanassiou
NTUA, Athens, Greece

5CO.15.3 Module-Level Power Electronics: the Business Case from an End-User Perspective

M.N. van den Donker, G. Verberne, K. Sinapis & W. Folkerts
ECN, Eindhoven, The Netherlands

5CO.15.4 Field and Laboratory Performance Characterisation of Microinverter and Power Optimizer Systems

D. Stellbogen, P. Lechner & M. Senger
ZSW, Stuttgart, Germany

5CO.15.5 Genetic Algorithm Selection of Optimal Values for 4-Bit Active Power Control of Solar Inverters

A. El Hassani El Alaoui, B. Ikken, Z. Naimi,
K. Belrhiti Alaoui, A. Benlarabi & A. Benazzouz
IRESEN, Rabat, Morocco
M. Taalabi & K. Lefrouni
EMI, Rabat, Morocco

5CO.15.6 Lessons Learned from the Design and Operation of a 300 kWp PV System with Full Self-Consumption of the Energy Produced

B. Gaiddon & M. Joos
Hespul, Lyon, France
A. Thebault & C. Derobert
Enercoop, Paris, France
N. Debray
Enercoop Bretagne, Rennes, France
M. Dupret & B. Rozel
Enertech, Felines, France

VISUAL PRESENTATIONS 5CV.3

15:15 - 16:45 Solar Resource and Forecasting / Sustainability and Recycling

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

ORAL PRESENTATIONS 2CO.4

17:00 - 18:30 Solar Cell Concepts Based on Passivating Contacts

Chairpersons:

S.W. Glunz
Fraunhofer ISE, Germany

S. De Wolf
EPFL, Switzerland

2CO.4.1 A Quantitative Measure for the Carrier Selectivity of Contacts to Solar Cells

R. Brendel & R. Peibst
ISFH, Emmerthal, Germany

2CO.4.2 Titanium Dioxide: a Promising Candidate Material as Electron-Selective Passivating Contact for Crystalline Silicon Solar Cells?

J. Melskens, B.W.H. van de Loo, B. Macco,
R.W.H.S. Scheerder & W.M.M. Kessels
Eindhoven University of Technology, The Netherlands

2CO.4.3 **Optimization of p+ Poly-Si / c-Si Junctions on Wet-Chemically Grown Interfacial Oxides and on Different Wafer Morphologies**
Y. Larionova, R. Peibst, M. Turcu, S. Reiter & R. Brendel
ISFH, Emmerthal, Germany
D. Tetzlaff & J. Krügener
Leibniz University of Hannover, Germany
T. Wietler
Leibniz Universität Hannover, Germany
U. Höhne & J.-D. Kähler
centrotherm, Hannover, Germany

2CO.4.4 **High Efficiency Tunnel Oxide Junction Solar Cell Enabling Record 22% Efficiency Solar Module**
J.B. Heng, Z. Xie, A. Reddy, B. Yang, P. Nguyen, J. Fu, K. Lam, C. Erben, Z. Huang, Y. Kang & Z. Xu
Silevo, Fremont, United States

2CO.4.5 **High Volume Manufacturing of High Efficiency Crystalline Silicon Solar Cells with Shielded Metal Contacts**
O. Schultz-Wittmann, D. de Ceuster, A. Turner, B. Eggleston, D. Suwito, V. Prajapati & S. Baker-Finch
First Solar, Santa Clara, United States

2CO.4.6 **n-Type Polysilicon Passivating Contacts for Industrial Bifacial n-PERT Cells**
M.K. Stodolny, Y. Wu, G.J.M. Janssen, I. Romijn & L.J. Geerligs
ECN, Petten, The Netherlands
M. Lenes & J.R.M. Luchies
Tempress Systems, Vaassen, The Netherlands

ORAL PRESENTATIONS 3CO.8

17:00 - 18:30 Organic Photovoltaic Devices

Chairpersons:

invited

R. Dunbar
CSIRO Energy Technology, Australia

3CO.8.1 ***Special Introductory Presentation***
Industrialization of OPV
S.Wieder
Merck, Darmstadt, Germany

3CO.8.2 **invited**

3CO.8.3 **Organic Photovoltaics for Energy Harvester of Wireless Sensor Network**
Y. Aoki
Rohm, Kyoto, Japan

3CO.8.4 **Digital Processing and Lifetime Study of Flexible Organic Photovoltaic Modules**
M. Manceau, A. Barbot, F. Ardiaca, N. Nguyen, M. Matheron & S. Berson
CEA, Le Bourget du Lac, France

3CO.8.5 ***EU PVSEC Student Award Winner Presentation***
Highly Efficient, All-Solution Processed, Mechanically Flexible, Semi-Transparent Organic Solar Modules
J. Czolk, D. Landerer, M. Koppitz, C. Sprau & A. Colsmann
Karlsruhe Institute of Technology, Germany

ORAL PRESENTATIONS 6CO.12

17:00 - 18:30 Grid and Energy System Integration (III) - Technology Solutions

Chairpersons:

H. Nussbaumer
Zurich University of Applied Sciences, Switzerland

S. Caneva
WIP - Renewable Energies, Germany

6CO.12.1 **Efficiency and Effectiveness of PV Battery Energy Storage Systems for Residential Applications - Experience from Laboratory Tests of Commercial Products**
C. Messner, R. Bründlinger, J. Kathan & J. Mayr
AIT, Vienna, Austria

6CO.12.2 **Characterising the Prevalence and Persistence of Solar Energy Fluctuations for Successful PV Integration Using Battery Storage Systems**
J. Barry, N. Munzke & J. Thomas
Karlsruhe Institute of Technology,
Eggenstein-Leopoldshafen, Germany

6CO.12.3 **PV Battery Learning Curve and Future Market Penetration**
F.P. Baumgartner
Zurich University of Applied Sciences, Winterthur, Switzerland

6CO.12.4 **Assessing the Potential of Hybrid PV–Battery Systems to Cover HVAC Loads under Southern European Climate Conditions**
J.C. Solano, L. Olivieri, E. Caamaño-Martín & G. Almeida Dávi
UPM, Madrid, Spain

6CO.12.5 Combined PV Solar Compression Cooling and Free Cooling System
P. Gantenbein, L. Omlin & D. Notter
Institut für Solartechnik, Rapperswil, Switzerland
A. Snegirjovs
Technical University, Riga, Latvia

6CO.12.6 Optimized Demand Side Management and Minimized Battery Storage for High Self-Consumption with PV Driven Low-Part-Load Heat Pumps or Compression Chillers
M. Spinnler, J. Shen, B. Heithorst, F. Kiefer, A. Kastl, A. Präbst & T. Sattelmayer
Munich University of Technology, Garching, Germany

ORAL PRESENTATIONS 5CO.16

17:00 - 18:30 Meteorology, Improved Yield Estimation and Soiling Effects

Chairpersons:

E. Lorenz
Fraunhofer ISE, Germany

C. Nyman
Soleco, Finland

5CO.16.1 *EU PVSEC Student Award Winner Presentation*
Combining Solar Irradiance Databases and PV Performance Model for PV System Performance Analysis
B. Kirn & M. Topic
University of Ljubljana, Slovenia

5CO.16.2 Impact of Wind on Intra-Module Energy Yield Variations
H. Goverde, J. Govaerts, E. Voroshazi, F. Catthoor & J. Poortmans
imec, Leuven, Belgium
G. Van den Broeck, B. Herteleer, D. Goossens, K. Baert & J. Driesen
KU Leuven, Belgium
D. Anagnostos
NTUA, Athens, Greece

5CO.16.3 Quantification of Losses Caused by Dynamically Changing Shadows in Multi-MW PV Plants Based on Advanced Monitoring Data Analysis
G. Mütter & B. Eizinger
Alternative Energy Solutions, Vienna, Austria
M. Edelbacher
Greentec Services, Diepoldsau, Switzerland

5CO.16.4 Snow Cover Mapping Improved and Updated for Site Assessment, Yield Forecast and Photovoltaic System Design
F. Kaiser & M. Zehner
Rosenheim University of Applied Sciences, Germany
G. Wirth
Cronimet Mining Power Solutions, Unterhaching, Germany
R. Gottschalg
Loughborough University, United Kingdom
G. Becker & F. Flade
SeV Bavaria, Munich, Germany
M. Schroedter-Homscheidt
German Aerospace Center, Wessling, Germany

5CO.16.5 Advanced Analyses of Loss Mechanisms for PV Systems in Delhi, India
A.M. Nobre, D. Dave, A. Khor, R. Malhotra & S. Karthik
Cleantech Energy, Singapore, Singapore
M. Peters
MIT, Cambridge, United States
T. Reindl
SERIS, Singapore, Singapore

5CO.16.6 Performance of Photovoltaic Panels under Soiling in Capital City of Chile
E. Urrejola, P. Ayala, M. Salgado, G. Ramírez-Sagner, C. Cortés & A. Pino
Fraunhofer Chile, Santiago, Chile
J. Antonanzas
University of La Rioja, Logrono, Spain
R. Escobar
Pontifical Catholic University of Chile, Santiago, Chile

VISUAL PRESENTATIONS 3CV.4

17:00 - 18:30 CdTe, CIS and Related Thin Film Solar Cells and Modules (II)

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

EU PVSEC Dinner

NOTES

Thursday, 23 June 2016

ORAL PRESENTATIONS 2DO.1

08:30 - 09:30 Aspects of Manufacturing and Processing of c-Si Cells

Chairpersons:

P. Fath
RCT-Solutions, Germany

H. Schlemm
Meyer Burger, Germany

2DO.1.1 ***EU PVSEC Student Award Winner Presentation***
Ultrafast Lifetime Regeneration in an Industrial Belt-Line Furnace Applying Intense Illumination at Elevated Temperature
D.C. Walter & J. Schmidt
ISFH, Emmerthal, Germany
T. Pernau
centrotherm photovoltaics, Blaubeuren, Germany

2DO.1.2 **Application of High Efficiency Emitters to Multicrystalline Silicon**
M. Kim, H. Li, D. Payne, S. Wenham, B. Hallam & M. Abbott
UNSW, Sydney, Australia

2DO.1.3 **Benefits of Screen Printed Finger Lines Manufactured from an Innovative Additive-Free Silver Paste Formulation**
C. Yüce, M. Schneider & N. Willenbacher
Karlsruhe Institute of Technology, Germany
M. König & A. Grumbach
Heraeus, Hanau, Germany
F. Clement, M. Pospischil & M. Linse
Fraunhofer ISE, Freiburg, Germany

2DO.1.4 **Comprehensive Study of Intermetallic Compounds in Solar Cell Interconnections Including Lead-Free, Low Melting Point Solders**
M. Möller, T. Geipel, A. Kraft & U. Eitner
Fraunhofer ISE, Freiburg, Germany

ORAL PRESENTATIONS 6DO.5

08:30 - 09:30 Grid and Energy System Integration (I) / Utility-Scale PV

Chairpersons:

I. Weiss
WIP - Renewable Energies, Germany

F. Bonemazzi
ENEL, Italy

6DO.5.1 Simulation of Local Energy Surplus Usage in Hybrid Grids with a High PV Penetration Rate
D. Stakic, G. Heilscher, H. Ruf, K. Ditz & D. Funk
Ulm University of Applied Sciences, Germany
F. Meier
Stadtwerke Ulm, Germany

6DO.5.2 Solar PV Resource for Higher Penetration through a Combined Spatial Aggregation with Wind
T. Bischof-Niemz & C. Mushwana
CSIR, Pretoria, South Africa

6DO.5.3 Techno-Economic Optimization of Photovoltaic Plant Layout by Using Design of Experiments Techniques
S.N. Ringlstetter, L. Haack, L. Sommer & R. Meyer
Suntrace, Hamburg, Germany
F. Dildey
Hamburg University of Applied Sciences, Germany

6DO.5.4 New Design Challenges in Large Scale PV Installations in Tough Contexts
F. Montanari
ENEL Green Power, Rome, Italy

ORAL PRESENTATIONS 3DO.9

08:30 - 09:30 Characterisation, Standards and Applications of Organic and Hybrid PV Devices

Chairpersons:

invited

Y. Aoki
Rohm, Japan

3DO.9.1 Progress in Standardization for OPV
J. Hauch
ZAE Bayern, Erlangen, Germany

3DO.9.2 Long-Term Outdoor Performance Evaluation of Organic PV Modules
R. Gehlhaar, E. Vandenplas, K. Cnops, D. Cheyns & T. Aernouts
imec, Leuven, Belgium
A.-F. Vaessen, H. Grandjean & S. Scheerlinck
Laborelec, Linkebeek, Belgium

3DO.9.3 Device Pre-Conditioning and Steady-State Temperature Dependence of Perovskite Solar Cells
R. Dunbar, W. Moustafa, T.W. Jones, K.F. Anderson, C. Fell & G.J. Wilson
CSIRO Energy Technology, Mayfield West, Australia
A. Pascoe & Y.-B. Cheng
ANU, Canberra, Australia

3DO.9.4 Calibration Procedure for the Accurate Power Measurements of Slow Responding PV Devices (Hetero-Junction, Dye-Sensitized and Perovskite Solar Cells)
G. Bardizza, D. Pavanello, R. Galleano, T. Sample & H. Müllejans
European Commission, Ispra, Italy

ORAL PRESENTATIONS 7DO.13

08:30 - 09:30 Contribution of PV to the Energy Transition

Chairpersons:

D. Stickelberger
Swissolar, Switzerland

M. Getsiou
European Commission DG RTD, Belgium

7DO.13.1 On the Role of Solar Photovoltaics in Global Energy Transition Scenarios
C. Breyer, D. Bogdanov, O. Koskinen, M. Baraza, U. Caldera, S. Afanasyeva, M. Child & J. Farfan
Lappeenranta University of Technology, Finland
A. Gulagi & A. Aghahosseini
Lappeenranta University of Technology (LUT), Finland
L.S.N.S. Barbosa
University of São Paulo, São Carlos, Brazil
P. Vainikka
VTT, Lappeenranta, Finland

7DO.13.2 Market4RES- Post-2020 Framework for a Liberalised Electricity Market with a Large Share of Renewable Energy Sources

T. Döring
SolarPower Europe, Brussels, Belgium
L. Olmos, P. Rodilla & C. Fernandes
Comillas, Madrid, Spain
A. Fontaine
RTE, La Defense, France
B. Caetano & R. Loureiro
FOSG, Brussels, Belgium
Y. Langer & H. Right
APX Group, Amsterdam, The Netherlands
S. Dourlens
Technofi, Sophia-Antipolis, France
W. Ove
SINTEF, Trondheim, Norway
B. Burgholzer
EEG, Vienna, Austria

7DO.13.3 The Relevance of PV in the Optimisation of Synergies Among Hybrid Energy Grids in Smart Cities – the Orpheus Project

S. Caneva, I. Weiss & S. Betz
WIP - Renewable Energies, Munich, Germany
G. Heilscher, H. Ruf, D. Stakic, K. Ditz & D. Funk
Ulm University of Applied Sciences, Germany
F. Meier
SWU Netz, Ulm, Germany
A. Schülke, T.G. Noh, A. Papageorgiou, S. Nicolas & S. Nicolas
NEC Laboratories, Cambridge, United Kingdom

7DO.13.4 Interactive Web-Service for Environmental Multi-Criteria LCA of Photovoltaic Systems Worldwide

P. Perez-Lopez, I. Blanc, B. Gschwind, P. Blanc & L. Menard
MINES ParisTech, Sophia-Antipolis, France
R. Frischknecht & P. Stolz
Treeze, Zurich, Switzerland
Y. Durand
ADEME, Valbonne, France
G. Heath
NREL, Golden, United States

VISUAL PRESENTATIONS 3DV.1

08:30 - 09:30 Silicon-based Thin Film Solar Cells and Modules II

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

PLENARY SESSION 5DP.1 / 6DP.2

09:50 - 12:10 Operation, Performance, Reliability and Sustainability of Photovoltaics // PV as Part of Our Built Environment: Solutions for Integration into Building Envelops and Energy Systems

Chairpersons:

M. Perrin
CEA, France

F.P. Baumgartner
Zurich University of Applied Sciences, Switzerland

5DP.1.1 *Keynote Presentation:* Identification of Technical Risks in the PV Value Chain and Quantification of the Economic Impact on the Business Model

D. Moser & M. Del Buono
Eurac Research, Bolzano, Italy
U. Jahn & M. Herz
TÜV Rheinland, Cologne, Germany
M. Richter & K. de Brabandere
3E, Brussels, Belgium

5DP.1.2 Mean Degradation Rates in PV Systems for Various Kinds of PV Module Failures

M. Köntges & S. Altmann
ISFH, Emmerthal, Germany
U. Jahn
TÜV Rheinland, Cologne, Germany

5DP.1.3 Forecasting and Observability: Critical Technologies for System Operations with High PV Penetration

P.-J. Alet
CSEM, Neuchâtel, Switzerland
V. Efthymiou
University of Cyprus, Nicosia, Cyprus
G. Graditi
ENEA, Portici, Italy
N. Henze
Fraunhofer IWES, Kassel, Germany
M. Juel
SINTEF, Trondheim, Norway
D. Moser & M. Pierro
EURAC, Bolzano, Italy
F. Nemac
ApE, Ljubljana, Slovenia
E. Rikos & S. Tselepis
CRES, Athens, Greece
G. Yang
Technical University of Denmark, Lyngby, Denmark

5DP.1.4 **PV Bifacial Yield Simulation with a Variable Albedo Model**
M. Chiodetti, A. Lindsay, P. Dupeyrat & D. Binesti
EDF R&D, Moret-sur-Loing, France
E. Lutun, K. Radouane & S. Mousel
EDF EN, Paris, France

6DP.2.1 ***Keynote Presentation:***
Emerging Performance Issues of Photovoltaic Battery Systems
J. Weniger, T. Tjaden, J. Bergner & V. Quaschning
Berlin University of Applied Sciences, Germany

6DP.2.2 **BIPV – Getting the Technology and Integration Balance Right**
A. Scognamiglio
ENEA, Portici, Italy

ORAL PRESENTATIONS 2DO.2

13:30 - 15:00 **Minority Carrier Lifetime Degradation and Regeneration**

Chairpersons:

G. Hahn
University of Konstanz, Germany

J.W. Müller
Hanwha Q CELLS, Germany

2DO.2.1 **Of Apples and Oranges: Why Comparing BO Regeneration Rates Requires Injection Level Correction**
S. Wilking, S. Ebert, C. Beckh, A. Herguth & G. Hahn
University of Konstanz, Germany

2DO.2.2 **The Development of In-Line Regeneration Tool for the Effective Suppression of Light-Induced-Degradation on p-Type Silicon Solar Cells**
K.-Y. Yen, J.-R. Huang, Y.-F. Lin, S.-P. Su, S.H.T. Chen & L.-W. Cheng
Motech Industries, Taoyuan County, Taiwan

2DO.2.3 **Degradation and Regeneration in mc Si After Different Gettering Steps**
A. Zuschlag, D. Skorka & G. Hahn
University of Konstanz, Germany

2DO.2.4 **Solutions for Preventing Carrier-Induced Degradation in Industrially Produced Multi-Crystalline PERC Cells**
C. Chan, D. Payne, A. Wenham, T.H. Fung, B. Hallam, M. Abbott & S. Wenham
UNSW Australia, Sydney, Australia

2DO.2.5 **Measures for Eliminating Light-Induced Lifetime Degradation in Multicrystalline Silicon**
D. Bredemeier, D.C. Walter, S. Herlufsen & J. Schmidt
ISFH, Emmerthal, Germany

2DO.2.6 **Impact of Al2O3/SiNx Passivation Layers on LeTID**
F. Kersten & J.W. Müller
Hanwha Q CELLS, Bitterfeld-Wolfen, Germany
J. Heitmann
Freiberg University of Technology, Germany

ORAL PRESENTATIONS 6DO.6

13:30 - 15:00 **Grid and Energy System Integration (II) - Case Studies**

Chairpersons:

W.C. Sinke
ECN, The Netherlands

G. Masson
Becquerel Institute, Belgium

6DO.6.1 **Integration of PV to Industrial Consumers with Multiple Grid Supply and Energy Management in Lebanon and Palestine**
M. Anzizu & X. Vallvé
Trama TecnoAmbiental, Barcelona, Spain
G. Velasco-Quesada
CEIB, Barcelona, Spain
H. Harajli
UNDP, Beirut, Lebanon

6DO.6.2 **Photovoltaic and Battery Energy Storage Systems in Shopping Malls: Energy and Cost Analysis of an Italian Case Study**
G. Barchi, R. Lollini & D. Moser
Eurac Research, Bolzano, Italy

6DO.6.3 **PV Application and Energy Management in Near-Zero Energy Buildings with Heat Pump and E-Mobility – Case Study of the Nexushaus**
J. Shen, S. Salfner, C. Hemmerle, F. Kiefer & W. Lang
TUM, Munich, Germany

6DO.6.4 Analysis of Stationary Electrical Storage Solutions for Residential Districts with High Photovoltaic Penetration
R. Völker, F. Schuldt, T. Kilper & K. von Maydell
Next Energy, Oldenburg, Germany

6DO.6.5 Advanced Simulation Platform for the Integration of Photovoltaics into Power Systems: SPIDER
F. Bourry & T.L. Phan
CEA, Le Bourget du Lac, France
B. Guinot, C. Bourasseau & S. Revol
CEA, Grenoble, France

6DO.6.6 Probabilistic Evaluation of UK Domestic Solar Photovoltaic Systems: An Integrated Geographical Information System PV Estimation Tool
P.A. Leicester, N. Doylend & P. Rowley
Loughborough University, United Kingdom

ORAL PRESENTATIONS 5DO.10

13:30 - 15:00 Failure Modes and Accelerated Testing

Chairpersons:

U. Jahn
TÜV Rheinland Energy, Germany

W. Knaupp
PV-Plan, Germany

5DO.10.1 ***Special Introductory Presentation:***
PV Degradation Curves: Non-Linearities and Failure Modes
D.C. Jordan, T.J. Silverman, B. Sekulic & S.R. Kurtz
NREL, Golden, United States

5DO.10.2 Acceleration Factors for Moisture Induced Degradation of Flexible PV Modules and Prediction of Field Performance
K. Hardikar, T. Krajewski & K. Toivola
MiaSolé, Santa Clara, United States

5DO.10.3 Bias and Irradiation Dependencies of CIGS Module Reliability during Heat Tests
K. Sakurai, K. Ogawa & H. Shibata
AIST, Tsukuba, Japan
A. Masuda
AIST, Tosu, Japan
H. Tomita, D. Schmitz & S. Tokuda
Solar Frontier, Atsugi, Japan

5DO.10.4 PV Module Damages Caused by Hail Impact and Non-Uniform Snow Load
G. Mathiak, J. Sommer, K. Kämmer, W. Herrmann, F. Reil & M. Hansen
TÜV Rheinland, Cologne, Germany

5DO.10.5 Investigation on the Impact of Module Cleaning on the Antireflection Coating
N. Ferretti, A. Sönmez & J. Berghold
PI Berlin, Germany
I. Ilse & C. Hagendorf
Fraunhofer CSP, Halle, Germany

ORAL PRESENTATIONS 7DO.14

13:30 - 15:00 PV Economics and Markets

Chairpersons:

T. Nordmann
TNC Consulting, Switzerland

C. Breyer
Lappeenranta University of Technology, Finland

7DO.14.1 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
I. Kaizuka
RTS, Tokyo, Japan

7DO.14.2 Global Photovoltaics in 2015 – Analysis of Current Solar Energy Markets and Hidden Growth Regions
C. Werner
Chris Werner Energy Consulting, Dessau, Germany
A. Gerlach
Hanwha Q CELLS, Bitterfeld-Wolfen, Germany
C. Breyer
Lappeenranta University of Technology, Finland
G. Masson
Becquerel Institute, Brussels, Belgium

7DO.14.3 Impact of FIT on the Cost of PV Systems in Japan
I. Kaizuka, H. Matsukawa, H. Yamaya, T. Ohigashi & O. Ikki
RTS, Tokyo, Japan

7DO.14.4 Technical Assumptions Used in PV Financial Models: Review and Analysis

J. Vedde
SiCon, Birkerod, Denmark
M. Richter & C. Tjendgdrawira
3E, Brussels, Belgium
B. Herteleer
KU Leuven, Belgium
M. Herz & U. Jahn
TÜV Rheinland, Cologne, Germany
B. Stridh
ABB Corporate Research, Västerås, Sweden
L. Frearson
CAT Projects, Alice Springs, Australia

7DO.14.5 Impact of Energy Storage in Conjuction With Solar PV on Wholesale Electricity Prices

F. Sanches, H. Gouzerh & N. Gourvitch
Green Graffe Energy, Paris, France
A. El Gammal, G. Masson & T.M.N. Ngo
Becquerel Institute, Brussels, Belgium

7DO.14.6 Electric Vehicles Powered with PV Electricity as a New Driver for Photovoltaic

U. Muntwyler
BUAS, Burgdorf, Switzerland

VISUAL PRESENTATIONS 3DV.2

13:30 - 15:00 Perovskite, Organic and Hybrid Devices

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

ORAL PRESENTATIONS 2DO.3

15:15 - 16:45 Silicon Solar Cell Characterisation and Modelling (I)

Chairpersons:

E. Cornagliotti
imec, Belgium

D.C. Walter
ISFH, Germany

2DO.3.1 Evaluation of Passivated Surface of Silicon with Laser Terahertz Emission Microscope (LTEM)

T. Mochizuki, J. Mitchell, K. Tanahashi, K. Shirasawa & H. Takato
AIST, Koriyama, Japan
A. Ito & H. Nakanishi
SCREEN, Kyoto, Japan
I. Kawayama & M. Tonouchi
Osaka University, Japan

2DO.3.2 Investigation of Al2O3 Passivation Layers by Photoluminescence Imaging under Applied Voltage

H. Haug & E.S. Marstein
Institute for Energy Technology, Kjeller, Norway
H. Savin
Aalto University, Espoo, Finland

2DO.3.3 Advanced Optical Characterization of Industrial PECVD Silicon Nitride Layers

N. Borojevic & Z. Hameiri
UNSW, Sydney, Australia
S. Winderbaum
Shamash, Mount Barker, Australia

2DO.3.4 On the Stability of Dielectric Passivation Subjected to Illumination and Temperature Treatments

D. Sperber, A. Herguth & G. Hahn
University of Konstanz, Germany

2DO.3.5 Two-Dimensional Characterization of Phosphorus-Implanted Emitter and Phosphorus-Diffused Emitter of Silicon Solar Cell Using Super-Higher-Order Scanning Nonlinear Dielectric Microscopy

K. Hirose, N. Chinone & Y. Cho
Tohoku University, Sendai, Japan
K. Tanahashi & H. Takato
AIST, Koriyama, Japan

2DO.3.6 A Simulation Study of Resistive Effect of Rear Tunneling Oxide Passivated Contacts in Bifacial n-PERT Silicon Solar Cell
C.-M. Wei, Y.-H. Lin, C.-C. Li & C.-C. Chuang
Motech Industries, Tainan, Taiwan

ORAL PRESENTATIONS 6DO.7

15:15 - 16:45 PV in Buildings and in the Environment: Focus on Product Designd and Integration

Chairpersons:

A. Scognamiglio
ENEA, Italy

F. Frontini
SUPSI, Switzerland

6DO.7.1 Hikari : a Positive Energy Building with an Architecturally Integrated PV Facade and a PV Roof-Top System (190 kWp)
B. Gaiddon
Hespul, Lyon, France
M. Valentin
SPL Lyon-Confluence, France
L. Alfonsi
Bouygues Immobilier, Lyon, France
M.-L. Laquerriere
Tecsol, Lyon, France
G. Gouranton
Terre Ciel Energies, Bidart, France
D. Corgier
Manaslu, Le Bourget du Lac, France

6DO.7.2 Visual Design of PV-Modules – a Crucial Factor for Façade Application Acceptance
A. Geissler
FHNW Switzerland, Muttenz, Switzerland
P. Fornaro & A. Bianco
University of Basel, Switzerland

6DO.7.3 Integration of Trackless Holographic CPV Modules in Buildings and Urban Furniture
H.-J. Rodríguez San Segundo, A.M. Villamarín Villegas & A. Calo López
IHT, El Puerto de Santa Maria, Spain
F.J. Pérez López
IHT, El Puerto de Santa María, Spain

6DO.7.4 Electrical Design and Layout Optimization of Flexible Thin-Film Photovoltaic Modules
J. Hofer, Z. Nagy & A. Schlueter
ETH Zurich, Switzerland

6DO.7.5 ZigZag Structure in Façade Optimizes PV Yield While Aesthetics Are Preserved
R.M.E. Valckenborg & W. Folkerts
SEAC, Eindhoven, The Netherlands
W. van der Wall
Wallvision, Heeze, The Netherlands
J.L.M. Hensen
Eindhoven University of Technology, The Netherlands
A. De Vries
Holland Solar, Utrecht, The Netherlands

6DO.7.6 Designing Agrivoltaico Solutions for Conventional Cereal Cropping Systems
S. Amaducci & M. Colauzzi
UCSC, Piacenza, Italy
A. Reboldi
REM TEC, Casalromano, Italy

ORAL PRESENTATIONS 5DO.11

15:15 - 16:45 Electrical Characterisation of PV Modules

Chairpersons:

T. Sample
European Commission DG JRC, Italy

T.R. Betts
Loughborough University, United Kingdom

5DO.11.1 Accurate Determination of Photovoltaic Cells and Modules Peak-Power from Their Current-Voltage Characteristics
B. Paviet-Salomon, J. Levrat, M. Despeisse & C. Ballif
CSEM, Neuchâtel, Switzerland
V. Fakhfouri, Y. Pelet & N. Rebeaud
Pasan, Neuchâtel, Switzerland

5DO.11.2 Electrical Performance Characterisation Intercomparison of High Efficiency c-Si PV Modules within European and Asian Laboratories

C. Monokroussos & D. Etienne
TÜV Rheinland, Shanghai, China
J. Ha
TÜV Rheinland, Shanghai, Japan
S. Dittmann
SUPSI, Canobbio, Switzerland
K. Morita
TÜV Rheinland, Yokohama, Japan
J. Stang & T. Herbrecht
TÜV Rheinland, Cologne, Germany
V. Fakhfouri & N. Rebeaud
Pasan, Neuchâtel, Switzerland
E. Salis, D. Pavanello & H. Müllejans
European Commission, Ispra, Italy

5DO.11.3 Comprehensive Characterized Solar Cells: Impact of Angular, Spectral, and Nonlinear Effects

T. Fey, I. Kröger, F. Witt & S. Winter
PTB, Braunschweig, Germany

5DO.11.4 Precise Determination of the STC I-V Curves by Wide-Range Linear Extrapolation of Outdoor I-V Curves on Partly Sunny Days

Y. Hishikawa, T. Doi, M. Higa, H. Ohshima & K. Yamagoe
AIST, Tsukuba, Japan

5DO.11.5 Uncertainty Analysis in the Power Rating Measurement of Solar Cell as Per IEC 61853-1

R. Singh, B. Bora, O.S. Sastry, S. Rai, M. Bangar & R. Dahiya
NISE, Gurgaon, India

5DO.11.6 Characterisation of n-Type Bifacial Silicon PV Modules

J. Lopez-Garcia, A. Pozza, D. Pavanello, B. Haile & T. Sample
European Commission, Ispra, Italy

ORAL PRESENTATIONS 5DO.15

15:15 - 16:45 Sustainability and Recycling

Chairpersons:

K. Wambach
bifa Environmental Institute, Germany

A. Wade
First Solar, Germany

5DO.15.1 Eco-Solar Factory: 40%plus Eco-Efficiency Gains in the Photovoltaic Value Chain with Minimised Resource and Energy Consumption by Closed Loop Systems

M.P. Bellmann
SINTEF, Trondheim, Norway
R. Roligheten
Steuler Solar Technology, Porsgrunn, Norway
G.S. Park
NorSun, Oslo, Norway
J. Denafas
Soli Tek R&D, Vilnius, Lithuania
F. Buchholz
ISC Konstanz, Germany
R. Einhaus
Apollon Solar, Lyon, France
I. Lombardi
Garbo, Cerano, Italy
B. Ehlen
Boukje.com Consulting, Bleiswijk, The Netherlands
K. Wambach
bifa Environmental Institute, Augsburg, Germany
P. Romero
AIMEN, Porrino, Spain
A. Bollar
INGESEA, Elgoibar, Spain

5DO.15.2 Status Quo of Emerging Photovoltaics from an Environmental Perspective

S. Weyand & L. Schebek
Technical University of Darmstadt, Germany

5DO.15.3 LCA and Data Monitoring for an Innovative Ready to Plug BIPV Roofing Steel Envelope

L. Samain & L. Fourdrinier
CRM Group, Liège, Belgium
R. Turconi, A.-L. Hettinger & R. Vignal
Arcelor Mittal, Maizières-lès-Metz, France

5DO.15.4 New Findings in Fire Prevention and Fire Fighting of PV Installations
U. Muntwyler, C. Renken & L. von Ballmoos
BUAS, Burgdorf, Switzerland

5DO.15.5 Recycling of Broken Si Based Structures and Solar Cells
M. Syvertsen & B. Ryningen
SINTEF, Trondheim, Norway
M. Di Sabatino
NTNU, Trondheim, Norway
W. Palitzsch
Loser Chemie, Langenweißbach, Germany
M. Schumann
Fraunhofer ISE, Freiburg, Germany
H.J. Möller
Fraunhofer ISE, Freiberg, Germany
C. Audoin, M. Serasset & D. Pelletier
CEA, Le Bourget du Lac, France
J. Diéguez
Silicio FerroSolar, Arteixo, Spain
A. Souto
Ferroatlantica, Arteixo, Spain
J. Denafas, L. Petreniene, M. Pranaitis, V. Cyras & R. Zolubas
Soli Tek R&D, Vilnius, Lithuania
A. Ulyashin
SINTEF, Oslo, Norway

5DO.15.6 FRELP 2 Project - Full Recovery End of Life Photovoltaic
L. Ramon
SASIL, Brusnengo, Italy
S. Ceola & S. Hreglich
Stazione Sperimentale del Vetro - SSV, Venice, Italy

VISUAL PRESENTATIONS 2DV.3

15:15 - 16:45 Silicon Feedstock, Crystallisation and Wafering

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

ORAL PRESENTATIONS 2DO.4

17:00 - 18:30 Silicon Solar Cell Characterisation and Modelling (II)

Chairpersons:

M.C. Schubert
Fraunhofer ISE, Germany

L.H. Slooff
ECN, The Netherlands

2DO.4.1 *EU PVSEC Student Award Winner Presentation*
Modelling and Characterization of Multicrystalline Silicon Blocks by Quasi-Steady-State Photoconductance
M. Goodarzi & D. Macdonald
ANU, Canberra, Australia
D. Chung & B. Mitchell
UNSW Australia, Sydney, Australia
T. Trupke
UNSW Australia, Kensington, Australia
R.A. Sinton
Sinton Instruments, Boulder, United States

2DO.4.2 Fourier Optical Measurement System: Enabling Ultrafast External Quantum Efficiency Measurements on Crystalline Silicon Solar Cells
J. Melskens, S.G.M. Heirman, M.A.A. Elshinawy, R. Koornneef & M. Schouten
Delft Spectral Technologies, The Netherlands

2DO.4.3 Genuine Bifacial Simulation and Optimization of an mc-Silicon PERC Solar Cell
N. Wöhrle, A. Alapont Sabater & J. Greulich
Fraunhofer ISE, Freiburg, Germany

2DO.4.4 Light Induced Degradation in PERC Solar Cells
J. Arumughan & R. Kopecek
ISC Konstanz, Germany
B. Martel & G. Raymond
CEA, Le Bourget du Lac, France
X. Brun
AET-Technologies, Meylan, France

2DO.4.5 Why Multi Busbars and Future Emitters Require Further Shrinking of Finger Line Width
L.J. Koduvelikulathu, J. Lossen & D. Rudolph
ISC Konstanz, Germany
M. Matusovsky & G. Dishon
Utilight, Yavne, Israel

2DO.4.6 Modelling The Long-Term Behaviour of Boron-Oxygen Defect Passivation in the Field Using Real Weather Data
B. Hallam, J. Bilbao, D. Payne, C. Chan, M. Kim, D. Chen, N. Gorman, M. Abbott & S. Wenham
UNSW Australia, Sydney, Australia

ORAL PRESENTATIONS 6DO.8

17:00 - 18:30 PV in Buildings and in the Environment: Focus on Characterisation and Evaluation

Chairpersons:

M. Topic
University of Ljubljana, Slovenia

H. Ossenbrink *(i)*
European Commission DG JRC, Italy

6DO.8.1 Bifacial PV Integrated on Building Balconies
S.R. Teixeira Freitas & M.C. Brito
University of Lisbon, Portugal

6DO.8.2 Indoor and Outdoor Characterization of Innovative Colored BIPV Modules for Façade Application
F. Frontini, P. Bonomo & E. Saretta
SUPSI, Canobbio, Switzerland
T. Weber & J. Berghold
PI Berlin, Germany
R. Karoblis & M. Pikutis
Viasolis, Vilnius, Lithuania
T. Lenkimas
GLASSBEL, Klaipeda, Lithuania

6DO.8.3 Quantification of Glare from Sunlight Reflected on Solar Installations
F. Ruesch, A. Bohren, M. Battaglia & S. Brunold
Institut für Solartechnik, Rapperswil, Switzerland

6DO.8.4 Integration of PV Modules in Energy Yield Optimized Carbon Concrete Composite Facades
S. Schindler & J. Schneider
Fraunhofer CSP, Halle, Germany
A. Heller
Leipzig University of Applied Sciences, Germany
M. Gorges
Technical University of Dresden, Germany
C. Rudolf
Solar Valley, Erfurt, Germany
L. Dämmig
SGB Steuerungstechnik, Leipzig, Germany

6DO.8.5 invited

6DO.8.6 Technical Evaluation of BIPV Power Generation Potential in EU-28
A. El Gammal
Becquerel Institute, Brussels, Belgium
D. Mueller & H. Bürckstümmer
Merck, Munich, Germany
R. Vignal
Arcelor Mittal, Luxembourg, France

ORAL PRESENTATIONS 5DO.12

17:00 - 18:30 Electroluminesence, Thermography, Failure Modes and Degradation Estimation

Chairpersons:

A. Metz
h.a.l.m. elektronik, Germany

P. Lechner
ZSW, Germany

5DO.12.1 Implementation of Aerial Thermography Inspection of PV Modules in the O&M Activities in Large PV Plants
J. Coello, L. Perez, A. Velasco & V. Parra
Enertis Solar, San Sebastián de los Reyes, Spain
M. Rosa & A. Cristobal
Aerotools-UAV, Alcobendas, Spain

5DO.12.2 Outdoor Electroluminescence Imaging of Crystalline Photovoltaic Modules: Comparative Study between Manual Ground-Level Inspections and Drone-Based Aerial Surveys
S. Koch, T. Weber & J. Berghold
PI Berlin, Germany
A. Fladung
Solartechnik-Fladung, Aachen, Germany
P. Clemens
SafeTwork, Saarbrücken, Germany

5DO.12.3 Outdoor Non-Destructive Infrared Thermography of Photovoltaic Modules and Plants for Inspection: IEC 62446-3
B. Jaeckel
UL International, Neu-Isenburg, Germany
B. Weinreich
HaWe Engineering, Gauting-Hausen, Germany
C. Buerhop-Lutz
ZAE Bayern, Erlangen, Germany
U. Jahn
TÜV Rheinland, Cologne, Germany

5DO.12.4 Data Mining Methods for Failure Classification on PV-Modules Monitored under Field-Conditions
G. Behrens, A. Dercho, H. Quakernack & T. Wächter
University of Applied Sciences Bielefeld, Minden, Germany
S. Hempelmann & I. Kruse
STORM Energy, Nuremberg, Germany

5DO.12.5 Assessment for IR Inspection Cycles and Efforts Related to System Design
A. Häring & T. Henne
SolarEdge Technologies, München, Germany
S. Dobler
Dosol, Regensburg, Germany

5DO.12.6 Estimation of the Degradation Rate of Fielded Photovoltaic Arrays in the Presence of Measurement Outages
A. Phinikarides, G. Makrides & G.E. Georghiou
University of Cyprus, Nicosia, Cyprus

ORAL PRESENTATIONS 2DO.16

17:00 - 18:30 Advanced c-Si Solar Cell Architectures

Chairpersons:

B. Terheiden
University of Konstanz, Germany

D. Muñoz
CEA, France

2DO.16.1 22.3% n-PERT Solar Cells on Epitaxially Grown Silicon Wafers
I. Kuzma-Filipek, M. Récaman-Payo, F. Duerinckx, E. Cornagliotti, P. Choulat, A. Sharma, M. Aleman, R. Russell, A. Uruena de Castro, J. Szlufcik & J. Poortmans
imec, Leuven, Belgium
R. Hao & T.S. Ravi
Crystal Solar, Santa Clara, United States

2DO.16.2 Co-Diffusion for p-Type PERT Solar Cells Using APCVD BSG Layers as Boron-Doping Source
S. Meier, S. Wiesnet, S. Maier, S. Mack, S. Unmüßig, S. Werner, P. Saint-Cast, D. Biro & A. Wolf
Fraunhofer ISE, Freiburg, Germany
C. Demberger & H. Knauss
Gebr. SCHMID, Freudenstadt, Germany

2DO.16.3 Pilot Production of 6inch IBC Solar Cells Yielding an Average Efficiency of 23% with a Low-Cost Industrial Process
Z. Li, Y. Yang, X. Zhang, W. Liu, Y. Chen, G. Xu, X. Shu, Y. Chen, P.P. Altermatt, Z. Feng & P.J. Verlinden
Trina Solar Energy, Changzhou, China

2DO.16.4 Co-Diffused Back-Contact Back-Junction Silicon Solar Cells with a Novel Screen-Printing Including Rear Innovation Technology
J.D. Huyeng, R. Efinger, A. Spribille, R. Keding, A. Wolf & F. Clement
Fraunhofer ISE, Freiburg, Germany
O. Doll
Merck, Darmstadt, Germany

2DO.16.5 5” Laser-IBC Solar Cells with 22.0% Efficiency
E. Hoffmann, M. Dahlinger, K. Carstens, R. Zapf-Gottwick & J.H. Werner
University of Stuttgart, Germany

2DO.16.6 Silicon Solar Cells with Passivated Contacts and Their Application in High-Efficiency Perovskite/c-Si Tandem Solar Cells
C. Ballif, J. Werner, G. Nogay, A. Walter, J. Geissbühler, J.P. Seif, F.-J. Haug, S. De Wolf & B. Niesen
EPFL, Neuchâtel, Switzerland
C. Allebé, D. Sacchetto, M. Despeisse, S.-J. Moon, S. Nicolay & J. Bailat
CSEM, Neuchâtel, Switzerland

VISUAL PRESENTATIONS 7DV.4

17:00 - 18:30 PV Economics and Markets / PV Global Issues, Policies and Strategies

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

NOTES

Friday, 24 June 2016

ORAL PRESENTATIONS 6EO.1

08:30 - 10:00 PV Applications without a Centralised Grid

Chairpersons:

P. Malbranche
CEA, France

X. Vallvé
Trama TecnoAmbiental, Spain

6EO.1.1 Designing High Efficient Solar Powered OLED Lighting Systems

P. Behrensdorff Poulsen, S. Thorsteinsson, A. Thorseth, D. Dan Corell, R. Overgaard Ploug, J. Wolff & C. Dam-Hansen
Technical University of Denmark, Roskilde, Denmark
A. Knott
Technical University of Denmark, Lyngby, Denmark

6EO.1.2 Selection of Weather Profile(s) for Testing Performance of SPV Pumps in Indian Climate

K. Yadav, O.S. Sastry, B. Bora, M. Kumar, R. Singh & M. Bangar
NISE, Gurgaon, India
A. Kumar & B. Prasad
TERI, New Delhi, India

6EO.1.3 Experimental Investigation of an Autonomous Battery-Less Reverse Osmosis Desalination System Powered by PV and Controlled by a Multi- Agent Decentralized Energy Management System

C.-S. Karavas, E. Dimitriou, E. Mohamed, G. Kyriakarakos, K.G. Arvanitis & G. Papadakis
Agricultural University of Athens, Greece
D. Piromalis
Piraeus University of Applied Sciences, Greece

6EO.1.4 Model-Based Design and Simulation of Control Strategies to Maximize the PV Hosting Capacity in Existing Isolated Diesel Networks - Using Solar Short-Term Forecasts for Predictive Control of Diesel Generation

D. Peters, R. Völker, T. Kilper, K. von Maydell & C. Agert
Next Energy, Oldenburg, Germany
M. Calais
Murdoch University, Australia
T. Schmidt
University of Oldenburg, Germany

6EO.1.5 **Industrial Hybrid Systems with High PV Penetration – Performance Analysis and Key Success Factors**
J.A. Notholt Vergara, V. Wachenfeld & M. Mostafa
SMA Solar Technology, Niestetal, Germany

6EO.1.6 **Energy Forecast for Mobile Photovoltaic Systems with Focus on Trucks for Cooling Applications**
M. Kühnel, B. Hanke, S. Geißendörfer, K. von Maydell & C. Agert
Next Energy, Oldenburg, Germany

ORAL PRESENTATIONS 7EO.2

08:30 - 10:00 From Global Assessment to Local Deployment

Chairpersons:

E. Perezagua
Consultores de Energía Fotovoltaica, Spain

W. Hoffmann *(i)*
ASE, Germany

7EO.2.1 **Gamifying the Energy Transition**
B. O'Donnell
Heliocentric Solutions, London, United Kingdom
D. Pfahl & J. Mehling
Prometeruse Foundation, Berlin, Germany

7EO.2.2 **Photovoltaic Development Standardizing Based on Roadmaps and Technology Readiness Levels**
P. Baliozian
Freiburg, Germany
S. Murad, S. Kim, R. Preu & F. Lorenz
Fraunhofer ISE, Freiburg, Germany
D. Morse
March, Germany

7EO.2.3 **Rooftop PV Potential Estimations: Automated Orthographic Satellite Image Recognition Based on Publicly Available Data**
K. Mainzer, D. Schlund, R. Mckenna & W. Fichtner
KIT, Karlsruhe, Germany
S. Killinger
Fraunhofer ISE, Freiburg, Germany

7EO.2.4 **Contribution of PV to the Energy Transition: the Case of Switzerland during the Next 15 Years**
A.V. Shah, Y.S. Riesen & N. Wyrsch
EPFL, Neuchâtel, Switzerland
J. Remund
Meteotest, Bern, Switzerland
A. von Kaenel
Meyer Burger, Gwatt, Switzerland
C. Ballif
CSEM, Neuchâtel, Switzerland

7EO.2.5 **Pro-PV Local Building Policy – State of Progress of the Lyon-Confluence Solar City Project**
B. Gaiddon & M. de l'Epine
Hespul, Lyon, France
M. Valentin & E. Vignali
SPL Lyon-Confluence, France
K. Lapray & O. Zanni
TRIBU, Lyon, France

7EO.2.6 **Progress of Solar Photovoltaic Systems in India**
S. Vasudevan & A. Murugesan
Arunai Engineering College, Tiruvannamalai, India

ORAL PRESENTATIONS 5EO.3

08:30 - 10:00 Economics, O&M and Reliability

Session Chair:

J. Binder
ZSW, Germany

K. Radouane
EDF EN, France

5EO.3.1 **Analysis of the Energy and Economic Influence of the O&M Annual Cost in the Profitability of PV Systems**
J.C. Lomas Monzón
Gerión Ingeniería, Granada, Spain
E. Muñoz-Cerón, G. Nofuentes Garrido & J. De la Casa
University of Jaén, Spain

5EO.3.2 **Reliability of Photovoltaic Solar Systems through Real O&M Follow-Up Data**
I. Lillo Bravo, A. Palomo & M. Silva Pérez
University of Seville, Spain
J. Guasumba
University of Fuerzas Armadas, Quito, Ecuador

5EO.3.3 Weather Sensitivity Analyses in Layout Planning
M. Bischoff & M. Dehler
Siemens, München, Germany
J. Leitner, K. Plociennik & T. Fleuren
Fraunhofer ITWM, Kaiserslautern, Germany

5EO.3.4 3D Solar Potential Modelling and Analysis: a Case Study for the City of Utrecht
B. Kausika & W. van Sark
Utrecht University, The Netherlands
M. Moshrefzadeh & T.H. Kolbe
Munich University of Technology, Germany

5EO.3.5 New Approach to Analyzing Longterm Performance of Large Populations of PV Systems in Feed in Tarif Markets with Minimal Efforts and Costs
T. Vontobel, T. Nordmann & R. Lingel
TNC Consulting, Feldmeilen, Switzerland

5EO.3.6 A Fast and Effective Approach to Modelling PV System Performance in Complex Shading Environments
I.R. Cole, D. Palmer, E. Koumpli (a.k.a Koubli), T.R. Betts & R. Gottschalg
Loughborough University, United Kingdom

PLENARY SESSION 7EP.1

10:30 - 11:30 PV Economics, Markets and Policies

Chairpersons:

S. Nowak *(i)*
NET Nowak Energy & Technology, Switzerland

P. Menna
European Commission DG Energy, Belgium

7EP.1.1 True Competitiveness of Solar PV - a European Case Study
E. Vartiainen
Fortum, Finland
G. Masson
Becquerel Institute, Brussels, Belgium
C. Breyer
Lappeenranta University of Technology, Finland

7EP.1.2 PV Financing
G. Agostinelli
IFC, Washington, United States

PROGRAMME

7EP.1.3 Value of PV and Wind in the Energy Market
P. Frankl, S. Müller
IEA, Paris, France

11:30 – 12:30 CONFERENCE CLOSING

Chaired by:

Marko Topič
Conference General Chairman
Chairman of European Technology & Innovation Platform Photovoltaics

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.

NOTES

Monday, 20 June 2016

VISUAL PRESENTATIONS 2AV.1

13:30 - 15:00 Silicon Solar Cell Improvements and Innovation (I)

2AV.1.1 Black Silicon Solar Cells
G. Ayvazyan, K. Ayvazyan & L. Lakhoyan
National Polytechnic University of Armenia, Yerevan, Armenia

2AV.1.2 Development of Novel Local Self-Contacting Al Paste for Cost-Effective Bifacial Solar Cells
K.Y. Wu & H.S. Chung
China Steel, Kaohsiung, Taiwan
C.L. Liao
Thintech Materials Technology, Kaohsiung, Taiwan

2AV.1.3 Nanostructured MgO-doped TiO2 Aerogels for Enhanced Monocrystalline Silicon Solar Cells
F. Meng, A. Nutasarin, Z. Dehouche & G. Fern
Brunel University, Uxbridge, United Kingdom

2AV.1.4 Development of Cost-Effective Silver Alloy Front-Side Paste for Silicon Solar Cells
D. Corbett & A. Savidis
Solar Capture Technologies, Blyth, United Kingdom
R. Goodall & J. Corteen
University of Sheffield, United Kingdom
E. Raj & S. Johnson
Johnson Matthey, Reading, United Kingdom
G. Kerr
Phoenix Scientific Industries, Eastbourne, United Kingdom

2AV.1.5 High Mobility and Transmittance Transparent Conductive HF-Doped In2O3 Thin Films and Its Application to Silicon Heterojunction Solar Cells
W.J. Wang, G.H. Wang, L. Zhao & H.W. Diao
CAS, Beijing, China

2AV.1.6 Invited

2AV.1.7 Influence of Rear Side Coating on Emitter Formation during POCl3 Diffusion Process
M. Steyer, A. Dastgheib-Shirazi, J. Engelhardt, G. Hahn & B. Terheiden
University of Konstanz, Germany

2AV.1.8 Optical Reflection Spectra of Silicon Surface with Nanowires Produced by Special Electrochemical Etching

M. Treideris, V. Strazdiené, I. Šimkiene, V. Bukauskas, A. Reza, S. Indrišiunas, M. Kamarauskas & A. Setkus
Center for Physical Sciences and Technology, Vilnius, Lithuania

2AV.1.9 Advances in Si Heterojunction Solar Cells on p-Type Wafers with Sputtered ZnO:Al as Transparent Conductive Oxide

L.V. Mercaldo, I. Usatii, E. Bobeico, M. Della Noce, L. Lancellotti & P. Delli Veneri
ENEA, Portici, Italy
M. Izzi & M. Tucci
ENEA, Rome, Italy

2AV.1.10 High Efficient n-Type and p-Type PERT Solar Cells by Industrially Feasible Processes

C.-C. Wang, C.-L. Lin, Y.-T. Cheng, Y.-H. Huang, C.-P. Tsao, C.-C. Chen & J.-W. Chien
Inventec Solar Energy, Taoyuan, Taiwan

2AV.1.11 Combination of Plasma-Damage-Less Cat-CVD with a New Low Temperature Impurity Doping Method, Cat-Doping, for Improvement of Solar Cell Performance

T.C.T. Huynh, S. Terashima, K. Koyama, C.T. Nguyen & H. Matsumura
JAIST, Ishikawa, Japan

2AV.1.13 Micro-Patterned (111) Silicon for Thin Film Solar Cells

R. Champory, F. Mandorlo, A. Fave, R. Orobtchouk & E. Fourmond
INSA Lyon, Villeurbanne, France
E. Drouard & C. Seassal
Ecole Centrale de Lyon, Ecully, France

2AV.1.14 Pilot Production of Bifacial Multicrystalline PERCT Cells Achieving 18.5% Efficiency and Singlefacial More Than 19%

A. Teppe, C. Gong, O. Voigt, I. Melnyk, F. Binaie Masouleh & P. Fath
RCT-Solutions, Konstanz, Germany
E. Wang & W. Guo
Lu'an Photovoltaic Technology, Changzhi, China

2AV.1.15 Investigation of Laser Ablation Process for High Efficiency Solar Cells

M.-S. Lin, S.-Y. Liu, Y.-L. Lee, K.-C. Lai, Y.-K. Tsao, C.-C. Chuang & C.-C. Li
Motech Industries, Tainan City, Taiwan

PROGRAMME

2AV.1.16 Effective SiNy Capping Layers on High-Power-Plasma PECVD AlOx for High Efficiency (21%) Industrial p-Type Mono PERC Solar Cells

C.-J. Hung, W.-C. Kao, K.-W. Tsai, C.-C. Chen, L.-Y. Wu, K.-Y. Ting, C.-Y. Kuo, K.-T. Chu & L.-W. Cheng
Motech Industries, Taoyuan, Taiwan

2AV.1.17 Rear Passivation and Point Contacts Formation by Laser Process through Stacks of a-Si:H(I) and a-Si:B/Sb for High Efficiency Silicon Solar Cell

Y. Han, E. Franklin, X. Zhang, A. Thomson & M. Ernst
ANU, Canberra, Australia

2AV.1.18 Effect of Laser Ablation on Electroplated-Metallization Crystalline Silicon Solar Cells

Y.-L. Lee, M.-S. Lin, S.-Y. Liu, K.-C. Lai, C.-C. Chuang & C.C. Li
Motech Industries, Tainan, Taiwan

2AV.1.19 Nanostructured Silicon Nitride (Si-N) Antireflection Coating for c-Si Solar Cells

H. Ghosh, S. Mitra, C. Banerjee, H. Saha & S.K. Datta
IIEST, Howrah, India

2AV.1.20 Black Silicon Solar Cells with Black Bus-Bar Strings

R. Schmidt Davidsen, S. Thorsteinsson, P. Behrensdorff Poulsen & O. Hansen
Technical University of Denmark, Lyngby, Denmark
P. Torben Tang & I. Mizushima
IPU, Lyngby, Denmark
J. Frausig
Gaia Solar, Hvidovre, Denmark
O. Nordseth
Institute for Energy Technology, Kjeller, Norway

2AV.1.21 Investigating Effects of p-n Junction Area and Geometry on IV Characteristics of High Efficiency Silicon Solar Cells

X. An, P. Teng, B. Hoex, C. Johnson, H. Mehrvarz, A. To, H. Li & A. Barnett
UNSW Australia, Sydney, Australia

2AV.1.22 Influence of c-Si Cell Architectures on 4-Terminal Perovskite/c-Si Hybrid Tandem Devices

D. Zhang, W. Verhees, M. Dörenkämper, S. Veenstra, Y. Wu, B. Geerligs & W. Soppe
ECN, Eindhoven, The Netherlands
W. Qiu, U. Paetzold & T. Aernouts
imec, Leuven, Belgium

2AV.1.23 Bifacial p-Type Solar Cells Exhibiting Low Temperature Coefficients: Heterojunction Technology
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.1.24 Influence of the Regeneration Kinetics of Bo Complexes by the Composition of Silicon Nitride Layers
M. Gläser, S. Jafari, S. Krause & D. Lausch
Fraunhofer CSP, Halle (Saale), Germany

2AV.1.25 HIT Cell with p+ Epi/poly-Silicon Intentionally Doped Emitter in Crystalline Silicon Substrate
M.Y. Ghannam, Y. Abdulraheem & A. Hajjiah
Kuwait University, Safat, Kuwait
J. Poortmans
imec, Leuven, Belgium

2AV.1.26 Spatially Resolved Degradation and Regeneration Kinetics in mc-Si
A. Zuschlag, D. Skorka & G. Hahn
University of Konstanz, Germany

2AV.1.27 Influence of Hydrogen Incorporation on the AlN Grown by RF Sputtering
A. Ben Or
Tel Aviv University, Ramat Aviv, Israel
L. Korte
HZB, Berlin, Germany
L.M. Montañez Huamán & R. Weingärtner
PUCP, Lima, Peru

2AV.1.28 22.6% Simplified Back-Contacted Silicon Heterojunction Solar Cell
A. Tomasi, M.J. Lehmann, J. Geissbühler, J.P. Seif & S. De Wolf
EPFL, Neuchâtel, Switzerland
B. Paviet-Salomon, L. Barraud, A. Descoeudres, G. Christmann, N. Badel, H. Watanabe, A. Faes, S. Nicolay, M. Despeisse & C. Ballif
CSEM, Neuchâtel, Switzerland
D. Lachenal & B. Strahm
Meyer Burger Research, Hauterive, Switzerland

2AV.1.29 Contact Formation on p-Doped Si by Screen-Printing Pure Ag Pastes for Bifacial n-Type Si Solar Cells
J. Engelhardt, S. Fritz, E. Emre & G. Hahn
University of Konstanz, Germany

2AV.1.30 Optimal Thermal Annealing of a-SiOx Layer Obtained by PECVD for Heterojunction Solar Cell Application
L. Martini, L. Serenelli, F. Menchini, M. Izzi & M. Tucci
ENEA, Rome, Italy
L. Imbimbo & R. Asquini
University of Rome, Italy

2AV.1.31 A New Type Back Contact Solar Cells Based on Si Wafer and Combined with the Multilayer MoOx/Ag/MoOx and Cesium Carbonate Films
W. Wu, J. Bao & H. Shen
Sun Yat-sen University, Guangzhou, China

2AV.1.32 Wet Oxidation Effects on the Electrical and Interface Properties of ALD Al2O3 and ALD-AlOx/SiNx Passivation Stacks for PERC Solar Cells
S. Joonwichien, K. Shirasawa, S. Simayi, K. Tanahashi, T. Mochizuki & H. Takato
AIST, Koriyama, Japan

2AV.1.33 Investigation on the Anti-PID Method of mc-Si Solar Cell for Mass Production
J. Lu, Q. Wei, W. Lian & Z. Ni
Talesun Solar, Suzhou, China

2AV.1.34 Chemistry of Mist Deposition of Organic Polymer PEDOT:PSS on Crystalline Si
H. Shirai, T. Ohki, Q. Liu & K. Ichikawa
Saitama University, Japan

2AV.1.37 Field-Effect Surface Passivation Paste by Screen-Printing for High Efficiency PERC
T. Hayasaka, S. Kodama, M. Shimizu, M. Hamada, N. Tanaka & T. Nojiri
Hitachi Chemical, Ibaraki, Japan

2AV.1.38 Ultra-Short Pulse Laser for Patterning High Quality Graphene Electrodes in Photovoltaic Applications
E.-M. Pechlivani, E. Mekeridis, S. Tsimikli & V. Matskos
Organic Electronic Technologies, Thessaloniki, Greece
A. Laskarakis & S. Logothetidis
Aristotle University - LAB LTFN, Thessaloniki, Greece

VISUAL PRESENTATIONS 6AV.4

13:30 - 15:00 Grid and Energy System Integration

6AV.4.4 Managing the Quality of Electricity Supply under High Penetration of Photovoltaic Generation with Load Shifting and Inverter Control
W. Martin, P.-J. Alet, L.-E. Perret-Aebi & C. Ballif
CSEM, Neuchâtel, Switzerland
A. Ghasem Azar & R. Hylsberg Jacobsen
Aarhus University, Denmark

6AV.4.6 Full Spectrum Hybrid Photovoltaics and Thermal Engine Utilizing High Concentration Solar Energy
J. Grandidier, B.J. Nesmith, T.J. Hendricks, J. Cepeda-Rizo, J. Paredes Garcia & M.E. Devost
NASA, Pasadena, United States
M.B. Petach, E. Tward, S.A. Whitney & D.E. Lee
Northrop Grumman Aerospace Systems, Redondo Beach, United States
H. Hayden, N. Fette & T. Beeney
SST, Tempe, United States

6AV.4.7 Optimizing the Integration of Solar Power in the National Electricity System – a Case Study of South Africa
N. Hartmann, C. Friebertshäuser & C. Kost
Fraunhofer ISE, Freiburg, Germany

6AV.4.8 Integration of Reverse Osmosis Seawater Desalination in the Power Sector, Based on PV and Wind Energy, for the Kingdom of Saudi Arabia
U. Caldera, D. Bogdanov, S. Afanasyeva & C. Breyer
Lappeenranta University of Technology, Finland

6AV.4.9 A Cost Optimal Resolution for Sub-Saharan Africa Powered by 100 Percent of Renewables by the Year 2030
M. Baraza, D. Bogdanov, S. Oyewo & C. Breyer
Lappeenranta University of Technology, Finland

6AV.4.10 Solar Photovoltaics – a Driving Force towards a 100% Renewable Energy System for India and the Saarc Region
A. Gulagi, D. Bogdanov & C. Breyer
LUT, Lappeenranta, Finland

6AV.4.11 Nationwide Photovoltaic Hosting Capacity in the Finnish Electricity Distribution System
J. Lassila, V. Tikka, J. Haapaniemi, M. Child, C. Breyer & J. Partanen
Lappeenranta University of Technology, Finland

6AV.4.12 GIS Based Assessment of Storage Impact on PV Integration into UK Electricity Network
C. Candelise & P. Westacott
Imperial College London, United Kingdom

6AV.4.16 Performance Analysis and Yield Assessment of Several Uncovered Photovoltaic-Thermal Collectors: Results of Field Measurements and System Simulations
C. de Keizer, M. de Jong & W. Folkerts
SEAC, Eindhoven, The Netherlands
M. Katiyar, C. Rindt & H. Zondag
Eindhoven University of Technology, The Netherlands

6AV.4.17 Simulation of the Load Flow at the Transformer in Low Voltage Distribution Grids with a Significant Number of PV Systems Using Satellite-Derived Solar Irradiance
H. Ruf & G. Heilscher
Ulm University of Applied Sciences, Germany
M. Schroedter-Homscheidt
German Aerospace Center, Wessling, Germany
F. Meier
Stadtwerke Ulm, Germany
H.G. Beyer
University of Agder, Grimstad, Norway

6AV.4.18 Challenges of PV Generation in Polar Regions. Case Study: the Norwegian Research Station "Troll" in Antarctica
S. Merlet & B. Thorud
Multiconsult, Oslo, Norway
T. Thiis & E. Olsen
UMB, Ås, Norway

6AV.4.19 Study on Optimal Installed Capacity of Photovoltaic Generation and Battery to Minimalize Total Cost in Factory
Y. Minamishima, S. Takayama & A. Ishigame
Osaka Prefecture University, Sakai, Japan
M. Takeuchi
NISSHIN ELECTRIC, Kyoto, Japan

6AV.4.20 The Utility of Power-to-Gas Concept for Integration of Increased Photovoltaic Generation into the Distribution Grid
F. Bigler, C. Park & P. Korba
ZHAW, Winterthur, Switzerland

6AV.4.21 PV Integration and Price-Based Demand Side Management: Optimum Time-of-Use Tariffs
N. Philippou, G. Makrides, M. Hadjipanayi, V. Efthymiou & G.E. Georghiou
University of Cyprus, Nicosia, Cyprus

6AV.4.22 Large-Scale Integration of Renewable Energy Sources: Technical and Economical Analysis for the Italian Case
M.G. Prina, G. Garegnani, R. Vaccaro & D. Moser
EURAC, Bolzano, Italy
D. Kleinhans
Next Energy, Oldenburg, Germany
G. Manzolini
Polytechnic University of Milan, Italy
S. Weitemeyer
University of Oldenburg, Germany

6AV.4.23 Conditions in Which a Photovoltaic System Is More Viable Than a Low-Temperature Solar Thermal System
I. Lillo Bravo, M. Silva Pérez & S. Moreno
University of Seville, Spain
E. Pérez
AICIA, Sevilla, Spain

6AV.4.25 Effective Integration of PV Source by Means of DC Micro-Grids
V. Musolino, P.-J. Alet, L.-E. Perret-Aebi & C. Ballif
CSEM, Neuchâtel, Switzerland

6AV.4.26 Photovoltaic Plant Orientation Strategies to Minimize Grid Exchange in Free Field and Building Integrated Setups
P. Ingenhoven, G. Barchi, M. Lovati & D. Moser
Eurac Research, Bolzano, Italy

6AV.4.27 PV Plant Repowering: Optimization of the Energy Which Can Be Fed into the Grid by Increasing the Installed PV Power. A Challenging Application for an Intelligent Active Power Curtailment with Additional Grid Protection Devices
R. Estrella Navarro
Skytron-Energy, Berlin, Germany
M. Kammerer & K. Albers
Parabel, Berlin, Germany

6AV.4.28 Evaporating Pure Rainwater to Increase the Yield of Commercial-Size PV Arrays
N. Cristi, A. Macq, L. Martin-Carron & D. Ugarte
SUNIBRAIN, Toulouse, France

6AV.4.29 Optimizing the Self-Consumption of Solar-Powered Smart Microgrids
A. Mahran, A. Minde, M. Noebels, K. Peter &
J. Glatz-Reichenbach
ISC Konstanz, Germany

6AV.4.31 Evaluation of Load Matching and Grid Interaction Parameters of a Net Plus-Energy House in Brazil with a Hybrid Grid-Connected Photovoltaic System and Demand-Side Management
G. Almeida Dávi, M. Castillo-Cagigal, E. Caamaño-Martín &
J. Solano
UPM, Madrid, Spain

6AV.4.32 Multi Agent System in a Smart Rail Microgrid: Application to a Tramway System
S. Boudoudouh, M. Ouassaid & M. Maaroufi
University Mohammed V-Agdal, Rabat, Morocco

6AV.4.33 Electromobility, the Heritage Clean Energy and the Utilization of Wasted Energy from Cars Toward the Sustainable Future
L. Barrera Aguilar
UPTlax, Tlaxcala, Mexico
H. Lima Gutierrez
UPT, Tlaxcala, Mexico
J.C. Roldán Maldonado & U. Becerril Franco
UPAEP, Puebla, Mexico

6AV.4.34 Advanced PV Inverter Functions: Survey and Verification Test
J. Freis, M. Cosic & B. Jaeckel
UL International, Neu-Isenburg, Germany

6AV.4.35 Stochastic Generation Scheduling with Solar PV and Storage Integration
C. Shang, D. Srinivasan & T. Reindl
NUS, Singapore, Singapore

6AV.4.37 Smart PV Home : Experimental Investigations
P. Dupeyrat, A.-S. Coince, C. Gachot, Y. Pollet,
S. Bernasconi, C. Le Sueur & G. Kwiatkowski
EDF, Moret-sur-Loing, France

6AV.4.38 Definition of a Desalination-Refrigeration Unit Powred by a Solar Photovoltaic Thermal Collectors PVT: a Case Study for Dakhla Morocco
M. Ibrahimi, A. Arbaoui & Y. Aoura
National School of Arts and Trades, Bouarfa, Morocco
E.M. Elkhattabi
USMBA, Fez, Morocco

6AV.4.39 Energy Flow Optimization of a Grid Connected PV System with Electrical Storage Based on Predictive Data
M. Bressan & C. Alonso
LAAS CNRS, Toulouse, France
M. Rabarijoelina & T. Sanchez
Solveo Energie, Fenouillet, France

6AV.4.40 **Demand Side Power Management of a Grid Connected Solar PV System with Vanadium Redox Flow Battery Storage**
A. Bhattacharjee & H. Saha
IIEST, Howrah, India

6AV.4.41 **Towards a Novel Proposal of a Solar Polygeneration System for Morocco's Public Hospitals**
L. Souad
University Mohammed V-Agdal, Rabat, Morocco

6AV.4.42 **Energy Storage System Management in Grid Connected PV Systems: From Simulation to Experiment on Field**
F. De Lia, S. Castello, M. Tucci & R. Schioppo
ENEA, Rome, Italy

VISUAL PRESENTATIONS 2AV.2

15:15 - 16:45 Silicon Solar Cell Improvements and Innovation (II)

2AV.2.1 **SiC Layer as Mechanical Enhancement for Solar Module**
C.-L. Wang, C.-C. Hsieh & H.-C. Tseng
WINAICO, Hsinchu, Taiwan
H.-H. Hsieh, Y.-H. Lee, M.-A. Tsai, W.-L. Yang, S.-H. Chen, M.-F. Lin, K.-W. Lu & S.-J. Wu
ITRI, Hsinchu, Taiwan

2AV.2.2 **Universal Nano-Texture Process For Diamond- And Slurry-Wire Sawn Mono/Poly-Crystalline Silicon Solar Cells**
K. Chen, J. Zha, F. Hu, X. Ye, S. Zou & X. Su
Soochow University, Suzhou, China

2AV.2.3 **Solution Processed Crystalline-Si/PEDOT:PSS Heterojunction Solar Cell Module**
H. Shirai, T. Ohki, Q. Liu & K. Ichikawa
Saitama University, Japan

2AV.2.4 **E-Ton's Printed-AlOx PERC Cells: Efficiencies Beyond 21 % with a Next-Generation AlOx Paste**
T.-C. Chen, Y.-S. Lin, C.-F. Lin, C.-H. Ku, C.-S. Hu & C.-C. Wen
E-TON Solar Tech, Tainan, Taiwan
J.Y. Hung
New E Materials, Kaohsiung, Taiwan
J.-C. Wang & S.-W. Chen
Eternal Chemical, Kaohsiung, Taiwan

2AV.2.5 **Wet Chemical Metallization of Silicon Solar Cells: Status and Perspective of Industrial Application**
A. Letize, B. Lee & D. Cullen
MacDermid, Waterbury, United States

2AV.2.6 **Investigation of Plasmonic and Transparent Conductive Oxide Work Function Effect with Different Metal Doping for Amorphous/Crystalline Silicon Heterojunction Solar Cells**
P.K. Parashar, R.P. Sharma, R. Kapoor & V.K. Komarala
IIT Dehli, New Delhi, India
V. Bharadwaj & S.P. Singh
Bharat Heavy Electricals, New Delhi, India

2AV.2.7 **Performance Enhancement of Textured and Planar Silicon Solar Cells Using Luminescent Down-Shifting Eu2+-Phosphor Silica-Layer**
Y.-J. Deng, W.-J. Ho, S.-K. Feng, G.-Y. Li & S.-H. Weng
NTUT, Taipei, Taiwan

2AV.2.8 **The Application of Multilayer SiNx Anti-Reflection Films in Polycrstalline Silicon Solar Cell Production**
H.N. Ma, Z. Li, L. Pang & D. Zhang
Yingli Green Energy, Baoding, China

2AV.2.9 **Study of One-Step Annealing for Plated Nickel-Copper Contacts on n-Type Monocrystalline Silicon Solar Cells**
J. Couderc, J. Dupuis & P.P. Grand
EDF, Chatou, France
H. El Belghiti & E. Delbos
KMG Ultra Pure Chemicals, Saint-Fromond, France
D. Aureau, A. Etcheberry & D. Lincot
CNRS-IRDEP, Chatou, France

2AV.2.10 **A Solar Module Prototype Assembled from Silicon Heterojunction Solar Cells Manufactured in Gen5 Kai PECVD Reactors**
D. Andronikov
RAS/ Ioffe, St-Petersburg, Russia
A. Abramov, S. Abolmasov, K. Emtsev, G. Ivanov, I. Nyapshaev, A. Semenov, G. Shelopin & E. Terukov
RAS/ Ioffe, St. Petersburg, Russia
D. Orekhov & E. Terukova
RAS / Ioffe, St-Petersburg, Russia
I. Shakhrai
Hevel Solar, Moscow, Russia
M. Joanny, A. Jouini & C. Roux
CEA, Le Bourget du Lac, France
F. Quesnel & R. Turchet
CEA LITEN - INES, Le Bourget du Lac, France
Y. Trouillot & N.J. Matsapey
ECM Greentech, Grenoble, France
G. Bubnov & G. Kekelidze
Moscow Technological Institute, Russia

2AV.2.11 Fabrication of Black Multicrystalline Silicon and Solar Cell by Cu and Ag Co-Assisted Chemical Etching
H. Shen, C. Zheng, T. Pu & Y. Jiang
NUAA, Nanjing, China

2AV.2.12 Optimized Single Side Doped Layer Removal of PERT Solar Cells
S. Simayi, Y. Kida & H. Takato
AIST, Koriyama, Japan
K. Shirasawa
AIST, Tsukuba, Japan
T. Suzuki
Nippon Kasei Chemical, Fukushima, Japan

2AV.2.13 Lowest Surface Recombination in n-Type Oxidised Crystalline Silicon by Means of Extrinsic Field Effect Passivation
S. Bonilla, P. Hamer & P.R. Wilshaw
University of Oxford, United Kingdom

2AV.2.17 Effective Surface Recombination of p+-Layer in p-Type Silicon PERT Bifacial Cell
Y. Eisenberg, L. Kreinin, N. Bordin & N. Eisenberg
Jerusalem College of Technology, Israel
G. Grigorieva & M. Kagan
OJSC RPE „KVANT“, Moscow, Russia
S. Hava
BGU, Beer-Sheva, Israel

2AV.2.18 23% Metal Wrap through Silicon Heterojunction Solar Cells - A Simple Technology Integrating High Performance Cell and Module Technologies
G. Coletti, Y. Wu, E.E. Bende, G.J.M. Janssen &
B.B. Van Aken
ECN, Petten, The Netherlands
F. Ishimura, K. Hashimoto & Y. Watabe
Choshu Industry, Sanyo Onoda, Japan

2AV.2.19 Novel Low Cost Wet Chemical Cleaning Processes for Industrial Large Area n-Type Silicon Solar Cells with 22% Efficiency
J. John, M. Haslinger, M. Aleman, A. Uruena de Castro,
E. Cornagliotti, L. Tous, R. Russell, F. Duerinckx,
J. Szlufcik & J. Poortmans
imec, Leuven, Belgium
A. Hajjiah
Kuwait University, Safat, Kuwait

2AV.2.20 Saw Damage Removal and Texturing of Crystalline Silicon by Maskless Inductively Coupled Plasma (ICP) Processes with SF6 and O2
J. Hirsch, M. Gaudig & N. Bernhard
Anhalt University of Applied Sciences, Köthen, Germany
M. Gläser, M. Werner, S. Großer & D. Lausch
Fraunhofer CSP, Halle, Germany

2AV.2.21 Surface Photovoltage Studies of n- and p-Type Crystalline Silicon Passivated by Thermal-ALD Aluminium Oxide
Y. Sun, R. Jia, B. Sun, X. Dou, K. Tao, Z. Jin & X. Liu
CAS, Beijing, China

2AV.2.23 Surface Passivation by Al2O3 Deposited on an Industrial Low Frequency PECVD Equipment
R. Monna & S. Dubois
CEA, Le Bourget du Lac, France
L. Crampette, C. Bourcheix, G. Lazzarelli & R. de Munnik
SEMCO Engineering, Montpellier, France

2AV.2.24 Surface Passivation of c-Si Using Silicon Oxynitride - Accentuating the Thermal Stability by Silicon Nitride Capping Layer
A. Soman & A. Antony
IIT Bombay, Mumbai, India

2AV.2.25 Low Temperature PECVD Formation of Boron-Doped Epitaxial Emitters for Crystalline Silicon Solar Cells
R. Leal & G. Poulain
TOTAL, Paris La Défense, France
F. Haddad, F. Silva, J.-L. Maurice & P. Roca i Cabarrocas
CNRS, Palaiseau, France

2AV.2.26 Hydrogen Plasma Treatment to Enhance a-Si/c-Si Interface Passivation
A. Soman & A. Antony
IIT Bombay, Mumbai, India

2AV.2.27 Softly Doped and Deep Emitters for P/Al Solar Cell Structure
M.A. Rasool, V. Fano, A. Otaegi, J.R. Gutiérrez,
J.C. Jimeno, N. Azkona & E. Cereceda
University of the Basque Country, Zamudio, Spain
A. Habib
Mansoura University, Egypt

2AV.2.28 Surface Passivation of Crystalline Silicon by Hydrogenated Amorphous Silicon\Sub-nm Al2O3 Stack
A.S.A. Ali
Zewail City of Science and Technology, Giza, Egypt
O. Tobail
Cairo University, Giza, Egypt

2AV.2.29 Process Development for Silicon Heterojunction Solar Cells
M. Hendrichs, A. Morales, L. Mazzarella, S. Kirner, M. Zelt, L. Korte, B. Stannowski & R. Schlatmann
HZB, Berlin, Germany

2AV.2.30 Laser Lithography for Interdigitated Back-Contacted Silicon Heterojunction Solar Cells
A. Singh, B. Turan & K. Ding
Forschungszentrum Jülich, Germany

2AV.2.31 Improved Silicon Heterojunction Photo-Conversion Efficiency Using In2O3:Sn Front Electrodes Grown from Sputter Targets with an SnO2 Content below 10 Wt. %
S. Calnan, L. Mazzarella, M.-S. Hendrichs, S. Kirner, M. Wittig, L. Korte, B. Stannowski & R. Schlatmann
HZB, Berlin, Germany
M. Dimer, W. Thom, U. Graupner & M. Thumsch
VON ARDENNE, Dresden, Germany

2AV.2.32 Silicon Oxynitride–Silicon Nitride Surface Passivation of p-Type c-Si Solar Cells with Laser Fired Rear Contacts
A. Soman, S. Mondal, S. Bhatia, B. Arunachalam, S. Kumbhar, S. Somasundaram, P. Nair & A. Antony
IIT Bombay, Mumbai, India

2AV.2.33 Emitter and Contact Optimization for High-Efficiency IBC Mercury Cells
A.A. Mewe, P. Spinelli, A.R. Burgers, N. Guillevin, E.J. Kossen & I. Cesar
ECN, Petten, The Netherlands
A.H.G. Vlooswijk
Tempress, Vaassen, The Netherlands

2AV.2.34 Optimized Lifetime of Black Silicon Nanostructures for Photovoltaic Applications
M. Plakhotnyuk, R. Schmidt Davidsen, M. Stenbæk Schmidt, R. Malureanu, E. Stamate & O. Hansen
Technical University of Denmark, Kongens Lyngby, Denmark

2AV.2.35 Analysis of Device Interface Properties on Mono-Crystalline Silicon Using Plasma Etching Process
C.Y. Yoo, K. Hong, J. Kim, E. Lee & Y.H. Cho
Shinsung Solar Energy, Seongnam-si, Korea South

2AV.2.36 Anti-Reflective Coating Made by Solution Based Deposition of TiO2 Nanoparticles
G. Peharz, B. Feketeföldi, C. Prietl, C. Auer & G. Jakopic
JOANNEUM RESEARCH, Weiz, Austria

2AV.2.38 Investigation of Deep Levels in Solar Cell Structure Based on HIT
V.G. Litvinov, N.V. Vishnyakov, V.V. Gudzev, A.V. Ermachikhin & S.P. Vikhrov
Ryazan State Radio Engineering University, Russia
E.I. Terukov, D.L. Orekhov, A.S. Abramov & S.N. Abolmasov
RAS/ Ioffe, St. Petersburg, Russia

VISUAL PRESENTATIONS 6AV.5

15:15 - 16:45 PV in Buildings and the Environment

6AV.5.1 The Electric Mondrian Toolbox Concept - a Luminescent Solar Concentrator Design Study
P. Moraitis & W.G.J.H.M. van Sark
Utrecht University, The Netherlands

6AV.5.2 Leaf Roof – Designing Luminescent Solar Concentrating PV Roof Tiles
G. Doudart de la Grée, A. Papadopoulos, A. Rosemann, M.G. Debije & M. Cox
Eindhoven University of Technology, The Netherlands
Z. Krumer & A.H.M.E. Reinders
University of Twente, Enschede, The Netherlands

6AV.5.4 Tunable Shade Windows with Integrated Luminescent Solar Concentrators and High Efficiency Lighting
P. Bernardoni, M. Tonezzer, D. Vincenzi, S. Baricordi, S. Fugattini & V. Guidi
University of Ferrara, Italy

6AV.5.5 Self-Shading in Bifacial Photovoltaic Noise Barriers
M.M. de Jong, M.N. van den Donker & W. Folkerts
SEAC, Eindhoven, The Netherlands
S. Verkuilen
Heijmans Wegen, Rosmalen, The Netherlands

6AV.5.7 Invited

6AV.5.8 Thermal Model of Building Integrated Air Type Photovoltaic-Thermal System under Varying Conditions
A. Jagomägi
Tallinn University of Technology, Estonia

6AV.5.9 Thermal Analysis of a BIPV/T Prototype for Fodder Drying
Y.B. Assoa
CEA, Le Bourget du Lac, France
S. Boddaert
CSTB, Sophia Antipolis, France

6AV.5.10 Opportunities for Thermal / Photovoltaic Hybrid Building-Integrated Systems in Hong Kong

B. Stobbe, O. Isabella & M. Zeman
Delft University of Technology, The Netherlands
L.F.N. Moses
Hong Kong University of Science and Technology, Hong Kong

6AV.5.11 Energy Performance of PV Modules as Adaptive Building Shading Systems

J. Jayathissa, J. Schmidli, J. Hofer & A. Schlueter
ETH Zurich, Switzerland

6AV.5.13 Experimental Analysis of the Performance of Façade-Integrated BIPV in Different Configurations

G. Van den Broeck, W. Parys, H. Goverde, J. Poortmans, J. Driesen, K. Baert & D. Saelens
EnergyVille, Genk, Belgium

6AV.5.14 Semi-Transparent Photovoltaic Windows Performance Modelling: on the Prediction of Cell Operating Temperatures

K. Kapsis & A. Athienitis
Concordia University, Montreal, Canada

6AV.5.15 A Multi Criteria Optimization Tool for BIPV Overhangs

M. Lovati, J. Adami, G. Demichele, L. Maturi & D. Moser
EURAC, Bolzano, Italy

6AV.5.16 Effective Positioning of Photovoltaic Modules in Solar Plants in the Urban Environment

R. Herrero Alonso, S. Shimura, R. Silva Simplicio, C. Biasi de Moura & M. Knörich Zuffo
University of São Paulo, Brazil

6AV.5.18 Obstruction Surveying Methods for PV Application in Urban Environments

S.R. Teixeira Freitas, A.R. Cristovão, R. Amaro e Silva & M.C. Brito
University of Lisbon, Portugal

6AV.5.19 Impact Impact of Different Architectural Parking Lot Layouts on Photovoltaic System Performance

C. Biasi de Moura, S. Shimura, R. Silva Simplicio, R. Herrero Alonso & M. Knörich Zuffo
University of São Paulo, Brazil

6AV.5.20 Simulation of Mismatch Losses for Parallel Connection of CIGS Module Strings with Different Orientations in BIPV Systems

R. Wächter, A. Jenninger & T. Repmann
Manz CIGS Technology, Schwäbisch Hall, Germany

6AV.5.21 Building Integrated Photovoltaics from Design Concepts to Real Buildings in Different Stakeholders' Visions in the European Funded Project Construct PV

A. Scognamiglio
ENEA, Portici, Italy
F. Frontini
SUPSI, Canobbio, Switzerland
C. Erban
Meyer Burger, Gwatt, Switzerland
K. Fath & R. Hecker
Zueblin, Stuttgart, Germany
G. Gijzen & T. Minderhoud
UNStudio, Amsterdam, The Netherlands
T.E. Kuhn
Fraunhofer ISE, Freiburg, Germany

6AV.5.22 Integration of Photovoltaic Module into Building Facade

G. Cattaneo
CSEM, Neuchatel, Switzerland
P. Heinstein, K. Söderström, C. Ballif & L.-E. Perret-Aebi
CSEM, Neuchâtel, Switzerland
A. Clua Longas, S. Lufkin & E. Rey
EPFL, Lausanne, Switzerland
K. Brooks
glass2energy, Villaz-St-Pierre, Switzerland

6AV.5.24 Appreciating Performance of a BIPV Lab in Bangalore (India)

M. Mani, G. Aaditya & B. N.C
Indian Institute of Science, Bangalore, India

6AV.5.25 Outdoor Characterization of Innovative BIPV Modules for Roof Application.

F. Frontini, P. Bonomo & C.S. Polo López
SUPSI, Canobbio, Switzerland
F. Cais
Tegola Canadese, Vittorio Vento, Italy
C. Erban
Meyer Burger, Gwatt (Thun), Switzerland

6AV.5.26 Architectural Solution for Using Area of Side Streets and Alleys to Utilize Solar Panels

A. Rahmani
KIT, Sanandaj, Iran

6AV.5.27 PVSITES Project – Building Integrated Photovoltaic Technologies and Systems for Large-Scale Market Deployment

M. Machado
Tecnalia Research & Innovation, San Sebastián, Spain
E. Rico
Onyx Solar Energy, Avila, Spain
T. Reijenga
BEAR-iD, Gouda, The Netherlands
P. Brassier
Nobatek, Anglet, France
P. Surguy
Film Optics, Watchfield, United Kingdom
V. Francisco
CTCV, Coimbra, Portugal
D. Brémaud
Flisom, Dübendorf, Switzerland
J. Martínez
Cricursa, Barcelona, Spain
F. Burgun
CEA, Le Bourget du Lac, France
R. Díaz
Acciona Infraestructuras, Madrid, Spain
D. Deramaix
Bureau d'Architectes Format D2, Sirault, Belgium
A. Bogucka
Vilogia, Paris, France
F. Noris
R2M Solution, Pavia, Italy
N. Van Khai
Cadcamation, Onex, Switzerland
I. Weiss
WIP - Renewable Energies, München, Germany

6AV.5.28 Smart-FLeX Solution Way Forward for Cost Competitive BIPV Production?

J. Ulbikas, A.J. Galdikas & A. Stonkus
Applied Research Institute for Prospective Technologies, Vilnius, Lithuania

VISUAL PRESENTATIONS 2AV.3

17:00 - 18:30 Silicon Solar Cell Improvements and Innovation (III)

2AV.3.1 Bifacial Solar Cells Fabricated by PERC Process for Mass Production

S.-Y. Chen, Y.-H. Lin, S.-H. Yu, W.-J. Lih & C.-H. Du
ITRI, Hsinchu, Taiwan
H.-Y. Chang, Y.-Y. Chiu & Y.-H. Wang
Big Sun Energy Technology, Hsinchu, Taiwan

2AV.3.2 The Investigation of Emitter Profile on Copper Plated Silicon Solar Cells

L.-Y. Li, C.-K. Peng & C.-H. Du
ITRI, Hsinchu, Taiwan
P. Yu
NCTU, Hsinchu, Taiwan

2AV.3.3 Influence of the Bottom Wo3 Layer on the Series Resistance in Silicon Based Solar Cells with WO3/Ag/WO3 Emitter

J. Bao, W. Wu & H. Shen
Sun Yat-sen University, Guangzhou, China

2AV.3.4 SiNx/SiOxNy Stack Passivation for n-Type Si

J. Zhu, R. Søndenå, E. Stensrud Marstein & S.E. Foss
Institute for Energy Technology, Kjeller, Norway
C. Zhou
CAS, Beijing, China

2AV.3.5 Application of Rear Etching in n-Type Crystalline Silicon Solar Cells Production

J.K. Ma, M.J. Chen, D.S. Zhang, Y.C. Li, J.G. Cui, J.C. Shi & B. Yu
Yingli Green Energy, Baoding, China

2AV.3.6 New Promising c-Si Solar Cell and Busbar Concepts for Industry Application

W. Mühleisen, L. Neumaier & C. Hirschl
CTR, Villach, Austria
S. Seufzer
KIOTO, St. Veit/Glan, Austria
M. Trobej
Energetica, Klagenfurt-Viktring, Austria
W. Pranger
Ulbrich of Austria, Müllendorf, Austria
J. Scheurer
Polytec-PT, Waldbronn, Germany
R. Lorenz
teamtechnik Maschinen und Anlagen, Freiberg, Germany
M. Schwark
AIT, Vienna, Austria

2AV.3.8 Analysis on Emitter of n-Type Monocrystalline Silicon PERT Photovoltaic Cell

T. Morioka, T. Watahiki, S. Nishimura, K. Nishimura, D. Niinobe, Y. Kobayashi, H. Tokioka & M. Yamamuka
Mitsubishi Electric, Amagasaki, Japan

2AV.3.9 Interface Carrier Selective Modification for Efficiency Enhancement to Silicon Hybrid Solar Cells

Y.-S. Kou, S.-T. Yang, H.-J. Syu, J.-W. Wu, S. Thiyagu, Y. Lai & C.-F. Lin
NTU, Taipei, Taiwan

2AV.3.10 Improved Passivation of Black Multi-Crystalline Silicon by Wet Chemical Pretreatment and Atomic Layer Deposition
Y. Jiang, H. Shen, T. Pu & C. Zheng
NUAA, Nanjing, China

2AV.3.11 Single-Chamber Silicon Deposition Process for Industrial Silicon Heterojunction Solar Cells
H. Li, O. Astakhov, D. Weigand, A. Lambertz & K. Ding
Forschungszentrum Jülich, Germany

2AV.3.12 Advantages of Transition to 4 and 5 Busbar Front Contact Grid Designs for Ni/Cu/Ag Plated Silicon Solar Cells
D. Pysch, J. Burschik, N. Bay, A. Hoffmann, H. Kühnlein, M. Passig, M. Sieber & K. Vosteen
RENA, Freiburg, Germany
Y. Shengzhao & P. Verlinden
Trina Solar Energy, Shanghai, China
B. Lee & A. Letize
MacDermid, Waterbury, United States

2AV.3.13 Black Silicon by Electrochemical Reduction of Silica Layers in Molten Salt
P.R. Coxon & D.J. Fray
University of Cambridge, United Kingdom
E. Juzeliunas
Klaipda University, Klaipeda, Lithuania

2AV.3.14 Metal Wrap through Heterojunction Solar Cell with Plated Electrode
F. Ishimura, L. Wenjun, E. Kobayashi, K. Hashimoto, S. Sato & Y. Watabe
Choshu Industry, Sanyo Onoda, Japan
E. Bende & G. Coletti
ECN, Petten, The Netherlands

2AV.3.15 Implantation of Phosphorus into Pyramidal Texture in Silicon Solar Cell
K. Tanahashi, M. Moriya, Y. Kida, T. Fukuda, K. Shirasawa & H. Takato
AIST, Koriyama, Japan

2AV.3.16 Excellent c-Si Surface Passivation by Atomic Layer Deposited TiO2 Films and Its Optical, Material Properties
B. Liao, N. Dwivedi, G. Kaur & B. Charanjit Singh
National University of Singapore, Singapore

2AV.3.17 Loss Analysis of 21.4% Industrial PERC Solar Cells
P. Saint-Cast, J. Greulich, S. Werner, U. Jäger, T. Dannenberg, S. Maier, K. Zimmermann, U. Belledin, R. Ackermann, S. Gutscher, A. Brand, M. Linse, M. Retzlaff, A. Krieg, K. Krieg, K. Krauß, J. Broisch, T. Chipei, H. Höffler & R. Preu
Fraunhofer ISE, Freiburg, Germany

2AV.3.19 Passivation of Silicon Solar Cells via Low Temperature Wet Chemical Oxidation
G. Kökbudak, E.H. Çiftpinar, O. Demircioglu & R. Turan
METU, Ankara, Turkey

2AV.3.20 Surface Passivation Provided by an Alneal through SiO2/TiO2 Bilayer
K.A. Collett, M. Cyrson, R.S. Bonilla & P.R. Wilshaw
University of Oxford, United Kingdom

2AV.3.22 Merging Homo- and Hetero-Junctions Silicon Solar Cells Advantages: a Novel Junction to Outperform Silicon Cells Efficiencies
T. Carrere, R. Varache & D. Muñoz
CEA, Le Bourget du Lac, France
R. Lachaume & J.-P. Kleider
GeePs, Gif-sur-Yvette, France
M. Coig
CEA, Grenoble, France

2AV.3.23 19.27%-Efficient Multi-Crystalline Silicon Solar Cell with MCCE Black Silicon Technology
S. Zou, X.-S. Wang, F. Cao & G. Xing
Canadian Solar, Suzhou, China

2AV.3.24 Solving the LID problem for PERC by LIR
J. Wu, X. Meng, X.-S. Wang & G. Xing
Canadian Solar, Suzhou, China

2AV.3.25 Novel Vacuum-Free Technique and Technologies for High Efficient and Low-Cost Photovoltaics
G.K. Zhavnerko & V.Y. Shiripov
Izovac Technologies, Minsk, Belarus
O.V. Sergeev
Next Energy, Oldenburg, Germany

2AV.3.26 Phosphorous Doping from APCVD Deposited PSG
F. Book, F. Mutter & G. Hahn
University of Konstanz, Germany
H. Knauss & C. Demberger
Gebrüder Schmid, Freudenstadt, Germany

2AV.3.27 Forward-Bias-Plated Ni/Cu Front Contacts for 20.5% Efficiency n-Type Bifacial Solar Cell
S.-Y. Liu, Y.-L. Lee, M.-S. Lin, C.-M. Wei, K.-C. Lai & C.-C. Chuang
Motech Industries, Tainan, Taiwan

2AV.3.28 The Effect of Surface Passivation at Low-Injection Level on Fill Factor of Silicon Heterojunction Solar Cells
L. Zhang, M. Ren, J. Wang, R. Yang, L. Li, Y. Meng & T. Guo
ENN Solar Energy, Langfang, China

2AV.3.29 Doped a-Si:H/μc-Si:H Hybrid Layers Used to Improve the Performance of Top-Con Silicon Solar Cells

K. Tao, R. Jia, Y. Sun, Z. Jin & X. Liu
CAS, Beijing, China
J. Wang
Nankai University, Tianjin, China

2AV.3.30 The Swiss Inno-HJT Project: Performance of Si-HJT Systems Produced in a Pilot R&D Line

B. Strahm, D. Bätzner, W. Frammelsberger, D. Lachenal, B. Legradic, J. Meixenberger, P. Papet & G. Wahli
Meyer Burger Research, Hauterive, Switzerland
M. Despeisse, C. Allebé, P.-J. Alet, N. Badel, A. Faes, A. Lachowicz, J. Levrat & C. Ballif
CSEM, Neuchâtel, Switzerland
Y. Yao, T. Söderström, J. Heiber, M. Lanz & S. Leu
Meyer Burger, Gwatt, Switzerland
V. Fakhfouri
Pasan, Neuchâtel, Switzerland

2AV.3.31 Review on Metallization and Interconnection for Si Heterojunction Solar Cells

A. Faes, M. Despeisse, J. Levrat, J. Champliaud, A. Lachowicz, N. Badel, J. Geissbühler, H. Watanabe & C. Ballif
CSEM, Neuchâtel, Switzerland
T. Söderström & Y. Yao
Meyer Burger, Gwatt, Switzerland
J. Ufheil
Somont, Umkirch, Germany
P. Papet & B. Strahm
Meyer Burger Research, Hauterive, Switzerland
J. Hermans
Meyer Burger, Eindhoven, The Netherlands
A. Tomasi
EPFL, Neuchâtel, Switzerland
J. Fleischer & P.V. Fleischer
PVP, Neufinsing, Germany

2AV.3.32 A Comparison of Three Well Known Laser Separation Methods for Half Cell Production

J. Röth & N. Bernhard
Anhalt University of Applied Sciences, Köthen, Germany
C. Belgardt & M. Grimm
3D-Micromac, Chemnitz, Germany

2AV.3.33 The Bifacial nPERT Solar Cell Coupling Boron Spin-on with POCl3 Diffusion and Its Glass-Glass Module Performance

C. Wu, Q. Wei, P. Ni, J. Lu & W. Lian
Talesun Solar, Suzhou, China

2AV.3.34 The IBC Structure as Support for Three Band-Gaps Tandem Devices

J.C. Jimeno, R. Gutiérrez, V. Fano & A. Habib
UPV/EHU, Zamudio, Spain
C. del Cañizo
UPM, Madrid, Spain

2AV.3.35 A Low Current High Efficiency Solar Cell Composed of a 80μm Thin Monocrystalline Silicon Foil Transferred on a Low Cost Substrate

G. Sun, E. Terraz, Y. Boye, Y. Salinesi, A Sow, A. Malinge & A. Straboni
S'Tile, Poitiers, France
J. Arumughan
ISC Konstanz, Germany

2AV.3.36 A Study on Tunnel Oxide Passivated Contact of Silicon Solar Cells

H. Kim, S. Bae, J.W. Yang, C.H. Lee, Y. Kang, H.-S. Lee & D. Kim
Korea University, Seoul, Korea South
K. Ji
LG Electronics, Seoul, Korea South

2AV.3.37 ITO/n-Si Based Solar Cells: the Influence of Interfaces on Solar Cell Efficiency

A. Simashkevich, L. Bruc, N. Curmei & D. Serban
Institute of Applied Physics, Kishinev, Moldova
M. Rusu
HZB, Berlin, Germany
A. Thøgersen & A. Ulyashin
SINTEF, Oslo, Norway

2AV.3.38 Lead Free Ohmic Connections on High Efficiency Silicon Solar Cells

E. Skuras, G. Sempros, H. Zoubos, E. Mantzopoulou, T. Giousis & D. Anagnostopoulos
University of Ioannina, Greece
T. Makris, P. Fleming & A. Santamaria
Ipsol Energy, Nottingham, United Kingdom

2AV.3.39 Investigations on Laser Fired Contacting and Annealing of RST Silicon PERC-Type Solar Cells

B. Albrecht, Y.P. Botchak Mouafi, P. Keller & G. Hahn
University of Konstanz, Germany
F. de Moro
SolarForce, Bourgoin-Jallieu, France

VISUAL PRESENTATIONS 6AV.6

17:00 - 18:30 Utility-Scale PV / PV Applications without a Centralised Grid

6AV.6.4 Optimal Design of Renewable Energy Resources Considering Electric Load Control for Carbon Free Jeju Island in Korea
C.-Y. Cho, S.-S. Kim, H.G. Lee, J.-W. Ko, J.-R. Lim, S.C. Woo, H.-L. Cha, D.K. Kim & H.K. Ahn
Konkuk University, Seoul, Korea South
W.C. Lawrence & C.-S. Won
LSIS, Anyang-Si, Korea South
H.-S. Jeong
Korea Water Resources, Daejeon -Si, Korea South

6AV.6.5 State of Charge Variation for Small off-Grid PV-Battery Systems in Bolivia
F. Benavente-Araoz, A. Lundblad, Y. Zhang & G. Linbergh
KTH Royal Institute of Technology, Stockholm, Sweden
P. Elia Campana
Mälardalen University, Västerås, Sweden
S. Cabrera
UMSA, La Paz, Bolivia

6AV.6.6 Optimization of Stand-Alone PV Power Systems with Hybrid Energy Storages Based on Ultra Capacitors
S.M. Karabanov, D.V. Suvorov, E.V. Slivkin, G.P. Gololobov & D.Y. Tarabrin
RSREU, Ryazan, Russia

6AV.6.8 A Power Managing Unit for Standalone Solar PV Installation
D. Oulad-Abbou & S. Doubabi
Cadi Ayyad University, Marrakech, Morocco
A. Rachid
University of Picardie, Amiens, France

6AV.6.9 Design and Cost Optimization of Small-Scale PV-Powered Reverse Osmosis Desalination (Case Study)
S. Hajji
Masen, Rabat, Morocco
N. Mbodji & A. Hajji
Agronomic and Veterinary Institute Hassan II, Rabat, Morocco

6AV.6.11 Rural Water Supply in Ethiopia with PV Pumps
C. Nyman
Soleco, Porvoo, Finland
T. Beshah
BISIT, Kerpen, Germany
T.B. Woldekirkos
Solatec, Addis Ababa, Ethiopia

6AV.6.12 Sizing of PV Array for Water Pumping Application
A.F. Almarshoud
Qassim University, Buraydah, Saudi Arabia

6AV.6.13 Performance of SPV Water Pumping System at Lower Irradiance Condition
M. Bangar, B. Bora, O.S. Sastry, R. Singh, S. Rai & R. Dahiya
NISE, Gurgaon, India

6AV.6.14 Optimum Array Sizing of Solar Photovoltaic Water Pumping System
R. Dahiya, B. Bora, M. Bangar & O.S. Sastry
NISE, Gurgaon, India
B. Prasad
TERI, New Delhi, India

6AV.6.15 Product Integrated PV: Why Design and Styling Is a Requirement
A.H.M.E. Reinders & W. Eggink
University of Twente, Enschede, Netherlands

6AV.6.17 A New Photovoltaic Charging Topology and Regenerative Braking Analysis for Solar Tricycle
D. Mohamed, I. Salhi & S. Doubabi
Cadi Ayyad University, Marrakech, Morocco
A. Rachid
University of Picardie, Amiens, France

6AV.6.18 Design, Characterization and Modelling of High Efficient Solar Powered Lighting Systems
P. Behrensdorff Poulsen, S. Thorsteinsson, J. Lindén, R. Overgaard Ploug, P. Nymann & F. Svane
Technical University of Denmark, Roskilde, Denmark
M.C. Mira Albert & A. Knott
Technical University of Denmark, Lyngby, Denmark
I. Mogensen & K. Retoft
Out-sider, Copenhagen, Denmark

6AV.6.19 Development of a Photovoltaic Powered Poultry Egg Incubator
I. Okonkwo & O. Onyekwere
University of Nigeria, Nsukka, Nigeria

6AV.6.20 Integration of Renewable Energy Technologies in the Community of the Agricultural University of Athens
C.-S. Karavas & G. Papadakis
Agricultural University of Athens, Greece

6AV.6.21 How Solar Energy Connected to Development in Rural India
A. Kumar
Asha for Education, Atlanta, United States

NOTES

Tuesday, 21 June 2016

VISUAL PRESENTATIONS 5BV.1

08:30 - 10:00 PV Cells and Modules (I)

5BV.1.1 Comparative Studies in Degradation Behavior of Single-Cell Module by Pressure Cooker Test (PCT) and Extended Damp Heat (DH) Test

Y.T. Li, W.-L. Yang & H.-S. Wu
ITRI, Hsinchu, Taiwan
C.-M. Tung, P. Yu & P. Yu
NCTU, Hsinchu, Taiwan
B.H. Hamadani & X.-H. Gu
NIST, Gaithersburg, United States

5BV.1.2 Influence of Backsheet Type on Formation of Acetic Acid in PV Modules

A. Mihaljevic & G. Oreski
PCCL, Leoben, Austria
G. Pinter
University of Leoben, Austria

5BV.1.4 Natural and Artificial Ageing on Backsheets - Comparison of Degradation Effects

B. Hirschmann & G. Oreski
PCCL, Leoben, Austria
G. Pinter
University of Leoben, Austria

5BV.1.5 A New Approach to Determine the Crosslinking in Polyethylene Vinyl Acetate via Raman Spectroscopy

S. Jäger, S. Wittmann, T. Kunz, C. Camus & J. Hauch
ZAE Bayern, Erlangen, Germany
M. Heindl
SKZ, Würzburg, Germany
A. Linsenmeyer
SUNSET, Adelsdorf, Germany
C.J. Brabec
University of Erlangen-Nuremberg, Germany

5BV.1.6 Thermal Analysis of Crystallite Size Distribution as a New Fast Method to Determine Ethylene Vinyl Acetate Encapsulant Crosslinking Degree

S. Ogier, M. Vite & M. Hidalgo
CEA LITEN - INES, Le Bourget du Lac, France
D. Chapron & P. Bourson
University of Lorraine, Metz, France
I. Royaud & M. Ponçot
University of Lorraine, Nancy, France

5BV.1.8 Effect of Different UV Cut off Wavelength of EVA Encapsulant on the Performance & Reliability of Cr-Si PV Modules
A.K. Singh & R. Singh
RenewSys, Bangalore, India

5BV.1.9 UV-Fluorescence Measurements – Imaging and Spectroscopy
B. Kubicek
AIT, Vienna, Austria
G.C. Eder & Y. Voronko
OFI, Vienna, Austria
D. Mayrhofer
Vienna, Austria

5BV.1.10 Gel Content Determination of Polyolefin Elastomer (POE)-Based PV Encapsulant: Proper Solvent Extraction and Development towards a Fast and Non-Destructive Approach
H.-Y. Li, A. Faes, J. Champliaud, C. Ballif &
L.-E. Perret-Aebi
CSEM, Neuchâtel, Switzerland

5BV.1.12 Module Inspection Using Line Scanning Photoluminescence Imaging
I. Zafirovska, O. Kunz & T. Trupke
UNSW Australia, Sydney, Australia
J. Weber
BT Imaging, Sydney, Australia

5BV.1.13 Optical Simulation for Ribbon with Optical Structure in c-Si PV Module
C.-W. Yang, C.-M. Yang & C.-L. Cheng
AU Optronics, Taichung, Taiwan

5BV.1.14 Influence of Photovoltaic Module Mounting Systems on the Thermo-Mechanical Stresses in Solar Cells by FEM Modelling
A.J. Beinert, M. Ebert & U. Eitner
Fraunhofer ISE, Freiburg, Germany
J. Aktaa
KIT, Eggenstein-Leopoldshafen, Germany

5BV.1.15 Non-Stationary Outdoor EL-Measurements with a Fast and Highly Sensitive InGaAs Camera
J. Adams, C. Buerhop-Lutz, T. Pickel, J. Teubner,
C. Camus & C.J. Brabec
ZAE-Bayern, Erlangen, Germany

5BV.1.16 Impedance Spectroscopy and Its Possible Use for Deffects Detection
L. Cerná, T. Finsterle, P. Hrzina & V. Benda
CTU Prague, Czech Republic

5BV.1.17 Quantitative Luminescence Analysis of Solar Modules in Full Daylight
Y. Augarten, A. Wrigley, A. Gerber, B. Pieters & U. Rau
Forschungszentrum Jülich, Germany

5BV.1.18 Impedance Characterization of PV Modules in Outdoor Conditions
M.I. Oprea, S.V. Spataru & D. Sera
Aalborg University, Denmark
S. Thorsteinsson & P. Behrensdorff Poulsen
Technical University of Denmark, Roskilde, Denmark
A.R. Andersen & R. Basu
EmaZys Technologies, Vejle, Denmark

5BV.1.19 Light Induced Degradation of P-Mono PERC from Ingot, Cell, Module to System
M.Y. Chang, H. Chen, C.H. Hsueh & C. Chen
AU Optronics, Taichung, Taiwan

5BV.1.20 Non-Destructive PV Module Failure Analysis Using Dark Lock-in Thermography
D. Philipp, I. Dürr, S. Stecklum & C. Völker
Fraunhofer ISE, Freiburg, Germany

5BV.1.21 Measuring Anti-Reflection Coatings on Patterned Glass
B. Brophy, Z.R. Abrams & P. Gonsalves
Enki Technology, San Jose, United States

5BV.1.22 Measuring Anti-Reflection and Anti-Soiling Properties of PV Module Coatings
M. Gostein & W. Stueve
Atonometrics, Austin, United States
B. Brophy
Enki Technology, San Jose, United States
K. Jung
University of California, Riverside, United States
S. Zhang, Y. Jin & J. Xu
Trina Solar Energy, Changzhou, China

5BV.1.23 Guidelines for the Development of Abrasion-Resistant AR Coatings: Input from Modelling and Experimental Work
R. Cauchois, M. Meuwissen, M. Tian, H. Keul,
P. Steeman & D. Reardon
DSM, Geleen, The Netherlands

5BV.1.24 Variations in Spectral Transmittance due to Dust on CdTe and Mono Crystalline Silicon Modules
S. Rai, B. Bora, O.S. Sastry, R. Singh, M. Bangar,
R. Dahiya, G.K. Jha & T.R. Khadka
NISE, Gurgaon, India

5BV.1.25 1500v PID Test Results on 60-Cells Modules with Different Encapsulants, Glasses and Double Glasses

B. Braisaz & D. Binesti
EDF R&D, Moret-sur-Loing, France
B. Commault, E. Gerritsen & M. Joanny
CEA LITEN, Le Bourget du Lac, France
N. Le Quang & G. Goaer
EDF ENR PWT, Bourgoin Jallieu, France
K. Radouane
EDF EN, Paris La Defense, France

5BV.1.26 Durability of Bifacial Solar Modules under Potential Induced Degradation: Role of the Encapsulation Materials

M. Barbato, M. Meneghini, A. Barbato & G. Meneghesso
University of Padua, Padova, Italy
G. Tavernaro & M.P. Rossetto
MegaCell, Carmignano di Brenta, Italy

5BV.1.27 Lifetime Warranty Test Method Considering Potential Induced Degradation Recovery Behavior

K. Kang, B. Kim, S. Park & S. Chang
LG Electronics, Gumi, Korea South

5BV.1.28 Does the New IEC 62804-2 PID Test Procedure Cover a Service Life of CIGS PV Modules?

P. Lechner, J. Schnepf & D. Geyer
ZSW, Stuttgart, Germany
R. Schäffler, R. Wächter & T. Repmann
Manz CIGS Technology, Schwäbisch Hall, Germany

5BV.1.29 An Investigation of Factors Contributing to Potential-Induced Degradation (PID) and Its Countermeasures

X.-S. Wang, S. Wan, A. Fu & G. Xing
Canadian Solar, Suzhou, China

5BV.1.30 Potential Induced Degradation (PID) – Applied Field Analysis and Monitoring Data Evaluation, Regeneration and Prevention in the Field

G. Mathiak, N. Bogdanski, W. Herrmann & F. Reil
TÜV Rheinland, Cologne, Germany

5BV.1.31 Analysis of PID Affected Photovoltaic Module during Regeneration and Degeneration Process

J. Vanek, J. Hylsky, D. Strachala, M. Sturm & P. Cudek
Brno University of Technology, Czech Republic

5BV.1.32 Yield Losses of PID-Affected PV Systems - Simulation of Yield Losses Beyond Power Loss

J. Arp
PV Lab Germany, Potsdam, Germany
B. Jaeckel
UL International, Neu-Isenburg, Germany
J. Behrschmidt
Obst & Ziehmann, Hamburg, Germany

5BV.1.33 PID and UVID Resistant n-Type Solar Cells and Modules

M.K. Stodolny, G.J.M. Janssen, B.B. Van Aken, C.J.J. Tool, M.W.P.E. Lamers, I.G. Romijn & J. Löffler
ECN, Petten, The Netherlands
P.R. Venema & M.R. Renes
Tempress, Vaassen, The Netherlands
O. Siareyeva & E.H.A. Granneman
Levitech, Almere, The Netherlands
J. Wang, J. Ma, J. Cui, F. Lang & Z. Hu
Yingli Green Energy, Baoding, China

5BV.1.34 Evaluation of Potential Induced Degradation for Crystalline Silicon Solar Cells using Na Evaporated Ethylene Vinyl Acetate

W. Oh, J. Kim, B. Kang & S.-I. Chan
KETI, Seongnam, Korea South
S. Bae, H.-S. Lee & D. Kim
Korea University, Seoul, Korea South

5BV.1.35 Recoverty Method for Solar Modulses Affected by Potential Induced Degradation in Utility-Scale Solar Plants

Y. Hu, L. Hu, P. Ni, Q. Wei, F. Qian, Y. Yan & C. Liu
Talesun Solar, Suzhou, China

5BV.1.36 Performance Evaluation of PV Modules After Accelerated Testing Followed by Four Years of Field Exposure in Hot-Humid Climate of Florida

V. Gade, N. Shiradkar, J. Opalewski & S. Vaishnav
Jabil Circuit, St. Petersburg, United States

5BV.1.37 PID Study of n-Type Bifacial Module

K. Liu, Z. Sun, B. Yu, X. Lv, T. Feng, D. Rong, J. Jiang & Y. Zhang
Yingli Green Energy, Baoding, China

5BV.1.38 Compatibility of PV Ribbons and Fluxes with EVA Encapsulant Films

N.S. Pujari
Alpha Cookson India, Bangalore, India
A. Lifton & M. Murphy
Alpha109, South Plainfield, United States

VISUAL PRESENTATIONS 5BV.2

13:30 - 15:00 Operation of PV Systems

5BV.2.1 Assessment of 13MWp DEWA PV Plant Cleaning Performance
H. Qasem, P. Banda & A. Elnosh
Dubai Electricity & Water Authority, United Arab Emirates
R. Bkayrat
First Solar, Dubai, United Arab Emirates

5BV.2.4 Safety Analysis of Grounding Resistance for Zero Energy Town Floating PV System Using n-Type Bifacial Solar Cell Modules
J.-W. Ko, J.R. Lim, H.-L. Cha & H.K. Ahn
Konkuk University, Seoul, Korea South
C.-S. Won & W.C. Lawrence
LSIS, Anyang, Korea South
H.-S. Jeong
Korea Water Resources, Daejeon, Korea South

5BV.2.5 Optimal Design, Field Performance and Impact of Energy Legislation on the Cost Effectiveness of a Domestic on-Grid Photovoltaic System in Morocco
N. Mbodji & A. Hajji
Agronomic and Veterinary Institute Hassan II, Rabat, Morocco
K. Ababou & A. Heddouch
SEWT, Rabat, Morocco

5BV.2.6 Development of a Matlab Based Sizing and Simulation Tool for Solar Photovoltaic Pumping System (PVPS)
R. Hasan & M. Zehner
Rosenheim University of Applied Sciences, Germany
O. Mayer
GE Global Research, Garching, Germany

5BV.2.7 Termovision Testing of the Solar Power Plant Lifetime in the Czech Republic
K. Jandová & J. Vanek
Brno University of Technology, Czech Republic

5BV.2.8 Simple and Accurate Monitoring of Expected PV Power Generation by Using Mini-PV Module
K. Saito & M. Kondo
Fukushima University, Japan
J. Yamazaki & D. Yoshino
The University of Aizu, Fukushima, Japan
N. Higuchi
Fukushima National College of Technology, Japan

5BV.2.11 Automatic Detection of Defective Solar Modules by Thermovision
J. Vanek, I. Repko & J. Klima
Brno University of Technology, Czech Republic

5BV.2.12 On the Way to Accurately Calculate Yearly Energy Harvest of a Solar Panel System
X. Liao, K. Spee & C. van der Schouw
Avans University of Applied Science, Hertogenbosch, The Netherlands

5BV.2.13 Parameter Estimation of Commercial Flexible Amorphous and Crystalline Silicon Solar Cell Using Firefly Optimization Algorithm
M. Louzazni, A. Khouya & K. Amechnoue
University Abdelmalek Essaadi, Tanger, Morocco

5BV.2.16 Evaluation of a Detailed Electro-Thermal PV Model on a 62.5 kWp Installation
D.G. Anagnostos & D. Soudris
NTUA, Athens, Greece
K.M. Paasch
University fo Southern Denmark, Sønderborg, Denmark
H. Goverde & F. Catthoor
imec, Leuven, Belgium

5BV.2.17 Modelling PV Modules Based on IEC 61853 Data
B. Gatzka, M. Hofmann, R. Hunfeld & S. Lindemann
Valentin Software, Berlin, Germany

5BV.2.18 Skelion: the 3D Simulation Tool for PV Systems
J. Pons Alemán
Skelion, Valencia, Spain
B. Soucase & I. Guaita
UPV, Valencia, Spain

5BV.2.19 Automatic Computation of Shading Mask on a PV Filed Based on Production Data
J. Dupas & B. Gaiddon
Hespul, Lyon, France
M. Joos & S. Fraisse
Epices Energie, Lyon, France

5BV.2.21 A Critical Review of PV System Design Rules for Optimizing Energy Yield and Space Utilization
N. Narayan, A.H.M. Smets & M. Zeman
Delft University of Technology, The Netherlands

5BV.2.23 Calculation- and Visualization-Tool (CVT) for Partial Shading of Photovoltaic Systems
F. Kuonen, U. Muntwyler, H. Heck, D. Gfeller & T. Schott
BUAS, Burgdorf, Switzerland

5BV.2.24 Implications of Reference Data Accuracy and Stability for Performance Monitoring of PV Sites
H. Staab & A. Clerc
Renewable Energy Systems, Kings Langley, United Kingdom

5BV.2.25 3 Year Field Performance of Anti-Soiling Coatings at Several Locations
B. Brophy
Enki Technology, San Jose, United States
K. Schexnaydre
SunEdison, Belmont, United States

5BV.2.27 Optimization of the Photovoltaic System Power by a New Hyperbolic Tangent Approximation of the of Artificial Neural Network MPPT under Xilinx System Generator
F. Dkhichi, B. Oukarfi, Y. El Kouari, D. Ouoba & A. Fakkar
University of Hassan II, Mohammédia, Morocco

5BV.2.28 Evaluation of Remote Diagnoses Performance by Using Operating Performance Index at Different Measurement Intervals for Residential PV Systems
M. Ajisaka & Y. Ueda
Tokyo University of Science, Japan

5BV.2.29 Performance Enhancement of a Neural Network Model for PV Panel Power Prediction Using Self-Organizing Maps
S. Pulipaka, P. Upadhyay & R. Kumar
BITS, Pilani, India

5BV.2.30 Study of Newly Installed PV Module Performance in Northern India
V. Khanna & A. Singh
NCU Gurgaon, Harayana, India
A. Shekher
NGU Gurgaon, Harayana, India
V. Budhraja
BITS, Goa, India

5BV.2.31 A Simultaneous IV Tracer System: Solution for Monitoring and Diagnosing Photovoltaic System
Y.-C. Ou & J.-L. Kwo
All Real Technology, Kaohsiung, Taiwan

5BV.2.32 The Design and Deployment of PV Systems at Aerodromes
P. Rodden, L. Frearson & M. Tuckwell
CAT Projects, Alice Springs, Australia

5BV.2.33 Comparison of Various Models for the Estimation of the Performance Loss Rate of 7 PV Technologies over 5 Years in Alpine Climate
P. Ingenhoven, G. Belluardo & D. Moser
Eurac Research, Bolzano, Italy

5BV.2.34 Drone-based Assessment of Cleaning Effects on Large PV Installations
M. Lanz, U. Muntwyler & E. Schüpbach
BUAS, Burgdorf, Switzerland

5BV.2.35 Floating PV Installations in the Maltese Sea Waters
M. Grech, L. Mule'Stagno & M. Aquilina
University of Malta, Msida, Malta
M. Cadamuro
General Membrane, Venice, Italy
U. Witzke
Pandia Energy, Victoria Gozo, Malta

5BV.2.36 Development, Application and Validation of a Compact, Portable Solar Cell Characterization Device Utilized for BIPV Analysis
D. Holzmann, C. Mayer, L. Neumaier & C. Hirschl
CTR, Villach, Austria

5BV.2.37 Thermal Classification Modelling and Energy Yield Performance of Different Crystalline Silicon Photovoltaic Modules with Innovative Packaging Components
G. Makrides, I. Koumparou & G.E. Georghiou
University of Cyprus, Nicosia, Cyprus
J. Bratcher & J. Pratt
Honeywell, Morristown, United States

5BV.2.38 Advanced Performance Monitoring System for Improved Reliability and Optimized Levelized Cost of Electricity
G. Makrides, A. Phinikarides & G.E. Georghiou
University of Cyprus, Nicosia, Cyprus
J. Sutterlueti
Gantner Instruments, Schruns, Austria
S. Ransome
Steve Ransome Consulting, Kingston upon Thames, United Kingdom

5BV.2.39 A Use of Artificial Intelligence for Improving PV Array Performance (Empirical Approach)
A. Macq, L. Mercier des Rochettes, L. Martin-Carron & N. Cristi
SUNiBRAIN, Colomiers, France
M.-P. Gleizes & C. Bernon
University of Toulouse, France

5BV.2.40 Floating PV Power System Evaluation over Five Years (2012 ~ 2016)
W. Lawrence, C.-S. Won, D.C. Kim, K.W. Kim, B.R. Kang & G.-H. Lee
LSIS, Anyang-Si, Korea South

5BV.2.42 Monitoring of over 10 GW of PV-Systems Throughout Europe – Analyses of Irradiance, Yield and Operational Performance of Modern PV Systems

M. Schneider, N. Riewald, L. Richter & C. Kurz
Meteocontrol, Augsburg, Germany
A. Hammer
University of Oldenburg, Germany
M. Hartmann & M. Zehner
University of Applied Sciences Rosenheim, Germany
R. Gottschalg
Loughborough University, United Kingdom

5BV.2.43 Investigation of Battery Energy Storage System (BESS) Unit Sizing Using Trnsys for an on-Campus Photovoltaic Charging Station

A. Esfandyari, B. Norton & M. Conlon
Dublin Institute of Technology, Ireland
S.J. McCormack
Trinity College Dublin, Ireland

5BV.2.44 Outdoor Performance and Modelling Study of Innovative Crystalline Silicon Photovoltaic Modules under Hot Climate Conditions

G. Makrides, A. Phinikarides & G.E. Georghiou
University of Cyprus, Nicosia, Cyprus
E. Herzog & M. Strobel
Hanwha Q CELLS, Bitterfeld-Wolfen, Germany

5BV.2.45 Performance Analysis of a New Class of Dual Axis Trackers

E. Menard, G. Dambrine, B. Binet & J. Boardman
HeliosLite, Le Bourget du Lac, France
J. Sudres
Quadran Energies Libres, Villeneuve-lès-Béziers, France

5BV.2.46 Evaluation of Soiling during a 2-Months Drought and Construction Works Near a PV Test Facility in North-East Italy

G. Belluardo, P. Ingenhoven & D. Moser
EURAC, Bolzano, Italy

5BV.2.47 Global Method for Calculating Location Specific MPP Tracking Losses Using Available Weather Statistics

M. Egler, S. Gordon & P. Yim
OST Energy, Brighton, United Kingdom

5BV.2.48 Cell to Module Losses of an MWT Module

L.H. Slooff, E.E. Bende, M.J. Jansen, L.A.G. Okel,
F.J.K. Danzl & P. Manshanden
ECN, Petten, The Netherlands

5BV.2.49 Annual Yield Comparison of Module Level Power Electronics and String Level PV Systems with Standard and Advanced Module Design

K. Sinapis, C. Tzikas, M.N. van den Donker & W. Folkerts
SEAC, Eindhoven, The Netherlands
T.T.H. Rooijakkers, G.B.M.A. Litjens & W.G.J.H.M. van Sark
Utrecht University, The Netherlands

5BV.2.50 IR-Imaging a Tracked PV-Plant Using an Unmanned Aerial Vehicle

C. Buerhop-Lutz, H. Scheuerpflug, T. Pickel & C. Camus
ZAE Bayern, Erlangen, Germany

5BV.2.51 aIR-PV-Check of Thin-Film PV-Plants – Detection of PID and Other Defects in CIGS Modules

C. Buerhop-Lutz, T. Pickel, H. Scheuerpflug & C. Camus
ZAE Bayern, Erlangen, Germany
C. Dürschner
Ing.-Büro Dürschner, Erlangen, Germany

5BV.2.52 Titanium-Dioxide Nanotechnological Coating Application on Photovoltaic Modules for Preventive Yield Maintenance over Time

A. Andaloro
Polytechnic University of Milan, Italy
L. Manni, M. Pravettoni & F. Frontini
SUPSI, Canobbio, Switzerland

5BV.2.53 IR-Images of Defective PV-Modules Influenced by Short-Time Changes of the Electric System

C. Buerhop-Lutz, T. Pickel & C. Camus
ZAE Bayern, Erlangen, Germany

5BV.2.55 Selection Criteria of PV Technology Based on Specific Site

G.K. Jha, R. Kumar, R. Siddiqui, S.R. Sykam, P. Rajput,
M. Morampudi, S.L. Panchal & G. Gowri
NISE, Gurgaon, India

5BV.2.58 Forecasting the Degradation Rate of Different Photovoltaic Systems Using Robust Principal Component Analysis and Arima

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

5BV.2.59 Success Factor Proven Reliability of PV Modules and Systems

W. Bergholz
Q-Team, Schwanewede, Germany
A. Raykov
Ucha.se, Sofia, Bulgaria
J. Wittmann
Beuth Hochschule Berlin, Germany

5BV.2.60 Performance of a Module and Defect Detection Algorithm for Aerial Infrared Images as a Function of the Flying Altitude
M. Dalsass
ZAE Bayern, Hof, Germany
S. Dotenco & F. Gallwitz
Nuremberg Institute of Technology, Germany
P. Luchscheider
ZAE Bayern, Erlangen, Germany
C.J. Brabec
FAU i-MEET, Erlangen, Germany

5BV.2.62 A Simulation Based Optical and Electrical Approach to Estimate Energy Yield for Various Designs of Curved Modules
H. Hanifi, C. Pfau, J. Schneider & J. Bagdahn
Fraunhofer CSP, Halle, Germany

5BV.2.63 A Software Suite for Simulation and Design of PV Plants
I. Lokhat, S. Boussac & B. Lelong
Cythelia, Montagnole, France

5BV.2.64 Spectral Studies Investigating the Influence of Dust on Solar Transmittance
M. Mani, P.C. Ramamurthy & K.K. Khanum
Indian Institute of Science, Bangalore, India

5BV.2.65 PID Detection and Management in Ground Mounted PV Installations
L. Garreau-Iles
DuPont, Meyrin, Switzerland
W. Nasse
Suncycle, Hamburg, Germany
W.J. Gambogi, J. Kapur & A. Bradley
DuPont, Wilmington, United States

5BV.2.66 Analysis of Different Shading Pattern on the Total Cross Tide Connected Configuration of Solar PV Power Plant
D. Singh, B. Pradhan, A. Sharma & K. Saikia
Central University of Jharkhand, Brambe, India
B. Bora, O.S. Sastry, Y.K. Singh, R. Singh, S. Rai,
M. Bangar, R. Dahiya & R. Singh
NISE, Gurgaon, India

5BV.2.67 Aaccurate Modeling and Maximum Power Point Detection of Photovoltaic Module Using a Few Collected Data
M.-A.-E.-H Mohamed
Al-Azhar University, Qena, Egypt

5BV.2.68 Design and Analysis of 10MWp Grid Connected PV System Installed West Kuwait
H.M. Abdullah, R.M. Kamel & M. El-Sayed
Kuwait University, Kuwait

5BV.2.70 Performance Analysis of Different Thin Film Module Technology in Indian Climatic Condition
Y.K. Singh, B. Bora, R. Singh, S. Chakravarty, O.S. Sastry,
R. Singh, S. Rai & K. Yadav
NISE, Gurgaon, India

5BV.2.72 Performance Comparison of PV Module Based on Temperature Coefficient in Indoor and Outdoor Conditions as per IEC 61853-1
M. Morampudi, B. Bora, G.K. Jha, R. Kumar, R. Siddiqui,
S. Panchal, G. Gowri, P. Rajput, S. Raghava & B. Dubey
NISE, Gurgaon, India
M. Singh
Kurukshetra University, India
G. Nanda
KIIT University, Bhubaneswar, India

5BV.2.73 Control Strategy of a Photovoltaic Module Emulator Based on Hill-Climbing and Single-Diode Model
B. Ospina & J.S. Parra
Universidad del Valle, Cali, Colombia
E. Franco & J.D. Bastidas-Rodriguez
Universidad Industrial de Santander, Bucaramanga,
Colombia

5BV.2.74 Optimum Sizing and Exploitation of Results of Ndem's Solar Power Plant Capacity
S.N. Leye & S. Mbodji
University of Alioune DIOP, Bambey, Senegal
F.S. Dia & G. Sissoko
University of Dakar, Senegal

5BV.2.75 LowCost-Outdoor-Electroluminescence: Significant Improvements of the Method
K. Mertens & A. Arnds
Münster University of Applied Sciences, Steinfurt, Germany
G. Behrens & A. Domnik
University of Applied Sciences Bielefeld, Minden, Germany

5BV.2.76 Innovative Semi-Automatic Cleaning Technique for High Concentration Photovoltaic Panels
D. Dahlioui, Y. Elfatimy, A. Benazzouz & A. Barhdadi
University Mohammed V-Agdal, Rabat, Morocco
G. Borelli, M. Carpanelli & D. Verdilio
Becar, Monteveglio, Italy

5BV.2.77 Modeling and Planning Optimum Sites for PV Solar Energy Farms in Qatar Using Geographic Information System (GIS)
Y.E. Mohieldeen, H. AL Hajiri & D. Martinez
Qatar Foundation, Doha, Qatar

5BV.2.78 PV Module Ageing in Southern Europe – Hot Spots and Impact on Yield
M. Grottke
WIP - Renewable Energies, Munich, Germany
F. Espín
Efficiency Services Consulting, Bullas, Spain

5BV.2.79 A Comparative Study of Different Types PV System Technologies
A. El Yaakoubi, K. Attari, A. Asselman, E. Aroudam & A. Djebli
Abdelmalek Essaadi University, Tetouan, Morocco

5BV.2.81 Investigation and Diagnostic Tools Comparison: Infrared Thermography vs Electroluminescence
D. Bertani & S. Guastella
RSE, Milan, Italy
C. Camilloni & C. Liciotti
KB Development, San Zeno Naviglio, Italy

5BV.2.83 DaySy Reliably Detects PID in the Field
L. Stoicescu & M. Reuter
Solarzentrum Stuttgart, Germany
J.H. Werner
Unversity of Stuttgart, Germany

5BV.2.84 Outdoor Performance of the Anti-Soiling and Anti-Reflection Coating for Photovoltaic Modules
S.-I. Chan, S. Kang, J. Kim, J.-H. Kim & W. Oh
KETI, Seongnam-si, Korea South
S. Choi & H. Hwang
University of Sungkyunkwan, Suwon, Korea South

5BV.2.85 Evaluation of a PV-Panel via Long Term High Speed Recording of IV-Curves
K.M. Paasch
University fo Southern Denmark, Sønderborg, Denmark
C. Cornaro
University of Rome II, Italy
M. Nymand
University of Southern Denmark, Odense, Denmark

VISUAL PRESENTATIONS 1BV.5

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

1BV.5.1 Models for Lambertian Optics in Si
L. Abenante
ENEA, Rome, Italy

1BV.5.3 An Inexpensive Spectral Sensor for MMPT in Partial Shade
M. López-Álvarez & J. Hernández-Ándres
University of Granada, Spain
S. Collins
University of Oxford, United Kingdom

1BV.5.4 Contact-Free Raman Spectroscopic Measurement of Residual Stress in Silicon Solar Cells Caused by Stringing
L. Neumaier, W. Mühleisen & C. Hirschl
CTR, Villach, Austria
T. Fischer
Teamtechnik, Ingersheim, Germany
J. Scheurer
Polytec PT, Waldbronn, Germany
W. Pranger
Ulbrich of Austria, Müllendorf, Austria

1BV.5.6 Air Cooling of Photovoltaic Panels: a Numerical Approach
L. Martin-Carron, D. Ugarte, A. Macq & N. Cristi
SUNiBRAIN, Toulouse, France
R. Becker, D. Graebling & R. Luce
CNRS, Pau, France

1BV.5.7 The Effect of Phosphorus Gettering on Fine-Grained Multicrystalline Silicon
K.E. Ekstrøm, A. Autruffe, L. Arnberg & M. Di Sabatino
NTNU, Trondheim, Norway
R. Søndenå
Institute for Energy Technology, Kjeller, Norway
G. Stokkan
SINTEF, Trondheim, Norway

1BV.5.8 New Modeling for Field Emission Current in Graphene-Oxide/n-Semiconductor Schottky Barrier Solar Cells
A.C. Varonides
University of Scranton, United States

1BV.5.9 New Modeling for Combined Thermionic and Field Emission Current in Ideal Graphene/n-Si Schottky Barrier Solar Cells in the Landauer Formula Context
A.C. Varonides
University of Scranton, United States

1BV.5.10 Temperature and Frequency Dependencies of Electrical Conductivity of the Nanostructured Photoabsorbers Cu2SnS3, for the Conversion of Solar PV
L. Essaleh, M. Belaqziz, H. Chehouani & S. Lahlali
Cadi Ayyad University, Marrakech, Morocco
K. Djessas
University of Perpignan, France
J.L. Gauffier
INSA Lyon, Toulouse, France

1BV.5.12 ZnO Nanowires Obtained by Electrochemical Method
L. Nkhaili, A. El Kissani, M. Ait Ali, A. Elmansouri & A. Outzourhit
Cadi Ayyad University, Marrakech, Morocco

1BV.5.13 Intrinsic Transport in Non-Uniformly Doped Si Regions
L. Abenante
ENEA, Rome, Italy

1BV.5.14 The Influence of the Exciton Nonradiative Recombination in Silicon on the Photoconversion Efficiency
A.V. Sachenko, V.P. Kostylyov, V.M. Vlasiuk & I.O. Sokolovskyi
NAS ISP, Kiev, Ukraine
M. Evstigneev
Memorial University of Newfoundland, St. John's, Canada

1BV.5.15 A Novel Synthetic Approach for CNTs-Decorated Nb3O7F Hierarchical Nanomaterials with Enhanced Photovoltaic Properties
F. Huang, Q. Liang, A. Yan, H. Liang & S. Zhang
China University of Mining and Technology, Xuzhou, China

1BV.5.16 Graphene-Perovskite Interaction Utilizing Graphene Coated Metal Nano-Spheres: Application in Photovoltaic
S. Bhardwaj & R.P. Sharma
IIT Delhi, New Delhi, India

1BV.5.18 Unveiling the Influence of Lead Halide on Thermal Stability of Perovskite Solar Cells
Y. Du, H.K. Cai, Y. Wu, J. Ni, J. Li, H. Wen, D. Zhang & J. Zhang
Nankai University, Tianjin, China

1BV.5.19 Numerical Simulation of Plasmon Coupling of Metal Nanoparticles in Perovskite Medium
S. Roopak & R. Sharma
Indian Institute of Technology, New Delhi, India

1BV.5.21 Colloidal Synthesis, Structural and Optical Properties of CuIn3Se5 Nanocrystals for Photovoltaics
M. Ghali, G.F. Ali, A.M. Eissa & M. Dewidar
Kafrelsheikh University, Egypt
M.K. El-Nimr
Tanta University, Egypt
H. Talaat
Ain Shams University, Cairo, Egypt

1BV.5.22 Intermetallic Phase Distribution of CuIn1-xGaxSe2 (CIGS) Electroless Deposited Solar Hybrid Electrode Contacts Using Nano-Indented Atomic Force Microscopy
S.H. Kwon, L.S. Zheng, E. Choi, M. Nam, K. Kang, A. Kim, S. Chae & S.G. Pyo
Chung-Ang University, Seoul, Korea South

1BV.5.24 Fast Processing of Sol-Gel TCO
J. van Deelen, M. Rem, N. Arfsten & P. Buskens
TNO, Eindhoven, The Netherlands

1BV.5.25 First Principle Investigation of Optical Properties of Rutile TiO2
A. Eddiouane, S. Boussaidi & H. Zgou
Ibn Zohr University, Ouarzazate, Morocco
H. Chaib
University of Agadir, Ouarzazate, Morocco
A. Nafidi
Ibn Zohr University, Agadir, Denmark

1BV.5.26 Investigation of the Relaxation Dynamics and Carrier Temperature of PbS QDs
W. Cao, Y. Lin, X. Wen, S. Huang, S. Shrestha & G.J. Conibeer
UNSW Australia, Kingsford, Australia

1BV.5.28 Vibrational Study of Hybrid Systems Based on Graphene for Photovoltaics
M. Boutahir, A.H. Rahmani, H. Chadli & A. Rahmani
University Moulay Ismail, Meknes, Morocco

1BV.5.29 Betavoltaics. Analysis of the Attainable Efficiency for Direct-Bandgap Semiconductors
A.V. Sachenko, R.M. Korkishko, V.P. Kostylyov, M.R. Kulish & I.O. Sokolovskyi
NAS ISP, Kiev, Ukraine
M.A. Evstigneev
Memorial University of Newfoundland, St. John's, Canada
A.I. Shkrebtii
University of Ontario, Oshawa, Canada

1BV.5.30 Black, Infrared Reflective Backsheet Structures for PV: where Aesthetics Meet Performance
S.L. Luxembourg, M. Kloos, A. Gutjahr, P. Manshanden & J.A.M. Van Roosmalen
ECN, Petten, The Netherlands
J. Theewis
Eurolacke, Tiel, The Netherlands

1BV.5.31 Investigations on Half Cells for Heterojunction Modules
H. Mehlich, F. Kirchhoff, M. Leonhardt, A. Waltinger & M. König
Meyer Burger, Hohenstein-Ernstthal, Germany
M. Grimm & C. Belgardt
3D-Micromac, Chemnitz, Germany
Y. Yao & T. Söderström
Meyer Burger, Gwatt, Switzerland
M. Gragert
Meyer Burger, Thun, Switzerland

1BV.5.32 Triangular Ribbons for Improved Module Optics
M. Mittag, A.J. Beinert, L.C. Rendler & U. Eitner
Fraunhofer ISE, Freiburg, Germany

1BV.5.34 DSM AR Coating Performance on PV Glass, Modules and System with Long Term Outdoor Exposure in Different Climates
M. Mrcarica, J. Gaury & N. Voicu
DSM Innovation Center, Sittard, The Netherlands

1BV.5.35 Thin-Film Barriers for Durable Thin-Film PV Modules
J. Hüpkes
Forschungszentrum Jülich, Germany
N. Wyrsch & F. Sculati-Meillaud
EPFL, Neuchâtel, Switzerland
G. Cattaneo
CSEM, Neuchâtel, Switzerland
B. Stannowski
HZB, Berlin, Germany

1BV.5.36 Proposed Evaluation Framework for Exploration of Smart PV Module Topologies
M.-I. Baka & D. Soudris
NTUA, Athens, Greece
F. Catthoor
imec, Leuven, Belgium

1BV.5.38 Towards Ultra-Thin Glasses for Solar Energy Applications
B. Allsopp & P. Bingham
Sheffield Hallam University, United Kingdom
R. Orman, S. Johnson & J. Booth
Johnson Matthey Technology Centre, Reading, United Kingdom
I. Baistow
Solar Capture Technologies, Blyth, United Kingdom
K. Lundstedt, P. Sundberg, C. Stålhandske & S. Karlsson
Glafo, Växjö, Sweden
A. Andersson
SP Technical Research Institute, Boras, Sweden
P. Aitor Postigo
IMM - CSIC, Tres Cantos, Spain

1BV.5.39 The Anti-Glaring Module Simulation, Proto-Type Design and Module Performance
Y.-C. Chen, C.-W. Yang, T. Lai & C.L. Cheng
AU Optronics, Taichung, Taiwan

1BV.5.40 Outdoor Durable Materials Technology for Light Management of PV Modules
C. Panofen, P. Wyman & K. Van Durme
DSM Advanced Surfaces, Sittard, The Netherlands

1BV.5.41 Lamination Cycle Time Optimization Using New POE Encapsulants
I. Fidalgo, R. Merino & B. Pérez
STRE, Asturias, Spain

1BV.5.42 A Bypass Diode for Integrated Smart Solar Cell Module
Z.Q. Ma, H.W. Du, F. Xu, M. Gao & L. Zhao
University of Shanghai, China

1BV.5.43 Selectively Modulated Aesthetic Reflector Technology (SMART) – a Novel Colour Coating for Photovoltaics Modules
A. Soman & A. Antony
IIT Bombay, Mumbai, India

1BV.5.44 Hybrid Encapsulation Film for PV Modules Operating at High Voltage
S.C. Pop & R. Schulze
Yingli Green Energy, San Francisco, United States
J. Kapur
DuPont, Wilmington, United States

1BV.5.45 Investigation on Yield Improvement and Application in Energy-Saving Building of Bifacial Module
Z. Sun, Y. Li, J. Jiang, X. Lv, D. Rong, Y. Zhang, Y. Geng, T. Feng, Y. He, K. Liu & B. Yu
Yingli Green Energy, Baoding, China

1BV.5.46 Phase Change Materials for Hybrid Technology: Review
D. Gonzalez Peña, M. Díez-Mediavilla, M.C. Rodríguez-Amigo & C. Alonso-Tristán
UBU, Burgos, Spain

1BV.5.47 Aisovol Project, a Photovoltaic Generation Solution as an Alternative Construction Material
C. Montes, A. Linares, E. Llarena, O. González, D. Molina, A. Pío, L. Ocaña, C. Quinto, M. Friend & M. Cendagorta-Galarza López
ITER, Granadilla de Abona, Spain
A.B. Cueli, J. Moracho, I. Petrina, J. Díaz, E. Zugasti, J. Bengoechea, M.J. Rodriguez, M. Ezquer Mayo, J.M. Cuadra & A.R. Lagunas
CENER, Sarriguren-Navarra, Spain

1BV.5.48 Design and Performance of High Efficiency ZWS(TM) Modules
B. Nadimpally, R. Nandan, F. Novoa, C. Kearns-McCoy, E. Rhee, V. Chaudhari, D. Amin, G. Shi, L. Ferry, O. Rezvanian, J. Bearden, J. Posbic & A. Deshpande
SunEdison, Maryland Heights, United States
S. Koppikar
SunEdison, Maryland Heights, India

1BV.5.49 An Experimental Investigation into Passive Temperature Regulation of a Novel WICPV System with Phase Change Material
S. Sharma, A. Tahir & T.K. Mallick
University of Exeter, Penryn, United Kingdom
N. Sellami
Heriot Watt University, Dubai, United Arab Emirates

1BV.5.50 Combination of nFOG™ and DSM AR Coating Technologies to Deliver Superior Quality of Anti-Reflective Coating on Solar Cover Glass
S. Tammela, K. Asikkala, T. Määttä & P. Merilaïnen
Beneq, Vantaa, Finland
J. Boonen, R. de Rijk & M. Mennig
DSM, Geleen, The Netherlands

VISUAL PRESENTATIONS 5BV.3

15:15 - 16:45 Balance of System Components

5BV.3.1 Integrated Testing and Measurement System for a PV Module-Based Transformer-Less DC/DC Converter
U. Chatterjee, A. Pevere, T. Dat Mai & J. Driesen
Catholic University of Leuven, Belgium
S. De Breucker
VITO, Mol, Belgium

5BV.3.2 A High Speed Global Maximum Power Point Tracking Algorithm for PV Systems
M. Basoglu & B. Çakir
Kocaeli University, Turkey

5BV.3.3 Analyzing the Performance of Commercial PV Modules under Field Conditions
J.-K. Lim, S.-I. Yoon, M.-S. Kim, J.H. Ahn, K. Lee,
M.-I. Hwang & E.-C. Cho
Hyundai Heavy Industries, Yongin, Korea South

5BV.3.4 Analysis of the Performance of PV Modules with Cell-String Level Optimizers from a LCOE Perspective
S. Zhang, P. Quan, S. Deng, E. Lee, J. Yu, M. Wu,
Z. Zhang, P.J. Verlinden & Z. Feng
Trina Solar Energy, Changzhou, China

5BV.3.5 Testing of Smart PV Modules
D. Gfeller, C. Renken, L. Borgna & U. Muntwyler
BUAS, Burgdorf, Switzerland

5BV.3.7 High Efficiency and Low Leakage Current Photovoltaic Power Conditioning System for Corner Grounded Three-Phase Grid
K.-I. Jeong & J.-M. Kwon
Hanbat National University, Daejeon, Korea South
B.-H. Kwon
Postech, Pohang, Korea South

5BV.3.8 Tracking of the Maximum Power Point in a Partially Shaded Photovoltaic Panel Using Kalman Algorithm
A. Aoune, S. Motahhir, A. El Ghzizal, S. Sebti & A. Derouich
USMBA, Fez, Morocco

5BV.3.9 Weighted Efficiency of SPV Power Converters/Inverters in Indian Composite Climate
K. Yadav, O.S. Sastry, B. Bora, M. Kumar, R. Singh &
R. Parmar
NISE, Gurgaon, India
A. Kumar & B. Prasad
TERI, New Delhi, India

5BV.3.11 Testing of Multi-MPPT PV Inverters: Approach and Test Results
D. Gfeller, L. Borgna & U. Muntwyler
BUAS, Burgdorf, Switzerland

5BV.3.12 Ekogrid - the Most Innovative Platform for IoT, M2M to Optimize PV Plant Energy Processes
R. Cancho, A. Rasello & F. Rasello
Integrare, Milan, Italy
Y. Bongiovanni
Ekogenio, Berlin, Germany

5BV.3.13 Comparing the Impact of the off-Grid System and on-Grid System on a Realistic Load
A. Algaddafi, N. Brown, R. Gammon & J. Alshahrani
De Montfort University, Leicester, United Kingdom

5BV.3.14 Aiming at Optimization of Tracking Technology through Seasonally Tilted Sun Trackers: an Indian Perspective
S. Mukherjee & S. Sengupta
Vikram Solar, Kolkata, India

5BV.3.15 Reduction of Leakage Current in Three-Phase Z -Source Neutral Point Clamped Inverter for Photovoltaic Systems
C. Bharatiraja & J. Munda
TUT, Pretoria, South Africa
S. Raghu
SRM University, Chennai, India

5BV.3.17 **Design and PIL Simulation of an AEKF for Real Time Battery SOC Estimation Using ARM Based Core**
A. Gaga, O. Diouri, Y. Cheddadi, F. Errahimi & N. Es-Sbai
USMBA, Fez, Morocco

5BV.3.18 **Performance Comparison of Three Inverters with Different Transformer Topology**
M. Kumar, O.S. Sastry, K. Yadav, R. Parmar, R. Singh & B. Bora
NISE, Gurgaon, India

5BV.3.19 **A Novel Suitable Resonant Filter to Improve the THD for a PV Inverter**
R. El Bachtiri, M. Khanfara & K. El Hammoumi
USMBA, Fez, Morocco

5BV.3.21 **Photovoltaic Modules Monitoring System Using a Wireless Sensor Network**
E. Ortega & G. Aranguren
University of the Basque Country, Bilbao, Spain
M.J. Sáenz, R. Gutiérrez & J.C. Jimeno
University of the Basque Country, Zamudio, Spain

5BV.3.22 **Experimental Evaluation of the Solar Radiation Gains over Photovoltaic Cells due to the Use of Ti02 Treated Surfaces. Aplications to Photovoltaic Systems with Micro-Inverters**
I. Lillo Bravo
University of Seville, Spain
R. Dominguez
AICIA, Sevilla, Spain
M. Larrañeta Gómez-Caminero & M. Silva Pérez
AICIA, Seville, Spain

5BV.3.24 **A Refined Method to Evaluate Grid-Connected PV Inverters for Western Regions of China**
B. Wang & N. Ma
Ningxia Panshi Inspection and Research, Yinchuan, China

VISUAL PRESENTATIONS 1BV.6

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

1BV.6.1 **Enhancement of Two-Step Photon Absorption due to Miniband Formation in InAs/GaAs Quantum Dot Superlattice Solar Cell**
S. Watanabe, T. Kaizu & T. Kita
Kobe University, Japan
S. Asahi, T. Kada & Y. Harada
Kobe Univesity, Japan

1BV.6.2 **Short-Circuit Current Density Boost with Oxygen Chemisorption/Desorption of ZnO Nanowires**
D.-C. Perng, K.-H. Chen, K.-H. Chen & M.-H. Hong
National Cheng Kung University, Tainan, Taiwan

1BV.6.4 **Effects of Luminescent Coupling in Perovskite/c-Si Multijunction Solar Cells with Nanostructured Interlayer**
T. Tayagaki
AIST, Tsukuba, Japan
Y. Kurokawa & N. Usami
Nagoya University, Japan

1BV.6.6 **5% Efficiency Enhancement in Thin-Film SiGe HIT Solar Cells Using 200nm Plasmonic Gold Nanoparticles**
H. Al Mazem, F.I. Chowdhury, S. Abdul Hadi & A. Nayfeh
Masdar Institute, Abu Dhabi, United Arab Emirates

1BV.6.7 **Copper Iodide – Hole Selective Contact for the Hot Carrier Solar Cell**
S. Chung, R. Patterson, S. Shrestha & G.J. Conibeer
UNSW, Sydney, Australia

1BV.6.9 **Potential of Poly-Crystalline ZnTe for Low-Cost Intermediate Band Solar Cell Application**
C. Liu, N. Tang, A. Ren, W. Li, L. Wu, J. Zhang & L. Feng
Sichuan University, Chengdu, China

1BV.6.10 **Integrated Power and Data Transceiver Devices for Power-by-Light Systems – a Concept Study**
H. Helmers, D. Lackner, G. Siefer, E. Oliva, F. Dimroth & A.W. Bett
Fraunhofer ISE, Freiburg, Germany

1BV.6.11 **Innovative Point-Contacting Technique for Thin-Film Silicon Solar Cells**
R. Khoury, P. Bulkin, D. Daineka & E.V. Johnson
CNRS, Palaiseau, France
J. Alvarez
CNRS, Gif-sur-Yvette, France

1BV.6.12 **Free the Bandgap! Series-Parallel Connection of Tandem Cells**
M. Stocks, Y.X. Loo & N. Lal
ANU, Canberra, Australia

1BV.6.13 **ZnO Nanorods as an Antireflection Coating for Silicon Solar Cells**
S.K. Sardana, P.S. Chandrasekhar & V.K. Komarala
IIT Dehli, New Dehli, India

1BV.6.14 Monovalent Cation Doping of PbS Nanocrystals
M. Chavez, H. Juárez Santiesteban, M. Pacio & O. Portillo
UPAEP, Puebla, Mexico
X. Mathew & E. Osorio
UPAEP, Temixco, Mexico

1BV.6.15 Synthesis and Controlling the Physical and Optical Properties of Zinc Oxide Nanowires with Applications in Photovoltaic Systems
N. Seifi Mamaghani, F. Shahshahani, J. Sabbaghzadeh & I. Hadi
Alzahra University, Tehran, Iran

1BV.6.16 Influence of GaAsSb Structural Properties on the Optical Properties of InAs/GaAsSb Quantum Dots
Z. Zhang, P.J. Reece & S.P. Bremner
UNSW Australia, Sydney, Australia
N.N. Faleev
Arizona State University, Tempe, United States

1BV.6.17 ZnO Nanorods as Antireflective Layer in Silicon Heterojunction Solar Cells
M. Ahrlich, O. Sergeev, M. Juilfs, A. Neumüller, M. Vehse & C. Agert
NEXT ENERGY, Oldenburg, Germany

1BV.6.18 Effect of Nanowire Length on Device Performance of n-ZnSe/p-Si Nanowire Heterojunctions
E. Coskun, H.H. Güllü, T. Çolakoglu, O. Bayrakli & M. Parlak
METU, Ankara, Turkey

1BV.6.19 Electric Properties of Nanocrystalline Diamond Thin Film Deposited on Active Substrate Solar Cell Structure
M. Kusko
Fill Factory, Rožnov pod Radhoštm, Czech Republic
M. Perný, V. Saly, M. Váry & J. Packa
Slovak University of Technology, Bratislava, Slovakia

1BV.6.20 Diode Property of Metal and/or Si Nanoparticle Embedded Liquid Source SiO2 on Si
H. Nagayoshi & H. Demura
TNCT, Tokyo, Japan
A. Ulyashin
SINTEF, Oslo, Norway

1BV.6.22 Atmospheric-Pressure Plasma Production of Silicon Quantum Dots for Photovoltaic Applications
M. Macias-Montero, T. Velusamy, P. Maguire & D. Mariotti
University of Ulster, Newtownabbey, United Kingdom
C.S. Ni, P. Connor & J.T.S. Irvine
University of St Andrews, United Kingdom
V. Svrcek
AIST, Tsukuba, Japan

1BV.6.23 Photo-Thermoionic Nanostructured Cells Development for High Concentrating Solar Applications
R. García-Gutierrez, R. Cabanillas-Lopez, C. Davila-Peralta, M. Barboza-Flores & R. Rodriguez-Carvajal
University of Sonora, Hermosillo, Mexico

1BV.6.27 Role of Textured Silicon Surface in Plasmonic Light Trapping for Solar Cells: Effect of Pyramids Width and Height
E. Thouti & V.K. Komarala
IIT Dehli, New Dehli, India
A.K. Sharma
IIT Dehli, New Delhi, India

1BV.6.28 Enhanced Light Scattering and Hydrophobicity of Glass with Upright Nanopyramid Structure for Solar Cells Using UV Nanoimprint Lithography
A. Peter Amalathas & M.M. Alkaisi
University of Canterbury, Christchurch, New Zealand

1BV.6.29 Improvement of Short Circuit Current of Single Junction Amorphous Silicon Solar Cells by Incorporating Nanoparticle as Back Reflector
S. Mandal, S. Dhar & A.K. Barua
IIEST, Howrah, India

1BV.6.30 Chemical Bath pH Influence on SnS Thin Film Physical and Optical Properties
J.L. Peña Chapa, A. Higareda, R. Mis-Fernández, I. Rimmaudo & V. Rejón
CINVESTAV, Merida, Mexico

1BV.6.33 I-V Double Exponential Modeling in Pc1d6
L. Abenante
ENEA, Rome, Italy

1BV.6.34 Lead and Bismuth Oxide Free Thick Film Metallizations with High Adhesion on Silicon Solar Cells
P. Gierth & L. Rebenklau
Fraunhofer IKTS, Dresden, Germany

1BV.6.36 Simulation of the Enhancement Offered by Innovative Optical Structures in the Conversion Efficiency of Photovoltaic Technologies
J. Walshe, J. Doran & H. Ahmed
Dublin Institute of Technology, Ireland
S.J. McCormack
Trinity College Dublin, Ireland

1BV.6.38 The Influence of Neutron and Xe-Ions Flux on c-Si – a-SiC Photovoltaic Device
M. Perný, M. Váry, V. Saly & M. Mikolasek
Slovak University of Technology, Bratislava, Slovakia
J. Huran
Slovak Academy of Sciences, Bratislava, Slovakia

1BV.6.40 Effects of Temperature and Post Deposition Annealing on SnS Polycrystalline Thin Film Growth
S. Di Mare, A. Salavei, D. Menossi, F. Piccinelli, E. Artegiani, A. Kumar, G. Mariotto & A. Romeo
University of Verona, Italy

1BV.6.41 Polyalkylene Carbonate Binders for Cleaner Burning Thick Film Ag Paste: Comparison to Commercially Available Ag Pastes
I.B. Cooper
SUNY College, Rochester, United States
R. Stephenson
Stephenson & Associates, Sunnyvale, United States
P. Ferraro
Empower Materials, New Castle, United States

1BV.6.42 Electrical Transport in Silicon Heterojunction Solar Cells with Nanocrystalline Silicon Oxide Front Surface Fields
A. Richter, F. Lentz & K. Ding
Forschungszentrum Jülich, Germany

1BV.6.43 Minority Carrier Lifetime Enhancement of C-Si/TiO2 Heterojunction by Post Deposition Annealing
S. Bhatia, S. Khotari, N. Raorane, S. Lodha, P.R. Nair & A. Antony
IIT Bombay, Mumbai, India

1BV.6.44 The Impact of Interface Trap Density on n-ZnO/p-Si Single Heterojunction Solar Cells
A. Ali
GC University Faisalabad, Pakistan
B. Hussain & A. Ebong
UNC Charlotte, United States

1BV.6.45 Impact of Minority Carrier Lifetime and Temperature on SiC Based Rear Contact SiGe Solar Cell for Concentrator Photovoltaic (CPV) Applications
R. Pandey, A. Kumar, R. Chaujar & A. Jain
Delhi Technological University, New Delhi, India

1BV.6.47 Comparative Study of the Effects of Rare Earth Ions Doped BiSrFeO3 Nanomultiferroic
M. Ayman
GUC, Cairo, Egypt

1BV.6.48 12.5% Silicon Nano-Hole Morphology with PEDOT:PSS Hybrid Solar Cell with Simple Solution Based Surface Treatment
Z. Li, A.B. Prakoso, L. Hong & R. Rusli
Nanyang Technological University, Singapore, Singapore

1BV.6.50 Feasible Strategy towards Low Temperature Fabrication of Flexible Perovskite Solar Cells
K. Wang, Y. Shi & C. Lan
Dalian University of Technology, Panjin, China
S. Hayase & T. Ma
Institute of Technology, Kitakyushu, Japan

VISUAL PRESENTATIONS 5BV.4

17:00 - 18:30 PV Cells and Modules (II)

5BV.4.1 Non-Uniformity Measurements of a Steady State Solar Simulator Using the Hishikawa-Hashimoto Method and Subsequent Improvement
U. Hoyer, M. Hofer, T. Pickel, C. Camus & J. Hauch
ZAE Bayern, Erlangen, Germany
C. Brabec
University of Erlangen, Germany

5BV.4.2 Measuring Uniformity under Simulated Sunlight
F. Plag & S. Winter
PTB, Braunschweig, Germany
F. Haas & K. Ramspeck
h.a.l.m. elektronik, Frankfurt am Main, Germany

5BV.4.3 Influence of Low Concentration on the Energy Harvest of PV Systems Using Bifacial Modules
H. Nussbaumer, G. Petrzilek, M. Klenk, S. Schartinger, N. Keller, T. Baumann, F. Carigiet & F.P. Baumgartner
Zurich University of Applied Sciences, Winterthur, Switzerland

5BV.4.4 Maximizing Energy Production by High Efficiency n-Type Bifacial Module
K. Shim, S.-Y. Cho, H. Kim & Y. Choe
LG Electronics, Seoul, Korea South

5BV.4.5 Bifacial Crystalline Silicon Solar Cell Basic Parameters and Characteristics
H.W. Choi, S.H. Jung & Y.B. Kim
GERI, Gumi, Korea South

5BV.4.6 Bifacial Outdoor Rotor Tester
F.P. Baumgartner, G. Petrzilek, S. Schartinger, T. Baumann, F. Carigiet, N. Keller, M. Klenk & H. Nussbaumer
ZHAW, Winterthur, Switzerland

5BV.4.7 Characterization and Testing of Bifacial Modules
A. Schmid, D. Philipp & C. Reise
Fraunhofer ISE, Freiburg, Germany

5BV.4.8 Angular-Dependent Outdoor Investigation of Bifacial Modules
S. Malik, D. Daßler, J. Fröbel & M. Ebert
Fraunhofer CSP, Halle, Germany

5BV.4.9 The Si-Traceable Calibration of Shunted Reference Solar Cells via Differential Spectral Responsivity Measurements
F. Witt, I. Kröger & S. Winter
PTB, Braunschweig, Germany

5BV.4.10 Investigation of the Influence of Temperature Inhomogeneity on the Measurement Uncertainty of Solar Cell Temperature Coefficients
A. Schweitzer, I. Kröger & S. Winter
PTB, Braunschweig, Germany

5BV.4.11 High Efficiency Photovoltaic Modules Performance Measurements Used Long Pulse I-V Simulator
H.-C. Liu, C.-T. Huang, W.-K. Lee & F.-M. Lin
ITRI, Hsinchu, Taiwan
J.-L. Kwo, Y.-C. Ou & L.-Y.-. Liao
AllReal Technology, Kaohsiung, Taiwan

5BV.4.12 Fault Detection of Photovoltaic Modules through Analysis of Reverse I/V Curves
G. Vannier, I. Tsanakas, N. Chaintreuil, D.L. Ha & F. Barruel
CEA, Le Bourget du Lac, France

5BV.4.13 Performance Monitoring of 4 PV Modules of Different Technologies under Outdoor Conditions in Benguerir, Morocco
A. Benazzouz, B. Ikken, Z. Naimi, A. Benlarabi, K. Belrhiti Alaoui & A. El Hassani El Alaoui
IRESEN, Rabat, Morocco

5BV.4.14 Portable LED Flasher - a Cost Effective Tool to Improve Quality of Field Tests
F.P. Baumgartner, D. Schär & R. Knecht
Zurich University of Applied Sciences, Winterthur, Switzerland
C. Frei & F. Beglinger
Electrosuisse, Fehraltdorf, Switzerland

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5BV.4.15 Exergy Analysis of a Solar Photovoltaic Module
F. Serrano-Casares & E. Zaragoza
UMA, Málaga, Spain

5BV.4.16 Short Circuit Current Measurements at Clear-Sky Conditions on Photovoltaic Modules: Basic for a Reliable Self-Reference Algorithm
M. Wachter, L. Gottschalk & B. Hüttl
University of Applied Sciences Coburg, Germany
A. Schulze
Rosenheim University of Applied Sciences, Germany
F. Becker & M. Sayala
Calyxo, Bitterfeld-Wolfen, Germany

5BV.4.17 Analysis of Air Mass Dependence of Three Photovoltaic Arrays
H. Wang, M.A. Muñoz-García & G.P. Moreda
UPM, Madrid, Spain
M.C. Alonso-García
CIEMAT, Madrid, Spain

5BV.4.18 Outdoor Performance and Seasonal Analysis of SunPower Based MaxeonTM Technology in Composite Climate of India
A. Sharma, D. Singh, K. Saikia & S.K. Samdarshi
CUJ, Brambe, India
B. Bora, O.S. Sastry, Y.K. Singh, B. Mohan Jha, R. Singh, S. Rai, M. Bangar, R. Dahiya, S. Chakraborty & K. Yadav
NISE, Gurgaon, India

5BV.4.19 Studying the Effect of Spectral Distribution with Seasonal and Irradiance Variations
I.K. Barua & B. Prasad
TERI, New Delhi, India
B. Bora, R. Singh, S. Rai, M. Bangar & M. Kumar
NISE, Gurgaon, India
O. Sastry
NISE, Gurgoan, India

5BV.4.20 Intercomparison of PTB and ESTI Spectroradiometers Using Simulated and Natural Sunlight
I. Kröger, F. Plag & S. Winter
PTB, Braunschweig, Germany
R. Galleano & H. Müllejans
European Commission, Ispra, Italy

5BV.4.21 Looking at the Yearly Yield from Various Angles: Optical Model Verification for Structured Glass
L.H. Slooff, A.J. Carr & P.M. Sommeling
ECN, Petten, The Netherlands
R. Van de Voort
SCX Solar, Someren, The Netherlands

5BV.4.22 Seasonal Analysis of Most Frequent Condition and Energy Rating of PV Module Technologies
B. Bora & O.S. Sastry
NISE, Gurgaon, India
B. Prasad
TERI University, New Delhi, India

5BV.4.23 Angle Resolved Performance Measurements on PV Glass and Modules
L. Tollund Juutilainen, S. Thorsteinsson, P. Behrensdorff Poulsen, A. Thorseth, M. Wubishet Amdemeskel & S. Canulescu
Technical University of Denmark, Roskilde, Denmark
P. Melchior Rødderb & K. Rødder
SolarLab, Viby, Denmark

5BV.4.24 Energy Rating of Crystalline Solar Modules: Investigation of Uncertainties due to Binning in Mass Production
G. Kleiss, H. Schülbe & B. Nacke
University of Hannover, Germany

5BV.4.26 Evaluating the Influence of Typhoon on PV Module Reliability
M.Y. Chang, C.H. Hsueh, H. Chen & C. Chen
AU Optronics, Taichung, Taiwan

5BV.4.27 Failure Classification of Defective PV Modules Based on Maximum Power Point Analysis
F. Fecher, T. Pickel, C. Buerhop-Lutz, C. Camus & C.J. Brabec
ZAE Bayern, Erlangen, Germany

5BV.4.28 Reliability of Bonding of the Rail Attachment Fixture to the Rear Glass of Dual-Glass PV Modules
J. Mao, Q. Zhu, J. Xu, H. Shen, Y. Shu, Z. Ji, P.J. Verlinden & Z.Q. Feng
Trina Solar Energy, Changzhou, China

5BV.4.29 Evaluation of the Durability of Metallization Pastes via Accelerated Aging Method
H.-C. Lin, Y.-C. Chen, C.-C. Wang, C.-T. Tsai & W.K.W. Huang
Gintech Energy, Miaoli, Taiwan

5BV.4.30 Effect of the Revision of Mechanical Load Test in IEC61215 Certification Standard
J.H. Ahn, K. Lee, M.-S. Kim, J.-K. Lim, S.-I. Yoon, M.-I. Hwang & E.-C. Cho
Hyundai Heavy Industries, Yongin, Korea South

5BV.4.31 A Methodology for Assessing Field Performance of Flexible PV Modules Based on Thermal Cycling Test Results
K. Hardikar & B. Liu
MiaSolé, Santa Clara, United States

5BV.4.32 In-Situ Monitoring of Moisture Ingress in PV Modules with Different Encapsulants
M. Jankovec, G. Matic & M. Topic
University of Ljubljana, Slovenia
E. Annigoni, F. Galliano & F. Sculati-Meillaud
EPFL, Neuchâtel, Switzerland
H.-Y. Li, L.-E. Perret-Aebi & C. Ballif
CSEM, Neuchâtel, Switzerland

5BV.4.33 Shadowing Investigations on Thin Film Modules
S. Wendlandt, T. Weber, J. Berghold, S. Krauter & P. Grunow
PI Berlin, Germany

5BV.4.34 Investigation of UV-Induced Degradation of Different Types of WPVS Reference Solar Cells
I. Kröger & S. Winter
PTB, Braunschweig, Germany
J. Hohl-Ebinger & S. Brachmann
Fraunhofer ISE, Freiburg, Germany

5BV.4.35 Influence of Lightning Strikes on Photovoltaic Modules Properies
I. Naxakis, V. Perraki & E. Pyrgioti
University of Patras, Greece

5BV.4.36 Effect of Temperature on Insulation Resistance of Different PV Technologies
M. Morampudi, S. Lata, G. Gowri, S.R. Sykam, P. Rajput, R. Kumar, G.K. Jha & R. Siddiqui
NISE, Gurgaon, India

5BV.4.37 PV Module Characterisation of the MS Tûranor PlanetSolar Catamaran after 5 Years on the World Oceans
S. Dittmann, M. Caccivio & M. Marzoli
SUPSI, Canobbio, Switzerland
P. Goulpiè & L. Ditton
PlanetSolar, Lausanne, Switzerland

5BV.4.39 Defect Identification and Correlation with Electrical Degradation of Field Aged Thin Film Photovoltaic Technologies in Composite Climate
R. Rawat
IIT Dehli, New Delhi, India
S.C. Kaushik
IIT Dehli, New Dehli, India
O.S. Sastry, Y.K. Singh, B. Bora & R. Singh
NISE, Gurgaon, India

5BV.4.41 Preliminary Assessment of Degradation in Field-Aged Multi-Crystalline Silicon PV Modules Installed in Hot-Humid Climate of Mid Ghana
D.A. Quansah & M.S. Adaramola
NMBU, Ås, Norway
G. Takiy
KNUST, Kumasi, Ghana

5BV.4.42 How to Reduce I-V Measurement Deviation between Research and Production
J. Abe, Y. Takeda, H. Kojima, K. Iwamoto, Y. Fujita, T. Morishima & K. Shibamoto
Kyoshin Electric, Kyoto, Japan

5BV.4.43 New Cross-Linking Assistant for Encapsulating Materials of EVA
Y. Kawamura & M. Yamaura
Nippon Kasei Chemical, Fukushima, Japan

VISUAL PRESENTATIONS 2BV.7

17:00 - 18:30 Silicon Solar Cell Characterisation and Modelling / Manufacturing and Processing

2BV.7.2 Temperature Dependence of the Main Characteristics of HIT Elements
A.V. Sachenko, Y.V. Kryuchenko, V.P. Kostylyov & I.O. Sokolovskyi
NAS ISP, Kiev, Ukraine
A.V. Bobyl, E.I. Terukov & M.Z. Shwarts
RAS/ Ioffe, St. Petersburg, Russia
A.S. Abramov & S.N. Abolmasov
TFTC Ioffe, St. Petersburg, Russia
D.A. Andronikov
TFTC Ioffe, St-Petersburg, Russia
M. Evstigneev
Memorial University of Newfoundland, St. John's, Canada

2BV.7.3 A Simulation Study of Depletion Effect of Negatively Charged Passivation Layer on n-Type Back-Contact Back-Junction Silicon Solar Cell
C.-M. Wei, C.-C. Li & C.-C. Chuang
Motech Industries, Tainan, Taiwan

PROGRAMME

2BV.7.4 TCAD Modeling of TLM Contact Resistance Structures
G. Gregory & K.O. Davis
University of Central Florida, Orlando, United States
A.M. Gabor, R. Janoch & A. Anselmo
BrightSpot Automation, Westford, United States
A.M. Payne
Suniva, Norcross, United States

2BV.7.6 Ultra-Thin Silicon Solar Cell: Flexibility, Modelling and Prediction
J. Han, M. Abbott, B. Hoex, L. Wang & A. Barnett
UNSW, Sydney, Australia
P. Hamer
University of Oxford, United Kingdom
A. Lochtefeld
AmberWave, Salem, United States

2BV.7.7 Investigation of Light Induced Degradation of High Performance Multi Crystalline Solar-Cells
K. Sporleder, T. Luka & M. Turek
Fraunhofer CSP, Halle, Germany
K. Hübener & K. Petter
Hanwha Q CELLS, Bitterfeld-Wolfen, Germany

2BV.7.8 Performance of c-Si Photovoltaic Devices Based on Optical Measurements and Spectral Irradiance in the Atacama Desert
P. Ferrada & A. Marzo
University of Antofagasta, Chile
H. Chu, E. Cabrera & A. Schneider
ISC Konstanz, Germany

2BV.7.9 Point-by-Point Parameter Mapping of a mc-Si Solar Cell
N. Kwarikunda & W. Okullo
Makerere University, Kampala, Uganda

2BV.7.10 Silicon Nanowire Based Photovoltaic Cells: Analytical vs Numerical Modeling
O. AL-Zoubi
AL-Albzyt Univeristy, Mafrag, Jordan

2BV.7.11 Numerical Calculation of Single Diode Solar Cell Modelling Parameters Using the Multi-Dimensional Newton-Raphson Method
F. Ghani & T.S. O'Donovan
Heriot-Watt University, Edinburgh, United Kingdom

2BV.7.12 Rapid Calculation of Series and Shunt Resistance Values for a Solar Cell
F. Ghani & T.S. O'Donovan
Heriot-Watt University, Edinburgh, United Kingdom

2BV.7.13 LED Technology Enhancement in IV Testing of Solar Cells
M. Martire, F. Bettin & M. Galiazzo
Applied Materials, Olmi di San Biagio, Italy

2BV.7.14 An Online, Web Based Solar Cell Simulation Interface for the Personalized Simulation of Various Solar Cell Architectures, Using Various Simulation Programs
R. Stangl, G. Anand, C. Ke, J. Wong & A.G. Aberle
SERIS, Singapore, Singapore

2BV.7.15 Estimating the Effect of LED Spectra on EQE Measurements
A.R. Paduthol, M.K. Juhl & T. Trupke
UNSW, Sydney, Australia

2BV.7.17 Influence of Thermal Dry Oxidation Process on the Silicon Solar Cell Emitter Profiling and Performance
A. Habib, M.A. Rasool, V. Fano, J.R. Gutiérrez & J.C. Jimeno
UPV/EHU, Zamudio, Spain
M.T. Ahmed
Mansoura University, Egypt

2BV.7.18 Characterization of Large-Area Laser Ablation Processes for IBC Solar Cells
S. Großer
Fraunhofer CSP, Halle, Germany
J. Theobald
ISC Konstanz, Germany
R. Mayerhofer
ROFIN-BAASEL, Starnberg, Germany

2BV.7.19 Enhanced Light Absorption by SiNx Antireflection Layer with Imbedded SiO2 Thin Film on Micro and Nano-Textured Crystalline Si Solar Cells
S.G. Ryu, H.Y. Ji, M.J. Kim & J.H. Peck
KITECH, Cheonan, Korea South
K. Kim
Chonbuk National University, Jeonju, Korea South

2BV.7.20 Inverted Random Pyramids: Simulation of the Influence of Surface Texture on Light Absorption in PERC Solar Cells
A. Stapf, C. Gondek & E. Kroke
Freiberg University of Technology, Germany

2BV.7.21 Automated Void Detection in PERC Cells with Photoluminescence
K. Ogutman, K.O. Davis, E. Schneller, H. Ali & W.V. Schoenfeld
University of Central Florida, Orlando, United States

2BV.7.22 A Rigorous Testing on Regenerated PERC Solar Cell
G. Li, J. Wang, J. Huang, S. Fu, J. Zhang, Y. Bai & L. Yang
Jinergy, Lvliang, China

2BV.7.23 The Design and Industry Road of a Low Cost and High Efficient Multi Busbar Technology
S. Wan, X.-S. Wang, D. Wang, Y. Wu, Z. Xia & G. Xing
Canadian Solar, Suzhou, China

2BV.7.25 Monofacial IV Measurements of Bifacial Silicon Solar Cells in an Inter-Laboratory Comparison
M. Rauer & J. Hohl-Ebinger
Fraunhofer ISE, Freiburg, Germany
K. Bothe
ISFH, Emmerthal, Germany
C. Comparotto
ISC Konstanz, Germany
P. Danzl & P. Manshanden
ECN, Petten, The Netherlands
M. Debucquoy
imec, Leuven, Belgium
N. Enjalbert & Y. Veschetti
CEA, Le Bourget du Lac, France
J. Wong
SERIS, Singapore, Singapore

2BV.7.28 A First Study of Terahertz Emission Spectroscopy for a-Si:H/c-Si Passivated Interface in HIT Solar Cells
J. Mitchell, T. Mochizuki & H. Takato
AIST, Koriyama, Japan
A. Ito & H. Nakanishi
SCREEN, Kyoto, Japan

2BV.7.30 Automated Statistical Algorithms to Interpret Root Cause Variance in Photovoltaic Cell Manufacturing
R. Evans & M. Boreland
UNSW Australia, Sydney, Australia

2BV.7.32 Alternative Inline Analysis of Acidic Etching Baths
L. Mohr, T. Dannenberg, M. Zimmer & J. Rentsch
Fraunhofer ISE, Freiburg, Germany

2BV.7.33 Dry Plasma Texturing of Mono-Si for Silicon Heterojunction Solar Cell Application
M.L. Addonizio, L. Fusco, A. Spadoni & A. Antonaia
ENEA, Portici, Italy

2BV.7.34 Evaluation of Boron Nitride Solid Source Diffusion in p-Type Emitter Formation for n-Type Crystalline Silicon Solar Cells
B. Singha & C. Singh Solanki
IIT Bombay, Mumbai, India

2BV.7.36 A Study of Improving Wafer Quality with the Phosphorus Gettering Process on Silicon Heterojunction Solar Cells
Z.-Y. Shih, W.-C. Hsieh, H.W. Yin, J. Chang & M.Y. Chen
AU Optronics, Taichung, Taiwan

2BV.7.37 Evaluation of Spatial ALD of Al2O3 for Rear Surface Passivation of mc-Si PERC Solar Cells
F. Kersten, I. Förster & S. Peters
Hanwha Q CELLS, Bitterfeld-Wolfen, Germany

2BV.7.38 Upgrade of an Industrial Al:BSF Solar Cell Line into PERC Using Spatial ALD Al2O3
F. Souren, X. Gay, B. Dielissen & R. Görtzen
SoLayTec, Eindhoven, The Netherlands

2BV.7.39 Back Side Passivation in Industrial Mass Production
K. Vanormelingen, J. Beijersbergen, E. Granneman, R. Schiermann, X. Pages & V. Kuznetsov
Levitech, Almere, The Netherlands

2BV.7.41 Innovative PECVD Reactor Concept for Smart Manufacturing of Silicon Heterojunction Solar Cells
O. Shojaei, F. Jeanneret & A. Limouzin
INDEOtec, Neuchâtel, Switzerland
A. Descoeudres, L. Barraud, M. Despeisse & C. Ballif
CSEM, Neuchâtel, Switzerland

2BV.7.43 Advantages of Waveform Adaptability in Low Frequency PECVD Applications
K. Ruda, W. Gajewski & P. Ozimek
TRUMPF Huettinger, Zielonka, Poland

2BV.7.44 The Optimization of Laser Contact Opening Process for n-Type Rear Junction Printing PERT Solar Cells
J. Lee, Y.S. Choi, J. Lee, H. Oh, D.-H. Kyeong, T. Kim, M.-I. Hwang & E.-C. Cho
Hyundai Heavy Industries, Yongin, Korea South

2BV.7.45 A Simple Route to Fabrication of Local Back Contacts to Silicon Solar Cells
C.-K. Hsu, J.-H. Yang & I.-C. Chen
National Central University, Jhongli, Taiwan
C.-W. Kuo, T.-M. Kuan & C.-Y. Yu
TSEC, Hsinchu, Taiwan

2BV.7.46 Fine Line Double Printing for Today and Tomorrow Cell Metallization and Module Interconnection
M. Galiazzo, O. Borsato & E. Bortoletto
Applied Materials, Treviso, Italy

2BV.7.47 Ultra Fine Finger Electrodes Reproduction by Screen Printing Method
K. Kawanaka, K. Masuri & J. Kawanobe
MURAKAMI, Chiba, Japan

2BV.7.48 The “Easy Plate” Process - Analysis of Process Route Options in Direct Plating of Nickel and Copper for Crystalline Silicon Solar Cell Metallization
J. Bartsch, S. Kluska, A. Büchler, A.A. Brand, S. Nold, G. Cimiotti, J.-F. Nekarda, M. Glatthaar & S.W. Glunz
Fraunhofer ISE, Freiburg, Germany

2BV.7.49 High-Productive Aluminum Deposition of Back Contacts for Hetero-Junction Solar Cells by Electron Beam Evaporation
J.-P. Heinß
Fraunhofer FEP, Dresden, Germany
H. Schlemm
Meyer Burger, Hohenstein-Ernstthal, Germany
F. Wünsch
Roth & Rau, Hohenstein-Ernstthal, Germany

2BV.7.50 High Efficiency Vacuum Coater for TCO Production for HIT Solar Cells
E. Khokhlov, S. Nastochkin, A. Yasunas, V.Y. Shiripov & K. Miasnikov
Izovac Technologies, Minsk, Belarus

2BV.7.51 Electroluminescence Characterization of Light-Induced Degradation Processes in Si Solar Cells
T. Mtchedlidze, K. Krechan, B. Pötschick & J. Weber
Technical University of Dresden, Germany
A. Herguth
University of Konstanz, Germany

2BV.7.52 The Progress and Improvement of the Initial Degradation of Industrial p-Type Czochralski-Grown Monocrystalline Silicon Solar Cells and Panels
S. Park, K.S. Lee, J.H. Lee, M.-H. Choi & Y. Choe
LG Electronics, Seoul, Korea South

2BV.7.53 Ultrahigh PID-Resistance for Mono Silicon PERC Solar Cells by Using Industrial Mass-Production Technology
C.-W. Kuo, T.-M. Kuan, L.-G. Wu, C.C. Huang, H.-Y. Peng & C.-Y. Yu
TSEC, Hsinchu, Taiwan

2BV.7.54 Comparison of Influence on mc-Si Solar Cell Performance of Dislocation Clusters and Grain Boundaries by Using Photoluminescence Imaging
X. Niu, S. Qiao, L. Zhang, M. Pan, Y. Zhang, W. Gao, D. Song & B. Yu
Yingli Green Energy, Baoding, China

2BV.7.56 Overcoming Image Blurring in Photoluminescence Imaging Metrology for Silicon Solar Cell Manufacturing
B. Mitchell, D. Chung, A. Teal & T. Trupke
UNSW, Sydney, Australia

2BV.7.57 Fabrication and Electrical Characterization of Semi-Transparent Silicon Solar Cells
T. Makris, P. Fleming & A. Santamaria
Ipsol Energy, Nottingham, United Kingdom
E. Skuras
University of Ioannina, Greece
A.R. Long
University of Glasgow, United Kingdom

2BV.7.58 Soldering Property and Element Investigation on Thermal Conditions by Infrared Lamp Tabbing Process for c-Si Solar Modules
S.H. Kim, H.J. Son & J.J. Lee
KETI, Gyeonggi-do, Korea South
K.-I. Jung
Zeus, Gyeonggi-do, Korea South
D. Kim
Korea University, Seoul, Korea South

2BV.7.60 Optical Loss Analysis of PV Modules
M.D. Abbott, K.R. McIntosh & B. Sudbury
PV Lighthouse, Coledale, Australia

2BV.7.61 Large Area IBC Zebra Solar Cells in Pilot Production: the Results of FP7 HERCULES Project Industrial Integration
G. Galbiati, V.D. Mihailetchi, H. Chu, A. Halm & R. Kopecek
ISC Konstanz, Germany

2BV.7.62 Depth Profiling of Non-Conducting Layers with rf GD-OES
J. Rinder, P. Keller, J. Steffens, B. Terheiden & G. Hahn
University of Konstanz, Germany

2BV.7.63 Impact of Operating Temperature and Absorption-Layer Thickness on All-Back-Contact (ABC) Solar Cell Efficiency
J.E. O'Connor & S. Michael
Naval Postgraduate School, Monterey, USA

2BV.7.64 Advantages of Inline High-Intensity LED Light-Annealing for LID Prevention
D. Ruf, E. Anderson, G. Cheng & J. Bell
Despatch Industries, Lakeville, USA

Wednesday, 22 June 2016

VISUAL PRESENTATIONS 4CV.1

08:30 - 09:30 III-V-based Devices for Terrestrial and Space Applications / Concentrator and Space Systems

4CV.1.3 Low Concentration GaAs/CuInGaSe and GaAs/Si Multi-Junction Solar Cells with Smart Stack Technology
K. Makita, H. Mizuno, R. Oshima, T. Tayagaki, J. Nishinaga, H. Shibata, H. Takato & T. Sugaya
AIST, Tsukuba, Japan
M. Baba & N. Yamada
Nagaoka University of Technology, Japan

4CV.1.4 CPVMatch - Concentrating Photovoltaic Modules Using Advanced Technologies and Cells for Highest Efficiencies
S.P. Philipps & A.W. Bett
Fraunhofer ISE, Freiburg, Germany
M. Baudrit
CEA, Le Bourget du Lac, France
K. Hillerich
AZUR SPACE, Heilbronn, Germany
V. Moreau
Cycleco, Ambérieu-en-Bugey, France
R. Parmesani
ASSE, Gorizia, Italy
E. Román
Tecnalia, Zamudio, Spain
G. Sala
UPM, Madrid, Spain
B. Schineller
AIXTRON, Herzogenrath, Germany
G. Timò
RSE, Milan, Italy

4CV.1.5 External Quantum Efficiency and First Results of Electric Performance Measurements on a Quadruple Junctionspace Solar Cell
G. Jüngst & A. Grás
INTA, Madrid, Spain
R. Campesato, G. Gori & E. Greco
CESI, Milan, Italy

4CV.1.6 On the Effect of Optical Configuration and Spectral Variation on the Performance of III-V Triple-Junction Cell Used in H-CPV Systems
R.D. Schultz, E.E. van Dyk & F.J. Vorster
NMMU, Port Elizabeth, South Africa

4CV.1.7 Design and Preparation of Antireflection Coating for Inverted Metamorphic 4 Junction (IMM 4J) Solar Cell
X. Sun, Y. Du & Z. Xiao
Tianjin Hengdian Space Power, China

4CV.1.8 Indoor Characterization of Wind Influence on CPV Modules through Cell-to-Ambient Thermal Resistance Measurements
A.V. Chekalin, V.D. Rumyantsev & N.A. Sadchikov
RAS/ Ioffe, St. Petersburg, Russia
N.Yu. Davidyuk
St. Petersburg Academic University, Russia

4CV.1.10 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

4CV.1.11 Temperature-Dependent Photovoltaic Properties of Lightweight Flexible InGaP/InGaAs/Ge Triple-Junction Solar Cells
K.-S. Kim, J.-H. Kim & B.-I. Choi
KIMM, Daejeon, Korea South
K. Kim, S.H. Jung, C.Z. Kim, H.-B. Shin & H.K. Kang
Korea Advanced Nano Fab Center, Suwon, Korea South
E.H. Lee & J.S. Yeo
Agency for Defense Development, Daejeon, Korea South

4CV.1.12 Radiation Effects on Advanced Multi Junction Solar Cells for Space Missions
R. Campesato, G. Gori, M. Casale & G. Gabetta
CESI, Milan, Italy
M. Sankaran, E.P. Suresh & B.R. Uma
ISRO Satellite Centre, Bangalore, India

4CV.1.13 Results and Achievements of the Large Area Multi-Source Solar Array Tester 'HighLIGHT Sat'
C. Droz, N. Bassi, G. Arnoux, Y. Pelet, N. Frick & F. Seydoux
Pasan, Neuchâtel, Switzerland
E. Fernández Lisbona & N. Girault
ESA-ESTEC, Noordwijk, The Netherlands

4CV.1.14 Next Generation Space Solar Cells Utilising Lattice-Matched 4J Dilute Nitride Technology – Project 'LONGESST'
A.D. Johnson & I. Davies
IQE, Cardiff, United Kingdom
C. Algora, I. Rey-Stolle, M. Ochoa & I. García
UPM, Madrid, Spain
K. Dessein & A. Peetermans
Umicore, Olen, Belgium
W. Meredith & S. McDougall
Compound Semiconductor Technologies, Glasgow, United Kingdom

4CV.1.15 A Quantum Engineering Approach to Voltage Preservation in Intermediate Band Solar Cells
P.M. Ushasree, G. Zoppi & N.S. Beattie
Northumbria University, Newcastle upon Tyne, United Kingdom
P. See
National Physics Laboratory, Teddington, United Kingdom
S. Tomic
University of Salford, Manchester, United Kingdom
M. Duchamp
Forschungszentrum Jülich, Germany
I. Farrer
University of Sheffield, United Kingdom
D.A. Ritchie
University of Cambridge, United Kingdom

4CV.1.16 Optically Enhanced GaInNAs Solar Cell
T. Aho, A. Aho, A. Tukiainen, V. Polojärvi, M. Raappana & M. Guina
Tampere University of Technology, Finland

4CV.1.18 Models of Light Collection of 3D-CPC Concentrators under Lambertian Irradiation
A. Parretta
University of Ferrara, Italy
M. Tucci
ENEA, Rome, Italy

4CV.1.20 How to Take into Account the Proton Back Irradiation Contribution to Degradation on Deployable Solar Panels
S. Rodríguez, J. Plá, J. Duran & M. Alurralde
CNEA, Buenos Aires, Argentina

4CV.1.21 Development of High-Efficiency Low-Concentrator Spectrum-Splitting Type Solar Cells
P. Sichanugrist
MEXT/FUTURE-PV Innovation, Fukushima, Japan
D.-W. Kang
Cheongju University, Korea South
Y. Takiguchi
Tokyo Institute of Technology, Japan
M. Konagai
Tokyo City University, Japan

4CV.1.22 The Development of the PV Concentrator System With Electrical and Thermal Output
A. Okhorzina & A. Yurchenko
Tomsk Politechnical University, Russia
N. Bernhard
Anhalt University of Applied Sciences, Köthen, Germany

4CV.1.23 **Ray Tracing Modelling of Reflector for Vertical Bifacial Panel**
M. Linde Jakobsen, S. Thorsteinsson &
P. Behrensdorff Poulsen
Technical University of Denmark, Roskilde, Denmark
P. Melchior Rødderb & K. Rødder
SolarLab, Viby, Denmark

4CV.1.24 **Integration of Spectral Splitting in a CPV-T Receiver Concept**
R. Reinbrech & R. Hoeller
University of Applied Sciences Upper Austria, Wels, Austria

4CV.1.25 **Performance Uniformity of Ultra-High Growth Rate Solar Cells Grown by MOCVD**
K.J. Schmieder, M.K. Yakes & R.J. Walters
US Naval Research, Washington, United States
E.A. Armour & Z. Pulwin
Veeco Compound, Somerset, United States
M.P. Lumb
George Washington University, United States

4CV.1.27 **High Performance GaAs Solar Cell Using Heterojunction Emitter and Its Further Improvement by ELO Technique**
S. Kim, S.-T. Hwang, W. Yoon & H.-M. Lee
LG Electronics, Seoul, Korea South

4CV.1.28 **Experimental Performance Study of a Hybrid Symmetric Concentrating Photovoltaic/Thermal Concentrator for Building Applications**
G.Z. Naman, B. Chen & S. Nazmi
Heriot-Watt University, Edinburgh, United Kingdom
T.K. Mallick
University of Exeter, Penryn, United Kingdom
H.M. Upadhyaya
Brunel University, London, United Kingdom

VISUAL PRESENTATIONS 3CV.2

13:30 - 15:00 **CdTe, CIS and Related Thin Film Solar Cells and Modules (I)**

3CV.2.1 **Growth of Cu2ZnSnS4 Thin Films by Sequential Reactive Sputtering of Metal Targets**
O.P. Singh, K.S. Gour, R. Parmar & V.N. Singh
NPL, New Delhi, India

3CV.2.2 **Properties of CuInS2 Nano-Particles on TiO2 Thin Film by Spray Pyrolysis for CuInS2 / TiO2 Composite Solar Cell**
G.-C. Park
Mokpo National University, Muan, Korea South
R. Kim
Photonic Device Integration, San Jose, United States

3CV.2.3 **Electrical Properties of CZTS Thin Films Grown by Coevaporation and Its Relation with Secondary Phase Formation**
G. Gordillo, F.E. Guzmán, J.S. Oyola Villegas, R. Moreno & A.A. Ramírez
National University of Colombia, Bogotá, Colombia

3CV.2.4 **Study on the Current Blocking Effect Induced by the Residual Secondary Phase Materials in the Cu2ZnSnSe4 Thin Film Solar Cells**
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 & S.K. Ahn
KIER, Daejeon, Korea South
D. Nam & H. Cheong
Sogang University, Seoul, Korea South
B. O
Chungnam National University, Daejeon, Korea South

3CV.2.5 **Dielectric Barrier Layer: Alternative Materials and Processing Comparison for Scalable PV Technologies on Rough Steel Substrates**
M.C. López-López, E. Sanchez-Cortezon & J.M. Delgado Sánchez
Abengoa, Sevilla, Spain
E. Zugasti, J. Armentia, M. Ezquer Mayo, M.J. Rodriguez & A.R. Lagunas
CENER, Sarriguren-Navarra, Spain

3CV.2.6 **Cadmium Sulfide Films Grown by Photochemical Deposition and Their Application in CIGS Solar Cells**
Z. Zhang, Y. Xiaojie & S. Lexi
Lingnan Normal University, Zhanjiang, China

3CV.2.7 **Fabrication of Vertical Cu2ZnSnS4/Mo/Si Nanocylinder Arrays Using a Patterned Si Nanowire Arrays Template**
C. Wang
Changchun University, China
T. Shimizu & S. Shingubara
Kansai University, Suita, Japan

3CV.2.8 Influence of the Preparation Conditions on the Properties ZnO:Al Thin Film Obtained by Sol-Gel Deposition
E.P. Zaretskaya & V.F. Gremenok
NASB, Minsk, Belarus
A.V. Semchenko, A.V. Rogachev & V.V. Sidsky
F. Skorina Gomel State University, Belarus

3CV.2.10 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, B. Ergashev, K.M. Kouchkarov & R. Yuldashev
Academy of Sciences of Uzbekistan, Tashkent, Uzbekistan
A. Bosio & N. Romeo
University of Parma, Italy
C.S. Ferekides & D.Y. Goswami
University of South Florida, Tampa, United States
A. Romeo
University of Verona, Italy
H.S. Ullal
NREL, Golden, United States
H.M. Upadhyaya
Brunel University, London, United Kingdom

3CV.2.11 Surface Photovoltage Study of Cu1.95Zn1.1Sn0.96Se4 Single Phase Powder
T. Dittrich, G. Gurieva, S. Kapil & S. Schorr
HZB, Berlin, Germany
L.E. Valle Rios
Free University of Berlin, Germany
N. Rujisamphan
KMUTT, Bangkok, Thailand

3CV.2.12 Investigations on the Structural, Optical and Electrical Properties of ZnO Thin Films with Various pH Values Prepared by Sol Gel Method for Photovoltaic Application
K. Meziane, A. Elhichou, A. Almaggoussii & A. El Hamidi
UCA Marrakech, Morocco

3CV.2.13 Structural and Optical Properties of RF-Sputtered ZnS:Cu Thin Films
O.M. Cheikh, L. Nkhaili, A. El Kissani, M. Chaik & A. Outzourhit
Ibn Tofail University, Kenitra, Morocco
M. Aggour
Cadi Ayyad University, Marrakech, Morocco

3CV.2.14 Formation of Cu2ZnSnSe4 Thin Films on Flexible Substrates by an Electrochemical Technique
V.F. Gremenok & S.A. Bashkirov
NASB, Minsk, Belarus
R. Juskenas, R. Giraitis & A. Naujokaitis
Center for Physical Sciences and Technology, Vilnius, Lithuania
M.B. Dergacheva & K.A. Urazov
National Academy of Sciences, Almaty, Kazakhstan
W.Y. Kim & S.-H. Chai
Hoseo University, Chungnam, Korea South

3CV.2.15 Influence of H2Se Flow Rate on Cu2ZnSnSe4 Based Solar Cells Made by Selenization of Metallic Precursors
S. Ranjbar
University of Aveiro, Portugal
G. Brammertz, B. Vermang, S. Sahayaraj, A. Mule, S. Oueslati, M. Meuris & J. Poortmans
imec, Leuven, Belgium
A.F. da Cunha
University Aveiro, Portugal

3CV.2.16 Fabrication of Cu-Based I-V-VI Photovoltaic Absorber Thin Films
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. Yoo, K. Kim & K.S. Shin
KIER, Daejeon, Korea South

3CV.2.17 Cost-Efficient, Earth-Abundant CuSbS2 Solar Cells Fabricated with Hybrid Ink
S. Banu, S.K. Ahn, J.S. Cho, J.H. Yun & A. Cho
KIER, Daejeon, Korea South

3CV.2.18 Characterization and Post-Processing of Cadmium Sulfide Polycrystalline Thin Films
H. Xu, L. Wu, W. Wang, G. Zeng, C. Liu, W. Li, B. Li, J. Zhang & L. Feng
Sichuan University, Chengdu, China

3CV.2.19 Identification of Loss Mechanisms in CIGS Micro-Cells for Concentrator Applications
E. Lotter, P. Jackson, S. Paetel & W. Wischmann
ZSW, Stuttgart, Germany

3CV.2.20 Stabilization of a Reactive Mid-Frequency Sputtering Process of Al-Doped Zinc Oxide Films with Rotatable Targets
V. Sittinger, F. de Campos Carreri, S. Jung, A. Kaiser, W. Werner & G. Bräuer
Fraunhofer IST, Braunschweig, Germany

3CV.2.21 Thickness Effect of Top-Cell CuGaSe2 Absorber Layers Grown on ITO/SLG Substrates for Application of Tandem Solar Cells
J. Yoo, J.H. Choi, K. Kim, Y.-J. Eo, J.H. Park, J. Gwak, S.-K. Ahn, A. Cho, S.J. Ahn, J.-S. Cho, K. Shin, K. Yoon, S.H. Kong & J.-H. Yun
KIER, Daejeon, Korea South

3CV.2.22 Electro-Mechanical Response of Sputter-Deposited Mo Thin Films for Back Contacts in CIGS Flexible Solar Cells
T. Jörg, M.J. Cordill, R. Franz & C. Mitterer
University of Leoben, Austria
C. Linke & J. Winkler
PLANSEE, Reutte, Austria

3CV.2.23 Improved CIGS-Module Efficiency by H2O Injection into TCO-Deposition-Process
J. Nowoczin, K. Oehlstorm, S. Jander & P. Kratzert
Solibro, Bitterfeld-Wolfen, Germany
O. Lundberg & L. Stolt
Solibro, Uppsala, Sweden

3CV.2.24 Band Alignment of CZTS at Grain Boundary
W. Li, Y. Feng, Z. Li, G. Zhong, C. Yang & X. Xiao
CAS, Shenzhen, China
Y. Ma
CUHK, Hong Kong, Hong Kong

3CV.2.25 Effect of Zn Doping on CdS Thin Film Deposited by RF Magnetron Sputtering
M. Terlemezoglu, H.H. Güllü, O. Bayrakli & M. Parlak
METU, Ankara, Turkey

3CV.2.26 Elaboration of ZnO:Ga Thin Films by Spray Pyrolysis for Photovoltaic Applications
Z. El Khalidi, S. Fadili & B. Hartiti
University Hassan II, Mohammedia, Morocco
A. Lfakir
University Moulay Ismail, Errachidia, Morocco
P. Thevenin
University of Lorraine, Metz, France

3CV.2.27 A Simple, Nontoxic And Low-Cost Chemical Bath Deposition Method For High Efficiency CZTSSe Thin Films Solar Cells
J. Li, G. Jiang, W. Liu & C. Zhu
CAS, Hefei, China

3CV.2.28 Comparative Studies of Transparent Conductive Oxide Layers for Application in Cu(In,Ga)Se2 Modules
T. Koida, J. Nishinaga, H. Higuchi, M. Iioka, A. Kurokawa, Y. Kamikawa-Shimizu, H. Shibata & S. Niki
AIST, Tsukuba, Japan

3CV.2.30 Mechanism of Early-Stage Degradation of CIGS Solar Cells Induced by Air Exposure
J. Nishinaga, Y. Kamikawa-Shimizu, T. Koida, H. Shibata & S. Niki
AIST, Tsukuba, Japan

3CV.2.31 Effects of the Extent of Cu-Rich Conversion on Surface Morphology of Three-Stage Co-Evaporated CuInGaSe2 Absorbers
K. Kim, J.H. Choi, J.S. Yu, J.-S. Cho, J. Gwak, S.J. Ahn, A. Cho, S.K. Ahn, Y. J. Eo, J.H. Park, K.S. Shin, K. Yoon & J.H. Yun
KIER, Daejeon, Korea South

3CV.2.32 Effects of Stacking Sequences in the Formation of CZTS Thin Film Using Electron Beam Evaporation
P.K. Kannan, S. Chaudhari & S.R. Dey
IIT Hyderabad, Sangareddy, India

3CV.2.33 Effect of Annealing Atmosphere and Stabilizing Agent on the Formation of CZTS Film Using a Simple Dip Coating Technique
S. Chaudhari, K. Kannan & S.R. Dey
IIT Hyderabad, Sangareddy, India

3CV.2.34 Optimization of Sulphurization Temperature for Obtaining Dense Cu2ZnSnS4 Films with Phase Purity and Preferred Composition
A. Agasti, S. Mallick & P. Bhargava
IIT Bombay, Mumbai, India

3CV.2.35 Super High Efficiency Cu(In,Ga)Se2 Thin-Film Solar Cells Approaching 25%: Results of the EU Project Sharc25
W. Witte, P. Jackson, D. Hariskos & F. Kessler
ZSW, Stuttgart, Germany
S. Buecheler, R. Carron, E. Avancini, B. Bissig & A.N. Tiwari
EMPA, Dübendorf, Switzerland
S. Siebentritt, F. Werner & M. Wolter
University of Luxembourg, Belvaux, Luxembourg
P. Pareige, P. Muguerou, S. Duguay, E. Cadel, C. Castro & M. Raghuwanshi
Université et INSA de Rouen, Saint Etienne du Rouvray, France
R. Menozzi & G. Sozzi
University of Parma, Italy
E. Bourgeois, G. Degutis & A. Hardy
imec, Leuven, Belgium
M. Bär, R.G. Wilks & T. Kunze
HZB, Berlin, Germany
S. Sadewasser & N. Nicoara
INL, Braga, Portugal
M. Puska, M. Fedina, H.-P. Komsa & V. Havu
Aalto University, Finland
D. Brémaud
Flisom, Dübendorf, Switzerland
B. Dimmler & R. Wächter
Manz CIGS Technology, Schwäbisch Hall, Germany

3CV.2.36 Impact of Contact Resistance on CIGS Panel Performance with Metal Interconnect
J. van Deelen, Y. Tezsevin, M. Barink & J.-P. Teunissen
TNO, Eindhoven, The Netherlands

3CV.2.37 Indirect Ablation of Cu(In, Ga)Se2-Layers by ns Pulses with a Wavelength of 1342 nm
K. Kaufmann
Anhalt University of Applied Sciences, Köthen, Germany
C. Hagendorf
Fraunhofer CSP, Halle, Germany

3CV.2.38 Electrical Element-Based Simulation of Thin Film CIGS Modules: Impact of Inhomogeneities
F. Braun & P. Borowski
AVANCIS, Munich, Germany

3CV.2.39 Analysis of Surface Composition, Electronic Properties, and Solar Cell Performance of UHV-Transferred CIGSe Thin Film Solar Cell Absorbers on Alkali-Containing Substrate Glass
W. Calvet, B. Ümsür, A. Steigert, I. Lauermann, B. Chacko, V. Parvan, T. Olar, C.A. Kaufmann, D. Greiner, J. Lauche, I. Majumdar, H. Allaf Navirian, R. Schlatmann & M.C. Lux-Steiner
HZB, Berlin, Germany
G. Voorwinden
Manz CIGS Technology, Schwäbisch Hall, Germany

3CV.2.40 Hot-Spot Analysis Using Distributed Equivalent Circuit Model for CIGS Solar Cells
J. Jo & M. Shin
Korea Aerospace University, Goyang, Korea South
Y. Kang
Korea University, Seoul, Korea South

3CV.2.43 Single Step and Room Temperature Sputtering Deposition Process for the CIGS Absorber Layer of Solar Cells
B. Ayachi
IEMN, Villeneuve d'Ascq, France
T. Aviles
CROSSLUX, Villeneuve d'Ascq, France
J.-P. Vilcot
IEMN, Villeneuve d'Ascq, France
C. Sion
Ecole Centrale Lille, Villeneuve d'Ascq, France

3CV.2.44 Effect of Sulfur on the Phase Formation of Cu2ZnSnS4 Solar Cell Material
V. Erkkara Madhavan
Qatar Foundation, Doha, Qatar
C. Sripan & A. Kasi Viswanath
Pondicherry University, India
R. Ganesan
Indian Institute of Science, Bangalore, India

PROGRAMME

VISUAL PRESENTATIONS 5CV.3

15:15 - 16:45 Solar Resource and Forecasting / Sustainability and Recycling

5CV.3.1 Quantitative Comparision of Measures from Calibrated PV Cells and Thermopile Pyranometer Supported by a Spectrophotometer
A. Tettamanti & M. Potenza
University of Milan, Italy
A. Calatroni
SOLUZIONE SOLARE, Vicenza, Italy

5CV.3.2 The Impact of Indoor and Outdoor Radiometer Calibration on Solar Measurements
A. Habte, M. Sengupta, A. Andreas & I. Reda
NREL, Golden, United States
J. Robinson
Groundwork, Logan, United States

5CV.3.3 Design and Test of a PTFE Made Scattering Optical Couplings to Substitute State-of-the-Art Cosine Corrector
R. Cahuantzi & A. Buckley
University of Sheffield, United Kingdom

5CV.3.5 Solargis Solar Resource and Meteorological Database for PV Power Simulation
T. Cebecauer, M. Suri, A. Skoczek & J. Betak
GeoModel Solar, Bratislava, Slovakia

5CV.3.6 Validation of Satellite Based Solar Irradiance According to the Heliosat-4-Method for Germany
K. Ditz, H. Ruf, D. Funk & G. Heilscher
Ulm University of Applied Sciences, Germany
M. Schroedter-Homscheidt
German Aerospace Center, Wessling, Germany
C. Köhler
German Meteorological Service, Offenbach, Germany

5CV.3.7 Satellite Data Assimilation in Regional Numerical Weather Prediction as a Key for Better Cloud Cover Forecasts in Tropical Environments
F. Kurzrock
ESPACE-DEV, Saint-Pierre, Reunion
S. Cros
Reuniwatt, Sainte-Clotilde, Reunion
F. Chang-Ming & L. Linguet
University of la Réunion, Sant-Denis, Reunion
R. Potthast
German Meteorological Service, Offenbach, Germany

5CV.3.8 Investigation of Reference Cell and Photodiode Calibrations under Different Conditions

A. Driesse
PV Performance Labs, Freiburg, Germany
W. Zaaiman & N. Taylor
European Commission JRC, Ispra, Italy
D.S. Riley & J.S. Stein
Sandia National Laboratories, Albuquerque, United States

5CV.3.11 Solar Potential in Castilla y León (Spain) through Mathematical Interpolation Methods

M.C. Rodríguez-Amigo, M. Díez-Mediavilla,
D. Gonzalez Peña, M.I. Dieste-Velasco & C. Alonso-Tristán
UBU, Burgos, Spain

5CV.3.12 Use of Lidar Data in Photovoltaic Energy Yield Estimation: the Case of Amsterdam Zuidas

R. Caroprese, O. Isabella & M. Zeman
Delft University of Technology, The Netherlands
J. Brinkman
Accenture, Amsterdam, The Netherlands

5CV.3.13 Global Vertical Irradiation in the Fourth Cardinal Orientations in Burgos, Spain

M. Díez-Mediavilla, M.C. Rodríguez-Amigo,
A. Pérez-Burgos, T. García-Calderón & C. Alonso-Tristán
UBU, Burgos, Spain

5CV.3.16 A New Method for the Benchmarking of Irradiance Predictions

A. Guérin de Montgareuil & T. Hedde
CEA, St Paul lez Durance, France
L. Bellemare
AME, Ducos, Martinique
R. Blondou & T. Soubdhan
UAG, Pointe-à-Pitre, Guadeloupe
M. David & P. Lauret
University of Reunion Island, St Pierre, Reunion
S. Mével & J.P. Morel
Meteo France, Carpentras, France
P. Poggi & C. Voyant
University of Corsica, Ajaccio, France

5CV.3.18 Evaluating a Model to Estimate DNI and DHI from POA Irradiance

M. Gostein & W. Stueve
Atonometrics, Austin, United States
K. Passow & A. Panchula
First Solar, San Francisco, United States

5CV.3.19 Detailed Irradiance Statistics for the Design of PV-Systems from a Set of Ground Stations in Central Africa (Rwanda)

H.G. Beyer
University of Agder, Grimstad, Norway
F. Habyarimana
University of Rwanda, Kigali, Rwanda

5CV.3.20 Stochastic Downscaling Algorithm to Generate High-Resolution Time-Series for Improved PV Yield Simulations

C.A. Duscha, J. Lezaca & R. Meyer
Suntrace, Hamburg, Germany
S.A. Buehler
University of Hamburg, Germany

5CV.3.21 Diagnosing Model Errors in Simulation of Solar Radiation on Inclined Surfaces

Y. Xie & M. Sengupta
NREL, Golden, United States

5CV.3.22 Algorithm for Technical and Economic Design Optimization of Photovoltaic Systems

J. Birtel & H. te Heesen
Trier University of Applied Sciences, Neubrücke, Germany

5CV.3.24 Maximum Power Point Modeling through Irradiance Based Duty Cycle Calculation

P. Upadhyay, S. Pulipaka & R. Kumar
BITS, PIlani, India

5CV.3.25 Comparative Life Cycle Assessment of PV Technologies

S. Dahiya & T. Vogt
Next Energy, Oldenburg, Germany

5CV.3.26 Water Usage for Photovoltaic Solar Manufacturing: Life Cycle Costs Analysis and Resource Demands

A. Yazdani
Exergy, Irvine, United States

5CV.3.27 Life Cycle Assessment of the Recycling of c-Si and CdTe PV Modules

P. Stolz & R. Frischknecht
Treeze, Uster, Switzerland
K. Wambach
Wambach-Consulting, Aindling, Germany
G. Heath & G. Heath
NREL, Golden, United States

5CV.3.30 Estimating Future Recycling Quantities of PV Modules in the European Union

G. Kleiss
SolarWorld, Bonn, Germany

5CV.3.31 Non-Compliance with End-of-Life Legislation: Risks for the Sustainable Development of PV in Europe
J. Clyncke & P.A. Lange
PV Cycle, Brussels, Belgium

5CV.3.32 Photovoltaic Modules under the EU WEEE Directive - First Results and Future Outlook
A. Campen
1cc, Holzgerlingen, Germany

5CV.3.35 Efficient Recovery Method for Unbroken Solar Cell from Photovoltaic Module
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

5CV.3.36 ECOLUX – PV Recycling Simply with Light
W. Palitzsch & U. Loser
Loser Chemie, Zwickau, Germany

5CV.3.37 Predictability of Solar Radiation by Ground-Based All-Sky Camera Imagery and Cloud Motion Vector Analysis: a Theoretical Investigation Using Modelled Cloud Fields and Radiative Transfer Simulations
A. Los
Dexa Solar, Noordwijk, The Netherlands
S.R. de Roode
Delft University of Technology, The Netherlands

5CV.3.38 Can We Do Better with Satellite Data Post-Processing?
G. Lizcano, P. Puig & O. Lacave
Vortex, Barcelona, Spain
J. Calbó
University of Girona, Spain

5CV.3.39 Long Term Projection of Global Horizontal Irradiance Ground Measurment Using Satellite Modeled Time Series
W. Ferrara
ENEL, Roma, Italy
I. Cascone
ENEL, Rome, Italy
O. Privitera
ENEL, Catania, Italy

PROGRAMME

VISUAL PRESENTATIONS 3CV.4

17:00 - 18:30 CdTe, CIS and Related Thin Film Solar Cells and Modules (II)

3CV.4.1 Vitreous Enamel as Sodium Source for Efficient Kesterite Solar Cells on Commercial Ceramic Tiles
I. Becerril-Romero, S. López-Marino, Y. Sánchez, M. Colina, V. Izquierdo-Roca, S. Giraldo, P. Pistor & E. Saucedo
IREC, Sant Adrià de Besòs, Spain
A. Perez-Rodriguez
IREC, Barcelona, Spain

3CV.4.2 Variable-Range Hopping Versus Inter-Grain Tunneling in Cu2ZnSn(SxSe1-x)4 Thin-Films Prepared by Spray Pyrolysis
K.G. Lisunov, L. Bruc, L. Dermenji, N. Curmei, D.A. Sherban, A.V. Simashkevich & E.K. Arushanov
Academy of Sciences of Moldova, Chisinau, Moldova
M. Rusu, G. Gurieva, S. Levcenko & S. Schorr
HZB, Berlin, Germany
M. Guc
IREC, Sant Adrià de Besòs, Spain

3CV.4.3 Introducing the Quality Factor as a Fast and Simple Link between PV Properties and the Crystal CIGS Structure
J. Emmelkamp, D. Roosen-Melsen & M. Theelen
TNO/Solliance, Eindhoven, The Netherlands

3CV.4.4 On the Interpretation of Photoluminescence and Vibrating Kelvin Probe Method for Quality Control of Cu(In,Ga)(Se,S)2 Thin Films
T. Lavrenko & T. Walter
Ulm University of Applied Sciences, Germany
B. Plesz
Budapest University of Technology and Economics, Hungary

3CV.4.5 The Negative Influences of Excessive Oxygen Gas on the Electrical Properties of ITO Films Deposited by Magnetron Sputtering
X. Tan, A.E. Delahoy & K.K. Chin
NJIT, Newark, United States
S. Peng & X. Cao
Bengbu Design & Research Institute for Glass Industry, Shanghai, China
J. Pan
CNBM, Chengdu, China
X. Wang
Evans Analytical, Liverpool, United States

3CV.4.6 Surface Recombination Effects on Thin Films Absorber Characterization Techniques
B. Bissig, S. Nishiwaki, F. La Mattina, R. Carron, J. Löckinger, S. Buecheler & A.N. Tiwari
EMPA, Dübendorf, Switzerland
C. Guerra-Nunez & I. Utke
EMPA, Thun, Switzerland
P.A. Losio
ZHAW, Winterthur, Switzerland

3CV.4.7 Characterization of CZTSe Thin Films for Solar Cell
O. Bayrakli, H.H. Güllü, M. Terlemezoglu & M. Parlak
METU, Ankara, Turkey
E. Coskun
METU, Canakkale, Turkey

3CV.4.8 Room Temperature Diffusion in Electroplated Cu/In/Ga Precursor Films
A. Hovestad, H. Rendering, J. Emmelkamp, F. van Zelst & F. van den Bruele
TNO, Eindhoven, The Netherlands
K. Bakker
ECN, Eindhoven, The Netherlands

3CV.4.9 Fabrication and Characterization of p-CuInSe2/n-Si Heterojunction Diodes
H.H. Güllü, O. Bayrakli, E. Coskun & M. Parlak
METU, Ankara, Turkey

3CV.4.10 Investigation of P3 Patterning Approaches in CZTSe Thin Film Solar Cells
E. Markauskas, P. Gecys & G. Raciukaitis
Center for Physical Sciences and Technology, Vilnius, Lithuania
I. Repins & C. Beall
NREL, Golden, United States

3CV.4.11 CuInSe2 Nanostructures Prepared by Metal Organic Chemical Vapour Deposition for Hybrid Photovoltaic Devices
S. Vatavu, N. von Morzé, J. Albert, S. Wiesner, V. Hinrichs, M.C. Lux-Steiner & M. Rusu
HZB, Berlin, Germany

3CV.4.12 Effects of AZO Thin-Film Thickness and Substrate Temperature on the Characteristics of Cu(In,Ga)Se2 Solar Cells
J.-C. Chang, C.-C. Li, W.-S. Lin, L.-T. Cheng, Y.-Y. Wang, Y.-F. Chen, S.-W. Chan, C.-R. Huang, T.-P. Hsieh & S.-Y. Tsai
ITRI, Hsinchu, Taiwan

3CV.4.14 Optimization of Post-Deposition Annealing in Cu2ZnSnS4 Thin Film Solar Cells and Its Impact on Device Performance
M.G. Sousa & A.F. da Cunha
University Aveiro, Portugal

3CV.4.15 Two-Stage Synthesis of CZTS Thin Films and the Influence of Geometry and Sulphur and Tin Sulphide Supply
S. Mazzamuto, N.M. Pearsall & I. Forbes
Northumbria University, Newcastle Upon Tyne, United Kingdom
Z. Wei & T.M. Watson
Swansea University, United Kingdom
G. Kissling & L.M. Peter
University of Bath, United Kingdom

3CV.4.16 Investigation of Light Induced Metastabilities through Colored Filters on Kesterite Cells
A. Mittal, T. Dimopoulos & M. Rennhofer
AIT, Vienna, Austria
M. Ursprung & L. Plessing
Crystalsol, Vienna, Austria
V. Schlosser
University of Vienna, Austria

3CV.4.17 The Influence of Sodium in High Ga-Content Cu(In1-x,Gax) Se2 (CIGS) Solar Cells
X. Hao, K.T. Chowdhury, T. Sakurai & K. Akimoto
University of Tsukuba, Japan
Y. Kamikawa-Shimizu, S. Ishizuka, A. Yamada & H. Shibata
AIST, Tsukuba, Japan

3CV.4.18 Effect of Annealing Temperature on SLSG/Mo/CIGS/CdS/ZnO:Al Heterojunctions
U. Canci Matur
Istanbul Technical Unversity, Turkey
N. Baydogan
Gedik University, Istanbul, Turkey

3CV.4.19 Low-Temperature Processing of Cu2ZnSnSe4 Solar Cells on Alkali-Free Polyimide Foils
I. Becerril-Romero, S. López-Marino, M. Espindola-Rodriguez, M. Neuschitzer, L. Acebo, E. Saucedo & P. Pistor
IREC, Sant Adria de Besos, Spain

3CV.4.20 Prospects for Highly-Sensitive Compositional Characterization of Multicomponent CIGS Solar Cells by Field Emission Electron Probe Microanalysis
T.-Y. Lin, C.-H. Chen, W.-C. Huang & C.-H. Lai
NTHU, Hsinchu, Taiwan

3CV.4.21 The Influence of Heating Time and Temperature on the Properties of CIGSSe Solar Cells
M. Flammini, N. Debernardi, M. Le Ster & M. Theelen
TNO/Solliance, Eindhoven, The Netherlands
B. Dunne
NEXCIS, Rousset, France

3CV.4.22 High-Rate and Low Cost HF/DC-iZnO Sputtering Combination for Cu(In,Ga)Se2-Based Thin Film Photovoltaics
L. Bürkert, M. Oertel & J. Meier
Manz CIGS Technology, Schwäbisch Hall, Germany

3CV.4.23 Advanced Light Management in Thin Film Solar Cells
W. Soppe, D. Zhang & K. van der Werf
ECN, Eindhoven, The Netherlands
R. van Swaaij
Delft University of Technology, The Netherlands
M. Creatore & B. Williams
Eindhoven University of Technology, The Netherlands
Z. Vroon & J. van Deelen
TNO, Eindhoven, The Netherlands
B. Crombach
C-Coatings, Velp, The Netherlands
R. van Erven
Morphotonics, Veldhoven, The Netherlands

3CV.4.24 Fabrication and Characterization of CuZn(In,Ga)Se3 Solar Cells with Different In/(In+Ga) Ratio
R. Kondrotas, I. Becerril-Romero, M. Colina Brito, Y. Sánchez, F. Oliva, P. Pistor, V. Izquierdo-Roca & E. Saucedo
IREC, Sant Adrià de Besòs, Spain
X. Alcobé & A. Perez-Rodriguez
University of Barcelona, Spain

3CV.4.25 Radiative Substrate Heating during Selenization: the Relation between Absorptivity and the Selenium Content in CIGS
J. Emmelkamp & D. Roosen-Melsen
TNO/Solliance, Eindhoven, The Netherlands

3CV.4.26 Temperature Dependence of Extremely Bright EL Inhomogeneities in CdTe PV Devices
M. Bokalic, R. Kimovec & M. Topic
University of Ljubljana, Slovenia
J.R. Sites
Colorado State University, Fort Collins, United States

3CV.4.27 Structural, Morphological, and Optical Properties of Single Step Electrodeposited Cu2ZnSnS4 (CZTS) Thin Films for PV Applications
H. Kirou, L. Atourki, E.H. Ihalane, A. Elfanaoui, K. Bouabid, M. Nya & A. Ihlal
Ibn Zohr University, Agadir, Morocco

3CV.4.28 Optical Loss Analysis of CIGS Solar Cells
O. Kiowski, A. Bauer, P. Jackson & M. Powalla
ZSW, Stuttgart, Germany

3CV.4.29 Characterization of (Ag, Cu)2ZnSn(S,Se)4 Kesterite Solar Cell Fabricated by Spray Pyrolysis of Aqueous Precursor Solution
W.-C. Huang, S.-Y. Wei, C.-H. Cai, T.-Y. Lin & C.-H. Lai
NTHU, Hsinchu, Taiwan

3CV.4.30 Study of MoOx Back Contact for Low Temperature CdTe Solar Cells on Superstrate Configuration
E. Artegiani, D. Menossi, F. Piccinelli, S. Di Mare, A. Salavei, A. Kumar, G. Mariotto & A. Romeo
University of Verona, Italy

3CV.4.31 The Influence of Compound Target Preparation, Sputtering Power and Substrate Temperature on the Achievement of Cu(In,Ga)Se2 Precursors Suitable to Get High Efficiency Solar Cells
A. Bosio, G. Rosa & N. Romeo
University of Parma, Italy
S. Mazzamuto
Northumbria University, Newcastle Upon Tyne, United Kingdom

3CV.4.32 Evolutionary Optimization of TCO/Mesh Electrical Contacts in CIGS Solar Cells
P.A. Losio & B. Ruhstaller
ZHAW, Winterthur, Switzerland
T. Feurer & S. Buecheler
Empa, Dübendorf, Switzerland

3CV.4.33 Comparative I-V Study Indoor/Outdoor on a Kesterite-Based Sub-Module
R. Aninat, D. Guisado-Mariscal, E. Sanchez-Cortezon & J.M. Delgado Sánchez
Abengoa Solar, Sevilla, Spain
G. Rey & J. Sendler
University of Luxembourg, Belvaux, Luxembourg
E. Garcia-Llamas
Autonomous University of Madrid, Spain
Y. Ren
Uppsala University, Sweden
M. Dimitrievska
IREC, Sant Adrià de Besòs, Spain

3CV.4.34 Analysis of Build-in Electrostatic Field in CdTe Thin Film Solar Cells by QE Measurements at Bias Voltage
L. Feng, L. Wu, X. Li, H. Xu, S. Cao, Q. Shu, W. Li, G. Zeng, J. Zhang & B. Li
Sichuan University, Chengdu, China

3CV.4.35 Electrical Properties of the Al/Cu(InGa)Se2 Junctions: Paving the Way towards Schottky Barrier CIGS Solar Cells?
B. Theys, F. Mollica, F. Donsanti & D. Lincot
CNRS, Chatou, France
T. Klinkert, E. Leite & M. Jubault
EDF, Chatou, France

3CV.4.37 Opto-Electronic Properties of Cu2ZnSnS4 Films Prepared Using Electroplating and CS2 Sulfurization Process
T. Shimizu, K. Nishida, T. Nishida, T. Ito & S. Shingubara
Kansai University, Osaka, Japan
K. Takase
Nihon University, Tokyo, Japan
C. Wang
Changchun University of Science and Technology, China
S. Tanaka
NICT, Hyogo, Japan

3CV.4.38 Monolithic Two-Terminal Hybrid a-Si:H/CIGS Tandem Cells
J. Blanker, Y.H. Liu, M. Zeman & A. Smets
Delft University of Technology, The Netherlands
Z. Vroon
Solliance/TNO, Eindhoven, The Netherlands

3CV.4.39 Interface Characterization of ZnS Buffer Layer Prepared by Sulfur Thermal Cracker on Cu(In,Ga)Se2 Absorber for Photovoltaic Application
D.-H. Cho, W.-J. Lee, J.-H. Wi, W.S. Han & Y.-D. Chung
ETRI, Daejeon, Korea South
T.G. Kim
UST, Daejeon, Korea South
J.W. Kim
KRISS, Daejeon, Korea South

3CV.4.40 Fabrication of CIGS Solar Cell with Sputtered Zn(O,S) Buffer Layer
T.R. Rana, S.Y. Kim & J.H. Kim
Incheon National University, Korea South
K. Kim & J.H. Yun
KIER, Daejeon, Korea South

3CV.4.41 CIGS Solar Cell with Sprayed Sn-Doped In2S3 Buffer
S.Y. Kim & J.H. Kim
University of Incheon, Korea South
K. Kim & J.H. Yun
KIER, Daejeon, Korea South

3CV.4.42 Study of Promotion of Antimony Doping to the Crystallization of Cu2ZnSnS4 (CZTS) Films during the Annealing Process
X.F. Zhang, Y. Umejima & M. Kobayashi
Waseda University, Tokyo, Japan

3CV.4.43 5.3 % Flexible CZTS(Se) Solar Cell Using a Two-Step Etching Process
J.-H. Min, K.-Y. Kim, W.-L. Jeong, H.-M. Kwak & D.-S. Lee
GIST, Gwangju, Korea South

3CV.4.44 Morphological and Structural Properties of the Uniform Cu2ZnSnSe4 Thin Film Deposited by Sputtering for Solar Cell Application
W.-L. Jeong, J.-H. Min & D.-S. Lee
GIST, Gwangju, Korea South

NOTES

Thursday, 23 June 2016

VISUAL PRESENTATIONS 3DV.1

08:30 - 09:30 Silicon-based Thin Film Solar Cells and Modules II

3DV.1.1 Periodic, Aperiodic and Random Texturing for Thin-Film Si Solar Cells: a Comparative Study
L.V. Mercaldo, I. Usatii, G. Pandolfi & P. Delli Veneri
ENEA, Portici, Italy
A. Micco, A. Ricciardi, M. Pisco & A. Cusano
University of Sannio, Benevento, Italy

3DV.1.2 Study of Shunt Distributions in Thin Film Multijunction Solar Cells
J. Holovsky, T. Finsterle, P. Hrzina, L. Cerná & V. Benda
CTU Prague, Czech Republic
J. Klusacek
ASCR, Prague, Czech Republic
J.-W. Schüttauf
EPFL, Neuchâtel, Switzerland

3DV.1.3 Fabrication of Wide Bandgap p-Type nc-SiC:H Window Layers for Thin-Film Silicon Solar Cells
D. Lim, E. Jang, J.H. Park, J. Yoo, S.K. Ahn, K. Yoon & J.-S. Cho
KIER, Daejeon, Korea South

3DV.1.4 Changes in Temperature-Coefficient of the Diode Model Caused by Light-Induced Degradation of a-Si/µc-Si Solar Cells
J.A. Weicht, F.U. Hamelmann & G. Behrens
University of Applied Sciences Bielefeld, Minden, Germany

3DV.1.5 Bifacial Power Generation of Ultra-Thin and Transparent a-Si:H Film Solar Cells
J.W. Lim, G. Kim & S.J. Yun
ETRI, Daejeon, Korea South
M. Shin
Korea Aerospace University, Goyang, Korea South

3DV.1.6 Electron Beam Crystallization of Amorphous Silicon Thin Films in the Solid Phase Regime and Assisted Simulations by Finite Element Method
S. Saager
Fraunhofer FEP, Dresden, Germany

3DV.1.7 Surface Texturization of Glass: a New and Innovative Way to Improve the Light Management in Superstrate Type Thin Film Solar Cell
G. Das, S. Bose, S. Mandal, S. Dhar, S. Mukhopadhyay, C. Banerjee & A.K. Barua
IIEST Shibpur, Howrah, India

3DV.1.8 Laser Ablation of Sub-Stoichiometric Silicon Oxide for Rear Side of PERC Thin Si Solar Cells
F. Gérenton, F. Mandorlo, E. Fourmond & M. Lemiti
INSA Lyon, Villeurbanne, France

3DV.1.9 Industrial Scale Optimization of SiOx Bottom n-Layer in Tandem Solar Cell
G. Condorelli, A. Battaglia, A. Canino & D. Rapisarda
3Sun, Catania, Italy
M. Foti
ST Microelectronics, Catania, Italy
C. Gerardi
Enel Green Power, Catania, Italy

3DV.1.10 An Equivalent Circuit Solar Cell Model
B.E. Pieters
Forschungszentrum Jülich, Germany

3DV.1.11 Development of Well Dispersed Tapered ITO Nanorods as a Potential Light Trapping Structure for Amorphous Silicon Based Solar Cells
S. Dhar, C. Banerjee & A.K. Barua
IIEST, Howrah, India

3DV.1.12 Comparison between Structural and Optical Properties of Aluminium- and Cobalt-Doped Zinc Oxide Thin Films Prepared by RF Sputtering
M. Chaik, C. Sambeval, H. El Aakib & A. Outzourhit
Cadi Ayyad University, Marrakech, Morocco

3DV.1.13 Temperature during the Formation of Reverse-Bias Breakdown Defects in Thin Film Modules
V. Payak, G. Olivera Pimentel, Y. Augarten, A. Gerber & B.E. Pieters
Forschungszentrum Jülich, Germany

3DV.1.14 Subbandgap Absorption Spectroscopy of Thin Film Photovoltaic Materials
J. Holovsky & A. Purkrt
ASCR, Prague, Czech Republic
M. Stuckelberger & M. Bertoni
ASU, Tempe, United States
T. Finsterle, L. Musálek & V. Benda
CTU, Prague, Czech Republic
F.-J. Haug
EPFL, Neuchâtel, Switzerland

3DV.1.15 Solar Cells and Mini-Modules Based on 40 µm-Thick Epitaxial Si Foils: Towards Conductive Bonding onto Low-Cost Si Powder Sintered Supporting Substrates
H. Sivaramakrishnan Radhakrishnan,
K. Van Nieuwenhuysen, J. Govaerts, V. Depauw, T. Bearda, M. Debucquoy, I. Gordon, J. Szlufcik & J. Poortmans
imec, Leuven, Belgium
R. Roozeman & J. Heikkinen
INKRON, Esbo, Finland
M. Schumann
Fraunhofer THM, Freiburg, Germany
R. Buchwald & H.J. Möller
Fraunhofer THM, Freiberg, Germany
A. Ciftja, G. Stokkan & E.-J. Øvrelid
SINTEF, Trondheim, Norway
A. Stonkus, P. Dubravskij & J. Ulbikas
Applied Research Institute for Prospective Technologies, Vilnius, Lithuania
A. Ulyashin
SINTEF, Oslo, Norway

3DV.1.16 Characterization of Doped Polycrystalline Silicon Thin Films Obtained by RF-Sputtering Deposition and Crystallization of Amorphous Silicon
A. Pacio, H. Juárez Santiesteban, M. Pacio & J.A. Garcia
BUAP, Puebla, Mexico
N. Budini
National University of Littoral, Santa Fe, Argentina
X. Mathew
UNAM, Temixco, Mexico

3DV.1.17 Two-Dimensional Characterization of Active Dopant Distribution in a p-i-n Structured Amorphous Silicon Solar Cell Using Scanning Nonlinear Dielectric Microscopy
K. Hirose, N. Chinone & Y. Cho
Tohoku University, Sendai, Japan

3DV.1.19 Deposition of Amorphous and Microcrystalline Silicon in Very High Frequency Range Up to 140 Mhz
B. Leszczynska, C. Strobel, S. Leszczynski, D.D. Fischer, M. Albert & J.W. Bartha
Technical University of Dresden, Germany
U. Stephan & J. Kuske
FAP, Dresden, Germany

VISUAL PRESENTATIONS 3DV.2

13:30 - 15:00 Perovskite, Organic and Hybrid Devices

3DV.2.1 Energy Yield Modelling of Perovskite/Silicon Multijunction Solar Cells
U.-W. Paetzold, R. Gehlhaar, J.G. Tait, M. Debucquoy, M. Jaysankar, T. Aernouts & J. Poortmans
imec, Leuven, Belgium

3DV.2.2 Design of Perovskite/Crystalline-Silicon Tandem Solar Cells
S. Altazin & L. Stepanova
Fluxim, Winterthur, Switzerland
K. Lapagna, P. Losio & B. Ruhstaller
ZHAW, Winterthur, Switzerland
J. Werner, B. Niesen, A. Dabirian, M. Morales Masis, S. De Wolf & C. Ballif
EPFL, Neuchâtel, Switzerland

3DV.2.3 Dye-Sensitized/c-Si and Perovskite/c-Si Tandem Solar Cells
M.F. Vildanova, A.B. Nikolskaia, S.S. Kozlov & O.I. Shevaleevskiy
RAS, Moscow, Russia

3DV.2.6 Trap and Recombination Centers Study in Organolead Halide Perovskites
G. Gordillo, C.A. Otalora, F.E. Guzmán & A.A. Ramírez
National University of Colombia, Bogotá, Colombia

3DV.2.12 Spectroscopic Ellipsometry Study of Soluble Organic-Inorganic Halide FAPb(IxBr1-x)3 Perovskite Thin-Film Solar Cells
T. Yamanaka, K. Uchiumi, K. Usuba, S. Funada, R. Ishikawa & H. Shirai
Saitama University, Japan

3DV.2.13 Perovskite Solar Cell Based on CH3NH3PbI3-2Cl2 / PC61BM
J. Vanek, D. Strachala, J. Hylsky, M. Kadlec, M. Sionova & M. Weiter
Brno University of Technology, Czech Republic

3DV.2.14 Processing and Optimization of the Perovskite Solar Cell Based on PEDOT:PSS/CH3NH3PbI3-XClX
M. Kadlec, J. Vanek, D. Strachala, M. Sionova & M. Weiter
Brno University of Technology, Czech Republic

3DV.2.15 Interfacial Engineering of Organic/Silicon Heterojunction Solar Cells Enables an Ultra-High Open-Circuit Voltage Beyond 660 mV
H. Jian, G. Pingqi & Y. Jichun
Chinese Academy of Science, Ningbo, China

3DV.2.16 Highly Efficient Perovskite Solar Cell Based on ZnO Nanorods through Interface Engineering
S. Li, P. Zhang, Y. Wang, D. Liu, Y. Yang, Z. Wu & Z.D. Chen
UESTC, Chengdu, China
H. Sarvari
University of Kentucky, Lexington, United States
J. Wu
University College London, United Kingdom

3DV.2.17 Threshold Trap Density for Valid Mott-Schottky Analysis in Carrier Selective Optoelectronic Devices
V. Nandal & P.R. Nair
IIT Bombay, Mumbai, India

3DV.2.18 Organolead Halide Perovskite Solar Cells
A.M. Jafar, F. Mustafa Al-Attar & M.K. Kalaf
Ministry of Science and Technology, Baghdad, Iraq
M.H. Suhail
University of Baghdad, Iraq

3DV.2.19 Morphological Differences with Solvent Treatment and Additives in Organic-Inorganic Halide Perovskite Solar Cells
A. Kanwat, H.P. Kim & J. Jang
Kyung Hee University, Seoul, Korea South

3DV.2.20 Conductive Inks with Epoxy Resin Based Vehicles for Perovskite Screen Printing Metallization
C. Montes, A. Linares, E. Llarena, O. González, D. Molina, A. Pío, L. Ocaña, C. Quinto, M. Friend & M. Cendagorta-Galarza López
ITER, Granadilla de Abona, Spain

3DV.2.24 Development and Optimization of the Blocking Layers in Perovskite Based Solar Cells
K. Habashy, V. Steenhoff, M. Vehse & C. Agert
Next Energy, Oldenburg, Germany

3DV.2.25 Low Temperature Solution-Processed NiOx Nanoparticles for High Efficiency Perovskite Solar Cells
C.-C. Cheng, M.-H. Jao & W.-F. Su
NTU, Taipei, Taiwan

3DV.2.26 Optimizing the Deposition of Thin Layers of Organic-Inorganic Hybrid Perovskite Methylammonium Lead Iodide (CH3NH3PbI3) on Large Surfaces through Their Optical Properties

L. Ocaña, C. Quinto, C. Montes, E. Llarena, O. González, D. Molina, A. Pío, M. Friend & M. Cendagorta-Galarza López
ITER, Granadilla de Abona, Spain
A. Linares
AIET, Granadilla de Abona, Spain
C. Hernandez-Rodriguez, S. González-Pérez & R. Guerrero-Lemus
ULL, La Laguna, Spain

3DV.2.28 Carrier Dynamics and Ionic Motion in CH3NH3Pb(I,Br)3 Probed by Nanometer-Scale Charge Transport and Surface Potential Microscopy

H.R. Jung, B.P. Nguyen, G.Y. Kim & W. Jo
Ewha Womans University, Seoul, Korea South

3DV.2.29 Effect of Temperature on the Stability of Methylammonium Lead Iodide Perovskite Solar Cells

S. Kim, S. Bae, T. Chung, S.W. Lee, K. Cho, S.H. Lee, Y. Kang, H.-S. Lee & D. Kim
Korea University, Seoul, Korea South

3DV.2.31 Grain Size Enhancement of Perovskite by Five Times with Polystyrene Doping for High Performances Perovskite Solar Cell

H.P. Kim, A. Kanwat, S.R. Vasa, A.R. bin Mohd Yusoff & J. Jang
Kyung Hee University, Seoul, Korea South

3DV.2.32 Highly Sensitive Organic Photodetector Based on Si/NiPcTS/PEDOT:PSS Bulk Hetrojunction Blend

M.A. Abood, F.I. Mustafa Al-Attar & I.M. Al-Essa
Ministry of Science and Technology, Baghdad, Iraq

3DV.2.34 Direct Laser Patterning of Transparent Electrodes on Barrier Film and Evaluation by a Novel 2D Damage Visualization Method

H. Fledderus, H.B. Akkerman, A.P. Langen, R.J. Abbel, W.H. Manders & P. Groen
TNO, Eindhoven, The Netherlands
N.F. Schilling
Fraunhofer IWS, Dresden, Germany

3DV.2.35 Selective Laser Structuring of Organic Solar Cells on Flexible Substrates for Roll to Roll Production

A. Gavrilova, R. Moser, H.P. Huber & J. Winter
Munich University of Applied Sciences, Germany
P. Kubis
ZAE Bayern, Nuremberg, Germany
S. Geiger & I. Richter
InnoLas, Munich, Germany

3DV.2.36 Band Gap Tunable Benzodithiophene-Based Copolymers with Active Layer Thickness Tolerance for Organic Solar Cells

S.-J. Moon, T.T.T. Bui, S. K. Lee, W. S. Shin, J.C. Lee & C.E. Song
KRICT, Daejeon, Korea South

3DV.2.37 Improvement in Performance and Stability of Large-Area Printed Inverted Polymer Solar Cells and Modules

Y.-C. Huang, H.-C. Cha, Z.-L. Yu, D.-H. Lu, C.-T. Yen, T.-Y. Chung, Y.-M. Sung, Y.-H. Su, C.-M. Chuang, C.Y. Chen & C.-S. Tsao
INER, Longtan, Taiwan

3DV.2.38 Homogeneous and Efficient Co-Evaporated MoO3:CuI Anode Buffer Layer for Organic Solar Cells

M. Hssein, L. Cattin, G. Louarn & J.C. Bennède
University of Nantes, France
L. Barkat & A. Khelil
University of Oran, Algeria
M. Addou
Ibn Tofail University, Kenitra, Morocco

3DV.2.39 Triazoloquinoxaline Bearing Copolymer for Electrochromic and Organic Photovoltaic Applications

S. Ozdemir Hacioglu, E. Aktas, G. Hizalan, N. Akbasoglu Unlu, A. Cirpan & L. Toppare
METU, Ankara, Turkey

3DV.2.40 The Effects of Different PCBM Derivatives on the Performance of P3HT:PCBM Organic Solar Cells

B. Kadem, A. Hassan & W. Cranton
Sheffield Hallam University, United Kingdom

3DV.2.41 Alkyl Chain Tunability of DPP-Based Small Molecules for Solution-Processed Organic Solar Cells

J.C. Lee, C.E. Song, S.R. Sanjaykumar, G.P. Kini, S. K. Lee, W. S. Shin & S.-J. Moon
KRICT, Daejeon, Korea South

3DV.2.42 Durability in Organic Solar Cells under Illumination through Long-Pass Filter

H. Sato & K. Harafuji
Ritsumeikan University, Kusatsu, Japan

3DV.2.43 Structure Engineering of Solution Processable Small Molecules for Organic Solar Cells

S. K. Lee, W. S. Shin, J.C. Lee, C.E. Song & S.-J. Moon
KRICT, Daejeon, Korea South

3DV.2.44 Enhancement of Power Conversion Efficiency of Dye Sensitized Solar Cells by Hybrid Polymer Composite of Nanocrystalline Rare Earth Oxides
M. Ubaidullah & T. Ahmad
Jamia Millia Islamia, New Delhi, India

3DV.2.45 Performance Studies of Dye-Sensitized Solar Cell (DSSC) by Swift Heavy Ion (SHI) Irradiation
H.K. Singh
Modi Engineering College, Modinagar, India
D.K. Avasthi
Inter University Accelerator Center, New Delhi, India
S. Aggarwal,
GGS Indraprastha University, New Delhi, India

3DV.2.46 Study on Dye-Sensitized Solar Cells Module Durability Optimization with Liquid Electrolyte
S.I. Park, C. Han, S.-I. Chan & C. Han
KETI, Seongnam-si, Korea South

3DV.2.47 Liquid Phase Exfoliated Graphene Nanoplatelets as a Low Cost Counter Electrode for Dye-Sensitized Solar Cells
S. Sankar, S. Prathapani, P. Bhargava, S. Bohm &
S. Mallick
IIT Bombay, Mumbai, India

3DV.2.48 Dye Sensitized Solar Cells Prototyped Using Glass Capillaries as Support
M. Gheorghe & S. Gheorghe
NANOM MEMS, Rasnov, Romania
N. Olariu & G. Mantescu
Valahia University of Targoviste, Romania

3DV.2.49 Titanium Oxide Films Deposited by E-Beam Evaporation
R. Chierchia, P. Mangiapane, L. Serenelli, F. Menchini &
M. Tucci
ENEA, Rome, Italy

3DV.2.50 PEDOT:PSS/rGO/CuNWs Based Counter Electrode for Use in DSSCs
A.S. Shikoh, Z. Ahmed, F. Touati, R.A. Shakoor &
M.A. Benammar
Qatar University, Doha, Qatar
Z. Zhu, T.S. Mankowski, M.A. Mansuripur & C.M. Falco
University of Arizona, Tucson, United States

3DV.2.51 Broadband and Omnidirectional Light Harvesting Enhancement of Dye-Sensitized Solar Cells
M.-Y. Hsieh & S.-Y. Kuo
Chang Gung University, Taoyuan, Taiwan

3DV.2.52 Performance of ZnO-Based Dye Sensitized Solar Cells Fabricated with Natural Dye Extracts from Musa Paradisiaca and Carica Papaya Peels as Sensitizers
A. Oluwaseun, M.K. Awodele & A.O. Awodugba
LAUTECH, Ogbomoso, Nigeria

3DV.2.53 Investigation of Photoluminescence Quenching in P3HT Induced by Holmium Doped ZnO Nanostructures
G.L. Kabongo, P.S. Mbule, B.M. Mothudi & M.S. Dhlamini
University of South Africa, Pretoria, South Africa
G.H. Mhlongo & K.T. Hillie
CSIR, Pretoria, South Africa

3DV.2.54 All-Solution Processes for Manufacturing Photoelectrodes and Dye-Sensitized Solar Cells Using Inkjet Printing Technology
C.-T. Chen & B.-C. Hu
KUAS, Kaohsiung, Taiwan

3DV.2.55 Preventing UV Degradation in Dye Sensitized Solar Cells
G. Gava Sonai & A.F. Nogueira
University of Campinas, Brazil
A. Tiihonen, K. Miettunen & P. Lund
Aalto University, Espoo, Finland

3DV.2.56 Dye-Sensitized Solar Cells Integrated onto Transparent Cellulose-Based Substrates
M. Özkan, S.G. Hashmi, M. Borghei, O. Rojas,
P.D. Lund & J. Paltakari
Aalto University, Espoo, Finland
K. Lobato
University of Lisbon, Portugal
A. da Cunha
University Aveiro, Portugal

3DV.2.57 Ga-Doped Zinc Oxide Films as Transparent and Conductive Substrates Applying in Dye-Sensitized Solar Cell
C. Li & S. Hou
Kochi University of Technology, Kami, Japan

3DV.2.58 Requirement of Durability Test for Organic Photovoltaic and Dye-Sensitized Solar Cell
S.-T. Hsu, Y.-S. Long & T.-C. Wu
ITRI, Hsinchu, Taiwan

3DV.2.59 A Case Study of Developing Semi Standards for Organic Photovoltaic and Dye-Sensitized Solar Cell in Taiwan
S.-T. Hsu, Y.-S. Long & T.-C. Wu
ITRI, Hsinchu, Taiwan

3DV.2.62 The Effect of Temperature on the Growth of High Quality Cadmium Sulfide Thin Films by RF Magnetron Sputtering for Solar Cell Applications
T.H. Chowdhury, M.A.A. Wadi, N.K. Kamaruddin, A.K.M. Hasan, N. Amin, M.H. Ruslan, K. Sopian & M. Akhtaruzzaman
National University of Malaysia, Bangi, Malaysia
I.M. Bedja
King Saud University, Riyadh, Saudi Arabia
A. Islam
NIMS, Tsukuba, Japan

3DV.2.63 Characteristics of Emerging PV under Levels Lighting Indoor
Y.-S. Long, S.-T. Hsu & T.-C. Wu
ITRI, Hsinchu, Taiwan

3DV.2.64 3-Dimensional Organic Thin-Film Solar Cell Fabricated by Electrospray Deposition
Y. Tajima, H. Takaku, H. Hayakawa & T. Aoyama
RIKEN, Wako, Japan

3DV.2.65 Carbon Nanotube-Assisted Recombination Reduction in Perovskite Solar Cells
H. Wang
Queensland University of Technology, Brisbane, Australia

3DV.2.66 Extremely Thin Absorber Methylammonium Tin Iodide Perovskite Heterojunction Solar Cell with ZnO-ZnO1-xSx Core-Shell Nanorods as Graded Bandgap Electron Transport Layer
F. Ballipinar, R.R. Thankalekshmi & A.C. Rastogi
Binghamton University, United States

VISUAL PRESENTATIONS 2DV.3

15:15 - 16:45 Silicon Feedstock, Crystallisation and Wafering

2DV.3.1 Scrap Recycling in an Electromagnetic Cold Crucible Furnace
J.M. Míguez Novoa, G. Varela & R. Ordás Badia
Silicio FerroSolar, Arteixo, Spain
N. Pourade & F. Boulle
EMIX, Saint Maurice la Souterraine, France

2DV.3.2 Recent Results for the Silicio Ferrosolar UMG-Silicon Feedstock
E. Zugasti, J. Armentia, M. Ezquer Mayo, M. Murillo, M.J. Rodriguez & A.R. Lagunas
CENER, Sarriguren-Navarra, Spain
J. Diéguez, J.M. Míguez Novoa & R. Ordás Badia
Silicio FerroSolar, Arteixo, Spain

2DV.3.3 Neutron Activation Analyses (NAA) Investigation of Transition-Metal Impurities Contents in Solar Grade Silicon Feedstock for Directional Solidification of Photovoltaic HEM Silicon Ingot
Y. Chettat & A. Lami
CRTSE, Algiers, Algeria
L. Hamidatou, M. Salhi & H. Slamene
CRNB, Djelfa, Algeria
A. Benmounah
UR–MPE, Boumerdès, Algeria

2DV.3.4 Mathematical Modeling of Metallurgical-Grade Silicon Plasma-Chemical Purification Process
S.M. Karabanov, D.V. Suvorov, D.Y. Tarabrin, E.V. Slivkin & G.P. Gololobov
RSREU, Ryazan, Russia
V.I. Yasevich & A.S. Karabanov
Energy Ryazan, Russia

2DV.3.5 Performance of FBR Blended CZ Wafers
O. Nordseth, R. Søndenå, C.C. You, M.S. Wiig, J. Zhu, B. Thomassen & S.E. Foss
Institute for Energy Technology, Kjeller, Norway
Y. Boulfrad
Norwegian Crystals, Glomfjord, Norway
G. Garrett
REC Solar, Houston, United States

2DV.3.6 Peering into Operating Polysilicon Reactors with a Suite of Online Instruments
T.J. Preston, H. Klette, G.M. Wyller, E.S. Marstein, W.O. Filtvedt & T.T. Mongstad
IFE, Kjeller, Norway

2DV.3.7 Silicon Production by Centrifuge CVD Reactor on the Way to Industrial Verification
W.O. Filtvedt & H. Klette
Institute for Energy Technology, Kjeller, Norway
S. Sørensen & J. Filtvedt
Dynatec Engineering, Askim, Norway

2DV.3.8 Silicon Purification through Magnesium Addition and Acid Leaching
J. Safarian & G. Tranell
NTNU, Trondheim, Norway

2DV.3.9 Contamination of Silicon during Electron Beam Melting
Al. Kravtsov & An. Kravtsov
KEPP-EU, Riga, Latvia

2DV.3.10 Use of the Czochralski Growth Technique to Remove Defects of Polycrystalline Upgraded Metallurgical Grade Silicon
F.C. Marques, A.D.S. Côrtes, R.B. Merlo,
D. Soares da Silva, G.A. Viana & P.R. Mei
UNICAMP, Campinas, Brazil

2DV.3.12 Behaviour of the Slip-Cast Crucible as a Contamination Source during Silicon Directional Solidification
H.V. Skarstad, A. Autruffe & M. Di Sabatino
NTNU, Trondheim, Norway
G. Stokkan
SINTEF, Trondheim, Norway

2DV.3.13 Impurities and Defects Distribution during the Growth of PV Silicon: Influence of Melt Convection and Gravity
A. Le Donne, S. Binetti & M. Acciarri
University of Milan, Italy
C. Reimann & J. Friedrich
Fraunhofer IISB, Erlangen, Germany
T. Jauss, A. Cröll & T. Sorgenfrei
University of Freiburg, Germany

2DV.3.14 Investigation of Deep-Level Defects in the Active Layer of Multicrystalline Silicon Solar Cells
V.G Litvinov, N.V. Vishnyakov, V.V. Gudzev,
A.V. Ermachikhin, S.M. Karabanov & S.P. Vikhrov
Ryazan State Radio Engineering University, Russia
A.S. Karabanov
Helios-Resource, Saransk, Russia

2DV.3.16 Influence of Diffusion Barrier on the Performance of High-Performance Multi-Crystalline Silicon
Q. Wang & W. Chen
Jinko Solar, Shangrao, China

2DV.3.17 Properties of Multi-Crystalline Silicon Ingot Grown by Self-Nucleating Crucible
J. Laurent & C. Martin
Vesuvius, Feignies, France
C. Reimann & M. Trempa
Fraunhofer IISB, Erlangen, Germany
T. Lehmann
Fraunhofer THM, Freiberg, Germany

2DV.3.18 Dislocation Formation in Seed Crystals Induced by Feedstock Indentation during Growth of Quasimono Silicon Ingots
M. Trempa, M. Beier, K. Roßhirt, C. Reimann & J. Friedrich
Fraunhofer IISB, Erlangen, Germany
C. Löbel, L. Sylla & T. Richter
SolarWorld Innovations, Freiberg, Germany

2DV.3.19 Spectral PL Imaging of Mono-Like Silicon Wafers
E. Olsen, S. Bergan, I. Burud & T. Mehl
NMBU, Ås, Norway
K.E. Ekstrøm & M. Di Sabatino
NTNU, Trondheim, Norway

2DV.3.20 Bulk Lifetime Improvement of n-Type Czochralski Silicon Crystals Grown from the Melt in "Liquinert" Quartz Crucible
T. Fukuda, K. Tanahashi, S. Simayi, K. Shirasawa &
H. Takato
AIST, Koriyama, Japan
Y. Horioka
FTB Research Institute, Noda, Japan
S. Sakuragi
Union Materials, Ibaraki, Japan

2DV.3.21 Influence of Growth Conditons on Thermal Process Sensitivity for n-Type Cz Silicon
T. Kojima, R. Suzuki, K. Nakamura & A. Ogura
Meiji University, Kawasaki, Japan
Y. Ohshita
TTI, Nagoya, Japan
E. Nishijima, I. Masada, S. Iida & S. Tachibana
Tokuyama, Japan

2DV.3.22 Cz Silicon Benchmark for p-Type PERC Solar Cells
P. Saint-Cast, J. Greulich, S. Werner, U. Jäger, I. Reis,
J. Haunschild & R. Preu
Fraunhofer ISE, Freiburg, Germany

2DV.3.23 The Benefit of Ultra-High Minority Carrier Lifetime Silicon Wafers for High-Efficiency and Innovative Solar Cells

I. MacLellan, S. Zijlstra, T. Hartmann, K.C. Chang & T. Cadwell
Ubiquity Solar, Sarnia, Canada
S. Sivoththaman & Z. Gao
University of Waterloo, Canada
J. Vedde
SiCon, Copenhagen, Denmark
R.N. Kleiman
McMaster University, Hamilton, Canada
P. Dold
Fraunhofer CSP, Halle, Germany
J. Olson
Jerry Olson Consulting, Boulder, United States
J. Bodker
SmarterEnergy, Copenhagen, Denmark
F. Faller
FSC Solar Consulting, Neustadt, Germany

2DV.3.25 Single Crystalline Si Wafers Sawn by Electrical Discharge for Photovoltaics

B. Jang, H. Moon, S. Choi, S. Park & J. Kim
KIER, Daejeon, Korea South

2DV.3.26 A Comparison of Residual Stress Induced by Fixed Abrasive Diamond Wire Sawing and Loose Abrasive Slurry Wire Sawing in Multi-Crystalline Silicon Wafers

V. Pogue, S. Melkote & S. Danyluk
Georgia Institute of Technology, Atlanta, United States

2DV.3.27 Effect of Abrasive Grit Shape on Surface Morphology, Subsurface Damage, and Fracture Strength of Diamond Wire Sawn Silicon Wafers

A. Kumar & S.N. Melkote
Georgia Institute of Technology, Atlanta, United States
S. Kaminski & C. Arcona
Saint-Gobain, Northborough, United States

2DV.3.28 Crack Distribution and Strength of Silicon Wafers Considering the Crystallographic Orientation of the Silicon Ingot in Diamond Wire Sawing Process

C. Klute, R. Koepge & S. Schönfelder
Fraunhofer CSP, Halle, Germany

2DV.3.29 Economic Evaluation of Advanced Coolant Supply to Diamond Wire Saws in Silicon Wafer Production

J. Ruth & G. Heser
Pall, Dreieich, Germany
R. Berndt
RBFM Consulting, Dresden, Germany

2DV.3.30 Ultrathin Single Crystalline Si Wafers by Using a Free Abrasive-on Multi-Wire Sawing Process for Photovoltaics

B. Jang, S. Choi, J. Kim & H.-E. Song
KIER, Daejeon, Korea South
S. Meyera, F. Kaule & D. Lausch
Fraunhofer CSP, Halle, Germany

2DV.3.32 Cost Effective Growth of Silicon Mono Ingots by the Application of a Mobile Recharge System in Cz-Puller

F. Mosel & A. Denisov
PVA TePla, Wettenberg, Germany
R. Sharma & P. Dold
Fraunhofer CSP, Halle, Germany

VISUAL PRESENTATIONS 7DV.4

17:00 - 18:30 PV Economics and Markets / PV Global Issues, Policies and Strategies

7DV.4.1 Building a Level Playing Field for Distributed Solar Photovoltaic in Australia

S. Teske
University of Technology Sydney, Australia

7DV.4.4 The PV Market Developments in Greece, Feed-in-Premium Scheme

S. Tselepis
CRES, Athens, Greece

7DV.4.5 Innovative Finance and Business Model for Photovoltaic Power Plants on Multiple Dwellings in Austria for Self-Consumption

S. Woess-Gallasch & D. Steiner
Joanneum, Graz, Austria
H. Rest-Hinterseer
Arbeitsgemeinschaft Erneuerbare Energie Salzburg, Austria
G. Korpitsch & M. Auer
KW Solartechnik, Graz, Austria
W. Aichinger
EAG, Salzburg, Austria

7DV.4.6 Assessing and Forecasting Economic and Environmental Impacts of PV Adoption

A.P. Sanfilippo & L. Pederson
Qatar Foundation, Doha, Qatar

7DV.4.7 The Study of the Efficiency of Photovoltaics and Wind Power Energy

P.P. Bezrukikh
RSREU, Ryazan, Russia
S.M. Karabanov
G.M. Krzhizhanovsky Power Engineering Institute, Moscow, Russia
P.P.jr. Bezrukikh
LUKOIL, Moscow, Russia

7DV.4.8 100% Renewable Energy in North America and the Role of Solar Photovoltaics

A. Aghahosseini
Lappeenranta University of Technology (LUT), Finland
D. Bogdanov & C. Breyer
Lappeenranta University of Technology, Finland

7DV.4.9 Framework Model for Post-Subsidy PV Market Forecast

A. El Gammal & G. Masson
Becquerel Institute, Brussels, Belgium
C. Werner
Chris Werner Energy Consulting, Dessau, Germany

7DV.4.10 Unsubsidised PV Markets: How a National Public-Private Financing Platform Could Reduce the Impact from Low Oil Prices

M. Bieri, R.S. Baker, S. Tay & T. Reindl
SERIS, Singapore, Singapore

7DV.4.11 Economic Evaluation for Stable Electric Power System with High Ratio of Photovoltaic Power System - Toward More Than 90% CO2 Emissions Reduction of Electric Power System in Japan

T. Inoue, S. Matsuda, H. Iwasaki & K. Yamada
JST, Tokyo, Japan

7DV.4.12 A Techno-Economic Guide to Iran Renewable Energy Market for Foreign Investment in Post-Sanction Era: Assessment of PV Plant Construction Potential in Free Zones of Iran Using Retscreen Software

S. Eslami, A. Bakhtiari & H. Akhbari
Shahid Beheshti University, Tehran, Iran
A. Gholami
Isfahan University of Technology, Iran

7DV.4.13 Bankability of New PV Projects, a Risk Assessment from Technical and Financial Perspectives

L. Nespoli, G. Corbellini & V. Medici
SUPSI, Canobbio, Switzerland

7DV.4.14 Socialised Savings from Decentralised Photovoltaics in South Pacific Markets

B. O'Donnell
Heliocentric Solutions, London, United Kingdom
H.S. Nguyen
INL, Ecully, France

7DV.4.15 BIPV- Potential and State of the Art in Austria: High Future Demand for 100% Renewables – Low Actual Share

S. Zamini & A. Schneider
Austrian Institute of Technology, Vienna, Austria

7DV.4.16 Prospects in Solar Water Desalination: Affordable H2O without CO2

V. Fthenakis
Brookhaven National Laboratory, Upton, United States
R. Bkayrat
First Solar, Dubai, United Arab Emirates
A. Khalid
IRENA, Abu Dhabi, United Arab Emirates
A. Atia
Columbia University, New York, United States
S. Sgouridis
Masdar Institute, Abu Dhabi, United Arab Emirates
T. Alghasham
MEDAD Technologies, Dubai, United Arab Emirates
K.C. Ng
KAUST, Jeddah, Saudi Arabia

7DV.4.18 The Impacts of the Increasing Costs of Electricity Tariffs on the Economic Feasibility of Distributed Generation with PV Systems in Brazil

J.P. Costa Nascimento, L.C. Macedo Blasques &
A. Cavalcante do Nascimento
IFPA, Belém, Brazil

7DV.4.19 From Financial to Patrimonial Valuation of BIPV: a Framework for Assessing BIPV Investment Attractiveness

A. El Gammal
Becquerel Institute, Brussels, Belgium
S. Krawietz
SETA Network, London, United Kingdom
D. Mueller & H. Bürckstümmer
Merck, Munich, Germany

7DV.4.20 Crowdfunding for Financing Solar Power Projects
T. Maidonis & S. Betz
WIP - Renewable Energies, Munich, Germany
T. Aschenbeck-Florange, A. Dlouhy & T. Drefke
Osborne Clarke, Cologne, Germany
A. Bergmann, B. Burton & M. Klaes
University of Dundee, United Kingdom
K. Harder
Abundance, London, United Kingdom
R. Kelly
BNRG Renewables, Dublin, United Kingdom
K. Kohl
European Crowdfunding Network, Brussels, Belgium
A. Raguet
Lumo, La Rochelle, France
A. Roesch
SolarPower Europe, Brussels, Belgium

7DV.4.22 Power-System-Wide Analysis of the Benefits of Reserve Provision from Solar Photovoltaics in South Africa: Full Economic Viability in Reach within the Next Five Years
T. Bischof-Niemz, J. Calitz & J. Wright
CSIR, Pretoria, South Africa

7DV.4.23 The Value of Decentralised Solar PV for Consumers, Suppliers and Society
T. Döring
SolarPower Europe, Brussels, Belgium

7DV.4.25 Sustainable Development of Solar PV Sector in MENA-Case Study
S. Zawaydeh
SZEO, Amman, Jordan

7DV.4.27 The Impact of the SERC Based Solar PV Outreach Training Program in Kenya
I. Da Silva, R. Geoffrey, T. Nalubega & M. Njogu
Strathmore University, Nairobi, Kenya

7DV.4.28 International Strategy and Policy Statement of Certified PV Module Registration and Management in Taiwan
C.-C. Chou & H.-C. Ma
ITRI, Hsinchu, Taiwan

7DV.4.30 A Pratical Analysis of the 58-15 Moroccan Law on Renewable Energy
R. El Bachtiri
University Sidi Mohammed Ben Abdellah, Fez, Morocco

7DV.4.31 Missing Gaps in the Challenge of Massive Intervention of Grid-Connected PV Systems in Peru
R. Espinoza & C. Luque
National University of Engineering Peru, Rimac-Lima, Peru
E. Muñoz-Cerón & J. de la Casa Higueras
University of Jaén, Spain

7DV.4.33 Start-Up Factory Kumasi (Ghana) – Paderborn (Germany): Smart Tropical House
T. Klaus, E.A. Schmitz, B. Klusmann, M. Piper & S. Krauter
University of Paderborn, Germany
L. Rongen & R. Gruber
University of Applied Sciences Erfurt, Germany
I. Nkrumah, K. Ampong, M. Donkor & R. Tamakloe
KNUST, Kumasi, Ghana

7DV.4.34 Policy Initiatives for Solar Power Generation in Western Himalayas of India
S.S. Chandel
National Institute of Technology, Hamirpur, India

7DV.4.35 A Survey Informed Modelling of Temporal Diffusion of PV-Based Communal Grids in a Rural Developing Community
N. Opiyo, R. Crook & P.G. Taylor
University of Leeds, United Kingdom

7DV.4.36 Large-Scale (Utility-Scale) Photovoltaic Power Plants 1980-2015, Literature Survey
D. Lenardic
Jesenice, Slovenia

7DV.4.38 SOLAR-ERA.NET - ERA-NET on Solar Electricity for the Implementation of the Solar Europe Industry Initiative

S. Nowak & M. Gutschner
NET Nowak Energy & Technology, St. Ursen, Switzerland
S. Oberholzer
Swiss Federal Office of Energy, Bern, Switzerland
C. Hünnekes, H. Bastek, D. Brockmann, M. Schulte & J. Kutscher
Forschungszentrum Jülich, Germany
S. Rabe
CEF-NRW, Dusseldorf, Germany
K. Wikman
TEKES, Helsinki, Finland
Y. Durand
ADEME, Valbonne, France
M. Gerbaud
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, Warszawa, Poland
K. Karaösz & I. Dogan
TUBITAK, Gebze, Turkey
O. Bernsen
The Netherlands Enterprise Agency, Den Haag, The Netherlands
S. Tselepis
CRES, Athens, Greece
C. Inglis
InnovateUK, Swindon, United Kingdom
L. Antoniou & D. Petsa
RPF, Lefkosia, Cyprus
A. Agrimi
Regione Puglia, Bari, Italy
C. Gadaleta Caldarola
ARTI, Valenzan, Italy
D. Tornabene & F. Montagnino
Regione Sicilia, Palermo, Italy
T. Zillner & U. Rohrmeister
Federal Ministry of Transport, Vienna, Austria
E. Lutter & G. Wörther
Klima- und Energiefonds, Vienna, Austria
P.-J. Rigole & T. Walla
Swedish Energy Agency, Eskilstuna, Sweden

7DV.4.39 Global Solar Resource and Photovoltaic Electricity Potential

M. Suri, T. Cebecauer, J. Betak, A. Skoczek & N. Suriova
GeoModel Solar, Bratislava, Slovakia

7DV.4.40 Solar Lighting Products and Small DC Appliances Put to the Market Test: a 3 Year Hands-on Experience

N. Baggio & F. Minichiello
Futura, Cittadella, Italy

7DV.4.41 An Overview of Patent Application Data in the Field of Photovoltaics

A. Visentin & B.E. Sagol
European Patent Office, Berlin, Germany
M. Boero & C. Königstein
European Patent Office, Rijswijk, The Netherlands

7DV.4.42 Could We Do without 'Legendary Firms' to Shape an Industry Structure? The Case of the Photovoltaic Industry

T.T. Pham
IFRIS-LISIS, Marne-la-Vallée, France

7DV.4.43 Is Europe Heading for the Post Paris Agreement Renewable Future Quickly Enough?

A. Lagaaij
SucceSun, Breukelen, The Netherlands

7DV.4.44 Development of Innovative Educational Material for Building Integrated Photovoltaics – Dem4BiPV

W. van Sark & A. Louwen
Utrecht University, The Netherlands
G. Georghiou & G. Makrides
University of Cyprus, Nicosia, Cyprus
E. Loucaidou & M. Ioannidou
Deloitte, Lemassol, Cyprus
H. Fechner & M. Tabakovic
University of Applied Sciences Technikum Wien, Vienna, Austria
I. Weiss, S. Arancón & S. Betz
WIP - Renewable Energies, Munich, Germany

7DV.4.46 Economic Feasibility Analysis of Choices for Not Connected Clients: Photovoltaic off-Grid Systems, Compared to Grid Based Systems

M.A. Muñoz, H. Wang & G.P. Moreda
UPM, Madrid, Spain

7DV.4.48 Innovation Brought by FP7-CHEETAH Project in Management of Knowledge Exchange for PV RTD

F. Roca, D. Casaburi & F. Beone
ENEA, Portici, Italy
K. Bittkau & A. Hoffmann
Forschungszentrum Jülich, Germany
I. Lauermann, M.C. Lux-Steiner & M. Schmid
HZB, Berlin, Germany
P. Malbranche
CEA, Le Bourget du Lac, France
I.T. Theologitis
SolarPower Europe, Brussels, Belgium
N. Taylor
European Commission DG JRC, Ispra, Italy
J.M. Kroon & P.M. Sommeling
ECN, Petten, The Netherlands
M. Drießen
Fraunhofer ISE, Freiburg, Germany
I. Gordon & K. Van Nieuwenhuysen
imec, Leuven, Belgium
S.A. Gevorgyan
DTU, Roskilde, Denmark
S. Binetti
University of Milan, Italy
S. Buecheler
EMPA, Dübendorf, Switzerland
C. del Cañizo
UPM, Madrid, Spain
A. di Carlo
University of Rome II, Italy
M. Grossberg
Tallinn University of Technology, Estonia
G. Halambalakis
CRES, Pikermi, Athens, Greece
A. Joyce
INETI, Lisboa, Portugal
E. Lotter
ZSW, Stuttgart, Germany
E.-J. Øvrelid
SINTEF, Trondheim, Norway
E. Román
Tecnalia-Robotiker, Zamudio, Spain
F. Ringleb
IKZ Institute for Crystal Growth, Berlin, Germany
G. Sánchez-Plaza
UPV, Valencia, Spain
J.F. Trigo
CIEMAT, Madrid, Spain
R. Turan
METU, Ankara, Turkey
N. Wyrsch
EPFL, Neuchâtel, Switzerland
S. Zamini
AIT, Vienna, Austria

PROGRAMME

7DV.4.49 Durasol - A French Multisite Platform for Assessing the Durability of Solarmaterial and Systems

J. Merten & F. Medlège
CEA, Le Bourget du Lac, France
D. Barakel
CNRS, Marseille, France
M. David
University of Reunion Island, St-Pierre, Reunion
F. Legrand
INSA LYON CNRS, Villeurbanne, France
J.L. Martin & F. Mezzasalma
CEA, St Paul lez Durance, France
D. Nelias
INSA Lyon, Villeurbanne, France
P. Poggi
University of Corsica, Ajaccio, France
O. Racurt
CEA, Le Bourge Du Lac, France

7DV.4.50 Australian PV System Market Analysis for the Powerwall

S.Rodrigues, R. Torabikalaki & F. Faria
M-ITI, Funchal, Portugal
H. Geirinhas Ramos
IST, Lisbon, Portugal
F. Morgado-Dias
University of Madeira, Funchal, Portugal

7DV.4.51 NOOR, a CSP/PV Hybrid Solution

A. Jamrani
Masen, Rabat,Morocc

For more information on the Poster Area please refer to the Poster Guide or visit www.photovoltaic-conference.com/conference

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PARALLEL EVENTS

For more information please refer to
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PARALLEL EVENTS

PARALLEL EVENTS

The EU PVSEC Parallel Events are open to all registered Conference Participants of the EU PVSEC 2016.

For detailed information and programme please visit www.photovoltaic-conference.com/parallel-events.

Monday, 20 June 2016

13:30 - 17:30

Enhancing PV Competitiveness with Energy Storage

jointly with the International Energy Agency Photovoltaic Power Systems Programme (IEA PVPS) - IEA PVPS Task 1

Tuesday, 21 June 2016

08:30 - 12:30

Acceleration of BIPV by international collaboration

jointly with the International Energy Agency Photovoltaic Power Systems Programme (IEA PVPS) - IEA PVPS Task 15, Zuyd Applied University and the Becquerel Institute

13:30 - 17:30

PV End-of-Life Management: Challenges and Opportunities

jointly with IRENA – International Renewable Energy Agency and the International Energy Agency Photovoltaic Power Systems Programme (IEA PVPS) - IEA PVPS Task 12

Wednesday, 22 June 2016

08:30 - 12:30

Solar PV: Changing our energy system

jointly with IRENA – International Renewable Energy Agency

13:30 - 17:45

PV Production, Quality, and Innovation Forum

jointly produced by SOLARUNITED and the Becquerel Institute

13:30 - 18:30

PHOTOVOLTAICS | FORMS | LANDSCAPES
Beauty and power of designed Photovoltaics

jointly with EC-JRC, ENEA and ETA-Florence Renewable Energies

Thursday, 23 June 2016

08:30 - 18:00

7th International Workshop on CIGS Solar Cell Technology (IW-CIGSTech 7)

jointly organized by Helmholtz-Zentrum Berlin für Materialien und Energie GmbH (HZB) and Zentrum für Sonnenenergie- und Wasserstoff-Forschung Baden-Württemberg (ZSW)

PARALLEL EVENTS

PARALLEL EVENTS

Enhancing PV Competitiveness with Energy Storage

jointly with the International Energy Agency Photovoltaic Power Systems Programme (IEA PVPS) - IEA PVPS Task 1

Day:	**Monday, 20 June 2016**
Time:	**13:30 - 17:30**
Site:	**Ground Floor, Auditorium Room 4**
Access:	**Open to all registered Conference participants of the EU PVSEC 2016**

Grid parity has been reached in some market segments but the real competitiveness of PV solutions has not been achieved yet everywhere. This workshop aims at redefining the concepts of competitiveness for PV solutions in the light of the last self-consumption regulations and the super-competitive tenders seen in Germany, India, the USA, the UAE or recently in Peru. In addition, the shift towards decentralized PV that several countries are attempting requires an in-depth look into the possibilities of energy storage, through batteries, but also energy storage in buildings or embedded in the grid.

Programme Outline

13:30
Welcome Speech & the Role of the IEA PVPS Program
Stefan Nowak - IEA-PVPS Chairman

Key note Speech
Cédric Philibert - IEA (invited)

Session 1 – From grid parity to Competitiveness

This session will explore the questions of competitiveness of PV through its main aspects: the declining PV system prices through learning curve analysis, the evolution of LCOE in the coming years and its drivers. The question of competitiveness will be approached through regulatory aspects, technical aspects including the impact on grid costs and electricity integration aspects.

A review of grid parity dynamics
Christian Breyer (invited) - LUT

Competitiveness of PV systems in Europe
Eero Vartianen (invited) - Fortum

Perspectives for cost decline in the PV industry
Linda Koschier (invited) - UNSW

A reality below competitive tenders
Fabrizio Binarri (invited) - Enel Green Power

15.00 Coffee-Break

15:30
Session 2 – Enhanced Competitiveness with Storage Options

This session will explore how storage can support PV development. The experience from short-term distributed storage in Germany will be detailled. The options for energy storage in the buildings or electric vehicules will be assessed while the question of embedding storage inside the grid to support PV development will be questioned. At the end the question of storage technologies and competitiveness will be discussed.

PV plus electricity storage
Izumi Kaizuka – RTS Corporation

PV with pump-hydro storage
Lv Fang – Chinese Academy of Sciences

Enhancing PV competitiveness with energy storage in buildings
Pedro Vicente Quiles – UMH (invited)

Virtual storage and innovative financial business models
tbd

17:00
Closing Speech
Stefan Nowak - IEA-PVPS Chairman, Net Energy

Contact for further information:
Gaëtan Masson, Task 1 Operating Agent g.masson@iea-pvps.org

Acceleration of BIPV by international collaboration

jointly with the International Energy Agency Photovoltaic Power Systems Programme (IEA PVPS) - IEA PVPS Task 15, Zuyd Applied University and the Becquerel Institute

Day:	**Tuesday, 21 June 2016**
Time:	**08:30 - 12:30**
Site:	**Ground Floor, Auditorium Room 4**
Access:	**Open to all registered Conference participants of the EU PVSEC 2016**

BIPV is seen as one of the key development tracks of PV towards mass application. To facilitate this key development, a number of international collaborative initiatives are undertaken. In this interactive seminar, a number of international collaboration projects and platforms will be presented, with the aim to pinpoint the next step in international needs for collaboration.

Programme Outline

08:30 - 10:00
International collaboration on BIPV

- **Opening session 1**
  Adel El Gammal, Becquerel Institute
- **Overview on international BIPV research activities**
  Pierluigi Bonomo, SUPSI
- **IEA PVPS Task 15, Acceleration of BIPV**
  Michiel Ritzen, Zuyd University
- **BIPV “Custom Fit”; a Dutch Belgium German research collaboration**
  Ando Kuypers, Solliance
- **PVSITES project: Building-integrated photovoltaic technologies and systems for large-scale market deployment**
  Maider Machado, Tecnalia

10:00 - 10:30 Break

10:30 - 12:30

Developments in BIPV research projects, mayor industrial actors

- **Opening session 2**
  Zeger Vroon, Zuyd University/Solliance
- **BIPV innovative business models**
  Adel El Gammal, Becquerel Institute
- **Market assessment for thin film BIPV**
  Menno van den Donker, SEAC
- **OPV in mass BIPV applications**
  David Mueller, Merck Group
- **A low cost BIPV approach for mass market**
  Valerick Cassagne, Total
- **Panel Discussion: BIPV from Architectural to mass market applications**

Closing Speech
Stefan Nowak, IEA-PVPS Chairman, Net Energy

Contact for further information: Zeger.vroon@zuyd.nl

PV End-of-Life Management: Challenges and Opportunities

jointly with IRENA – International Renewable Energy Agency and the International Energy Agency Photovoltaic Power Systems Programme (IEA PVPS) - IEA PVPS Task 12

Day: **Tuesday, 21 June 2016**
Time: **13:30 - 17:30**
Site: **Ground Floor, Auditorium Room 4**
Access: **Open to all registered Conference participants of the EU PVSEC 2016**

Programme Outline

13:30 - 13:40

Welcome Remarks

- Stephanie Weckend, Programme Officer, KPFC, IRENA,
- Andreas Wade, Vice-Chair Strategy Committee SolarPower Europe / Deputy Operating Agent IEA-PVPS Task 12

13:40 - 14:00

Official Launch of the IRENA IEA PVPS Task 12 Report "End-of-Life Management: Solar Photovoltaic Panels"

- Henning Wuester, Director, Knowledge Policy and Finance Centre, IRENA (10 min)
- Stefan Nowak, Chair, IEA PVPS (10 min)

14.00 - 14:30

Main findings of the Report – Waste projections, Panel compositions, Waste classification (25 min presentation, 5 min Q&A)

- Dr. Karsten Wambach (bifa)
- Andreas Wade

14:30 - 15:45

Panel Discussion – Country/Regional Approaches to PV Waste Management – Examples from the Report

Moderator: Stephanie Weckend
(15 min presentation, 15 min Q&A at the end)

- EU (Alexandre Roesch, SolarPower Europe, Belgium)
- Japan (Keiichi Komoto, Mizuho Information & Research Institute, Japan)
- US (Prof. Vasilis Fthenakis, Brookhaven National Laboratories, USA)
- Germany (representative from the BMU – tbc)

15:45 - 17:00

Panel Discussion – Emerging Opportunities for the Private Sector

Moderator: Andreas Wade
(10 min presentation, 20 min Q&A at the end)

- Perspectives from a pan European Producer Compliance Scheme (Jan Clyncke, PV CYCLE, Belgium)
- Perspectives from a recycling technology solution provider (Dr. Wolfram Palitzsch, Loser Chemie, Germany)
- Perspectives from a PV Producer & Recycler (Andreas Wade, First Solar)
- Perspectives from the Glass/Metals Recycling Industry (tbc)

17:00 - 17:10

Closing Remarks

Solar PV: Changing our energy system

jointly with IRENA – International Renewable Energy Agency

Day:	**Wednesday, 22 June 2016**
Time:	**08:30 - 12:30**
Site:	**Ground Floor, Auditorium Room 4**
Access:	**Open to all registered Conference participants of the EU PVSEC 2016**

Solar PV has become a key energy technology. Continuous innovation and deployment have seen deployment levels grow from 38 GW to more than 230 GW in the last five years, driven by solar PV module price declines of up to 80% between the end of 2009 and 2015. In both developed and developing countries, large-scale utility-scale solar PV systems have beaten new gas- or coal-fired power stations in terms of costs. Rooftop solar PV systems provide households with cheaper electricity than buying electricity from the grid. Innovative solutions like solar lights and solar home systems are providing cheap electricity to non-electrified regions in Africa and Asia

Solar PV is truly changing our energy system. However, with this transformation comes new challenges that need to be addressed if the rapid growth in solar PV is continue. How do we ensure that solar PV becomes the preferred power source to satisfy future electricity demand? Solar PV has the potential (1550 GW by 2030 in the latest IRENA vision), but it is by no means a certainty and for its potential to be fully realized policy makers, regulators and investors need to set and operate in the right business, legal and regulatory environment.

Part of the solution must also be continued rapid technology progress and innovation, both learning-by-doing for monocrystalline and polycrystalline cell production and performance, as well as new technologies and materials based on fundamental R&D efforts. Systems integration and sector coupling creates new technology challenges such as the need for greater system flexibility, while electricity storage will become important early for islands and other small isolated networks and could be important in the longer term for large integrated networks as well. This will be happening against a backdrop where localised electricity production by solar PV systems will likely be cheaper than electricity from centralised power stations further away, pushing today's utility model to its limit.

IRENA has undertaken analysis to provide a solid and compelling outlook for solar PV, and inform policy makers and the general audience of the transformative power provided by solar PV, as well as many of the many technology innovations needed. The scope of analysis is global, but is centered on two questions:

- What are the opportunities and challenges for solar PV in electricity systems with stagnating versus expanding electricity needs?
- What will the importance be of distributed versus centralised solar PV systems within these different constituencies?

Join the IRENA / EU PVSEC Parallel Event to hear about recent research and work by IRENA and others into the issues facing the continued accelerated installation of solar PV, with a focus on:

- The evolution of Solar PV in growing and stagnating electricity markets
- Recent and future trends in innovation for solar PV and the enabling technologies for high shares of variable renewables
- The right enabling policies to support solar PV, the transition to a sustainable energy sector, as well as the regulatory and market changes required

Programme Outline

08:30 - 08:45
Welcome and Introduction

- Dolf Gielen, Director of IRENA Innovation and Technology Centre, IRENA

08:45 - 09:30
Solar PV: A tale of two markets
Opportunities and challenges for solar PV in electricity systems with stagnating versus expanding electricity needs, the importance be of distributed versus centralised solar PV systems.

- **Solar PV market expert** (confirmed)
  Gaëtan Masson, Founder & Director, Becquerel Institute
- **Innovation and cost reduction potential of solar PV to 2025**
  Michael Taylor, Senior Analyst, IRENA (confirmed)

09:30 - 09:50 Coffee Break

09:50 - 10:45
Innovation has delivered: Solar PV competiveness has arrived
Solar PV is one of the most innovative renewable power generation technologies. Continuous investment in R&D, commercialisation of new materials and manufacturing processes has delivered real cost reductions. Hear about the state of today's technology and the potential for the future

- **Solar PV Japanese market expert**
  Keiji Kimura, Senior Analyst, Renewable Energy Institute Japan (confirmed)
- **Enabling grid and advanced storage technologies for solar PV**
  Sin Taek Yim, Senior Manager, Samsung SDI (confirmed)
- **Commercialization of Solar PV mini-grid and cost**
  Konstantinos Vergos, Senior Manager, DHYBRID (confirmed)
- **Emerging market overview, Brazil**
  Camila Ramos, Managing Director, Clean Energy Latin America (confirmed)

10:45 - 11:30
Facilitating policy and infrastructure:
Solar PV faces challenges in continuing its growth as renewables continue to challenge the incumbent's entrenched positions. Support policies need to recognise the changing nature of the challenge facing growth in variable renewables and adapt more rapidly, while at the same time taking a holistic approach to the electricity system and market frameworks? What needs to be done, by whom?

- **Renewable energy policy expert**
  Henning Wuester, Director of Knowledge, policy and finance, IRENA (invited)

11:30 - 12:00
Panel Discussion and Q & A time
How to prepare for the future?
How can the expectations and challenges facing solar PV in existing and new markets be addressed by policy makers, regulators and industry? Where does the responsibility lie to push forward a more integrated policy and market framework for the integration of variable renewables? Are there prerequisites for success (e.g. market reform) and the sequence of policy implementation? Are the lessons that have been learned from front-runners in PV deployment transferable to new markets? Join our panellists to discuss these topics.

Moderation by
Dolf Gielen, Director of IRENA Innovation and Technology Centre, IRENA

Panellists: All speakers

PV Production, Quality, and Innovation Forum

jointly produced by SOLARUNITED and the Becquerel Institute

Day: **Wednesday, 22 June 2016**
Time: **13:30 - 17:45**
Site: **Ground Floor, Auditorium Room 11**
Access: **Open to all registered Conference participants of the EU PVSEC 2016**

PV Production, Quality and Innovation Forum will be led by top-level managers, chief developing engineers of SOLARUNITED member companies and further industry experts from manufacturers and suppliers of PV production equipment and related raw materials. In three dedicated sessions the latest status and outlook on changing dynamics, processes, and production technology steps in the PV manufacturing supply chain will be presented.

Programme Outline

Market Session

13:30 - 13:40
Welcome and Introduction – Bryan Ekus, Director, SOLARUNITED

13:40 - 14:10
PV Trends & Market Overview by – Gaëtan Masson, Director, Becquerel Institute

Technology & Innovation

14:10 - 15:00
Panel Session – Technology development: will heterojunction revolutionize the industry?

A moderated panel session that will debate the possible market emergence of Multi-junction (MJ) technology, as to how likely, and when it will disrupt the convention c-Si marketplace? This panel of leading PV manufacturers will also discuss what the PV market looks like today; where they see the technology going tomorrow; the pitfalls and obstacles in future manufacturing; and how ML technologies will impact the conventional c-Si energy market.

Session Moderator – Nabih Cherradi, CEO, Desert Technologies and Co-Chair of the SOLARUNITED Quality Committee

Panelist

- Prof. Christophe Ballif, Vice President, CSEM PV-Center
- Jens Eckstein, Managing Director, SINGULUS TECHNOLOGIES
- Dr. Christian Buchner – CEO at Schmid Technology GmbH
- Dr. Jan M. Kroon, Senior Researcher Solar Energy, ECN Solar Energy
- Dr. Jochen Rentsch, Head of Department "Wet Chemical and Plasma Technologies / Cell Process Transfer" Division PV Production Technology and Quality Assurance , Fraunhofer Institute for Solar Energy Systems (ISE)
- Benjamin Strahm, R&D Manager Meyer Burger Research AG, Hauterive (NE)– Meyer Burger
- Wim C. Sinke – Manager Program Development, ECN Solar Energy & Vice Chair, PV Technology Platform

15:00 - 15:15 Coffee Break

Quality Session

15:15 - 16:00
Panel Session – The Quality Challenge: how to collect reliable and accurate standardized data from the field?

Two moderated panel sessions that will scrutinize the aspect of the Quality Challenge, which is how to collect reliable and accurate standardized data from the field? This panel of principal experts will share their insights as to the magnitude of module failures, and analyze methods of how to counteract future reliability glitches in the field, while ensuring a proper communication between the downstream and upstream parts of the PV value chain.

Session Introduction by: Laura Azpilicueta, Sr. VP – Global Sales & Business Development at EVASA and Chairwomen of the SOLARUNITED Quality Committee & Ulrike Jahn, TÜV Rheinland Energie und Umwelt GmbH

16:00 - 16:45
Quality Session Part A

Viewpoints from testing labs, material providers, and industry trade associations

Session Moderator – Laura Azpilicueta, Sr. VP – Global Sales & Business Development at EVASA and Chairwomen of the SOLARUNITED Quality Committee

Panelist

- Ioannis-Thomas Theologitis, Senior Advisor, Solar Power Europe
- Dr. Stefan Padlewski, Marketing Manager, DuPont Photovoltaic Solutions
- Ulrike Jahn, TÜV Rheinland Energie und Umwelt GmbH
- Roland Roesch, Senior Program Officer, IRENA – International Renewable Energy Agency
- Invited Speaker – Flex

16:45 - 17:30
Quality Session Part B

Viewpoints from banking, finance, O&M, and insurance underwriters

Session Moderator – Gaëtan Masson, Director, Becquerel Institute

Panelist

- Matthias Graf von Armansperg, Partner, Accelios Solar
- Thomas Schätz, Project Manager, AdlerSolar
- David Moser, Group leader. Institute for Renewable Energy
- Michael Schrempp, Head of Green Tech Solutions, Munich Re

17:30 - 17:45
Meeting summaries and open discussions with all participants

Moderated by: Jo-Anne Duff, Head of Event Content, Solar Media Limited

17:45
Meeting ends

More information available at www.solar-united.org

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PHOTOVOLTAICS | FORMS | LANDSCAPES

Beauty and power of designed Photovoltaics

jointly with the European Commission, DG JRC, ENEA and ETA-Florence Renewable Energies

Day: **Wednesday, 22 June 2016**
Time: **13:30 - 18:30**
Site: **Ground Floor, Auditorium Room 4**
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Photovoltaics | Forms | Landscapes is a series of annual events (1st edition Hamburg, 26th EUPVSEC; 2nd edition: Frankfurt, 27th EUPVSEC; 3rd edition Paris, 28th EUPVSEC, 4th edition Amsterdam 29th EUPVSEC, 5th edition Hamburg 31st EUPVSEC) serving as a discussion framework to investigate the new phenomena associated with the rapid spread of large photovoltaic systems. It promotes reflection on the implications for our way of living and on what new issues of design could arise. This is done on all scales: from modules, to buildings, to cities, to landscapes.

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PARALLEL EVENTS

7th International Workshop on CIGS Solar Cell Technology (IW-CIGSTech 7)

jointly organized by Helmholtz-Zentrum Berlin für Materialien und Energie GmbH (HZB) and Zentrum für Sonnenenergie- und Wasserstoff-Forschung Baden-Württemberg (ZSW)

Day: **Thursday, 23 June 2016**
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7th International Workshop on CIGS Solar Cell Technology (IW-CIGSTech 7)

jointly organized by Helmholtz-Zentrum Berlin für Materialien und Energie GmbH (HZB) and Zentrum für Sonnenenergie- und Wasserstoff-Forschung Baden-Württemberg (ZSW)

IW-CIGSTech 7 will be an international workshop focusing on CIGS solar cell technology, combining scientific and technological aspects with their industrial applications. The workshop will consist of invited talks, discussions and poster presentations. The organizers would be delighted to welcome you in Munich for a day of lively discussions of CIGS technology topics. Further details will be published soon.

THE LOW COST HIGH EFFICIENCY PHOTOVOLTAICS TECHNOLOGY

Photovoltaics (PV) today are dominated by crystalline silicon (c-Si) technology. Among alternative, thin-film technologies, CIGS is the most advanced and the most efficient. The PV modules with CIGS (Cu(In,Ga)(Se,S)2) absorbers are very effective in converting light directly into electricity. They are very well positioned in the field of PV technologies with present record efficiencies for small cells of 22.3 % and for production size modules of 16.5 %.

The recent progress at the cell level paves the way for progress at the mini module level (currently 18.7%, aiming at > 21%) and towards total area module efficiencies of 18%. The latter is expected to be realized in the near future through transfer and adaptation of laboratory technology. Low cost CIGS PV modules can provide electricity below € 0.05 / kWh (LCOE) and contribute to CO2 reduction in a significant manner.

Programme Outline

INTRODUCTION and OVERVIEW

8:30
Welcome
Prof. Dr. Rutger Schlatmann, HZB (DE)
Prof. Dr. Michael Powalla, ZSW (DE)

8:40
Role of CIGS in future PV - The CIGS white paper
Prof. Dr. Ayodhya N. Tiwari, EMPA (CH)

9:00
ETIP PV views on trends and challenges for CIGS technology
Prof. Dr. Marko Topič, University of Ljubljana (SVN)

9:20
Discussion

9:30 Coffee Break

PRODUCTION of CIGS MODULES

9:50
Recent research progress of high-efficiency CIGS solar cell in Solar Frontier
Dr. Takuya Kato, Solar Frontier (JPN)

10:10
Avancis: [Company contribution]
N.N., Avancis GmbH (DE)

10:30
Stion:[Company contribution]
Alex M. Schwarz, Stion Corp. (USA)

RESEARCH on CIGS MODULES

10:50
Recent Progress in R&D at Solibro Research
Dr. Olle Lundberg, Solibro Research AB (SE)

11:10
Atmospheric Pressure In-Line RTP for CIGS
Dr. Sebastian Schmidt, HZB (DE)

11:30
Discussion and Poster Presentations

12:10 Lunch Break / Poster Presentations

FLEXIBLE CIGS MODULES

13:30
Commercial flexible CIGS technology
Dr. Urs Schoop, Global Solar Energy (USA)

13:50
MiaSolé [Company contribution]
Atiye Bayman Ph.D., Miasolé Hi-Tech (USA)

CIGS EQUIPMENT SUPPLIERS

14:10
Manz CIGSfab: Current Status and Outlook
Dr. Kay Orgassa, Manz CIGS Technology GmbH (DE)

14:30
Equipment to enable GW-scale Production of Highly Efficient CIGS Modules
Dirk Beisenherz / Stefan Zorn, Singulus Technologies AG (DE)

14:50 **Discussion**

15:00 Coffee Break

FUTURE PERSPECTIVES & RESEARCH I

15:15
The prospect and current status of CIGS thin-film solar cells in China
Prof. Yun Sun, Institute of Photo- Electronic Thin Film Device and Technology, Nankai University (CHN)

15:45
Innovative Approaches for CIGS solar cells
Prof. Dr. Daniel Lincot, IRDEP/IVPF (F)

16:05
Overview of R&D on CIGS solar cells in Japan / The NEDO CIGS consortium
Dr. Shigeru Niki, AIST (JPN)

16:25
Roadmap CIGS towards 25% efficiency
Dr. Stefan Paetel, ZSW (DE)

16:45 Coffee Break

FUTURE PERSPECTIVES & RESEARCH II

17:00
Interface Characterization to aid in the Development of alternative Buffer Layers
Prof. Dr. Clemens Heske, KIT (DE)

17:20
CIGS-based Tandems
N.N., EMPA (CH)

17:40
Summary – Outlook – Good-bye
Workshop Committee

18:00 ff: Joint relocation to dinner event by public transport

GENERAL INFORMATION

For more information please refer to
www.photovoltaic-conference.com/general-information

GENERAL INFORMATION

VENUE OF EU PVSEC 2016

ICM – International Congress Center Munich, Germany
Messe München Locations
Messegelände/ Entrance west
81823 Munich
Germany

Telephone : +49 89 949-23023

http://www.icm-muenchen.de

For detailed Travel and Transport Information please visit
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INFORMATION

Find here a general overview of the EU PVSEC 2016 ticketing categories and registration benefits:

EU PVSEC 2016 Registration Benefits

Registration Category	Conference Sessions	Parallel Events	Intersolar Europe 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)						✓		

* on registered day/s only

ACCESS

EU PVSEC Conference

Upon arrival at ICM - International Congress Center Munich, 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	19 June 2016	16:00 – 18:00
Mon	20 June 2016	07:30 – 19:00
Tue – Thu	21 -23 June 2016	08:00 – 19:00
Fri	24 June 2016	08:00 – 12:00

Conference Badge

Your personalised Conference badge authorises you to visit:

- all EU PVSEC Conference sessions on day/s registered
- all EU PVSEC Parallel Events on day/s registered
- the Intersolar Europe Exhibition on all days

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.

Intersolar Europe Exhibition

The Exhibition is open to all Conference Delegates.

Opening hours are from:

Wed	22 June 2016	09:00 – 18:00
Thu	23 June 2016	09:00 – 18:00
Fri	24 June 2016	09:00 – 17:00

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 261.

CONFERENCE PROCEEDINGS

The EU PVSEC 2016 Proceedings contain all scientific papers presented at the EU PVSEC 2016 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 2016 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 2016 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 297)

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 2016 - on the website and in a digital special issue of the renowned scientific journal 'Progress in Photovoltaics'.

Progress in PHOTOVOLTAICS
Leading journal for PV research
www.interscience.wiley.com/journal/pip

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, 20 June 2016 during the Opening Ceremony in the Main Auditorium Room 1.

Congratulations to the Becquerel Prize Winner 2016:

Prof. Christophe Ballif
Director EPFL "Photovoltaics and Thin Film Electronics Laboratory" and "CSEM PV- Center", Neuchatel, Switzerland

He receives the award in honour of his scientific merits in the development of silicon heterojunction solar cells. The decision of the Becquerel Prize Committee is based in particular on the outstanding work of Prof. Ballif on silicon thin-film and silicon wafer solar cells and the transfer of PV-technologies to industry. His research on tandem solar cells with a focus on silicon/perovskite and silicon/III-V compounds is highly recognized.

Prof. Ballif is one of the pioneers in the development of high efficiency crystalline solar cells with heterojunctions and passivated contacts. His work spans the field from fundamentals to novel manufacturing processes, pilot tools and production lines.

Prof. Ballif has published very extensively, and is one of the most highly cited researchers in the field of solar cells. His unwavering enthusiasm has energized dozens of PhD students and postdoctoral fellows. His passionate promotion of solar energy technology as the main electricity source for the future of humankind has contributed enormously to its acceptance by society.

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, 24 June 2016. The winners will be invited on stage and the winning posters will be projected in the Auditorium.

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 2016.

41 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, 24 June 2016.

Take the chance to attend the presentation of their outstanding work in the following Oral sessions:

Monday, 20 June 2016

Mr. Francois Gibelli
CNRS, Chatou, France

1AO.1.5 Different Electron and Hole Thermodynamics from Hot Carrier Solar Cell Modeling

Mr. Antonio David Utrilla
UPM - Technical University of Madrid, Madrid, Spain

1AO.3.3 Thin GaAsSb Capping Layers for Improved Performance of InAs/GaAs Quantum Dot Solar Cell

Tuesday, 21 June 2016

Mr. Thomas Allen
ANU - The Australian National University, Canberra, Australia

2BP.1.3 Calcium Contacts to n-Type Crystalline Silicon Solar Cells

Above programme may be subject to adaptation.

Wednesday, 22 June 2016

Mr. Gilbert El Hajje
CNRS Centre National de la Recherche Scientifique, Chatou, France

3CO.5.2 Quantitative Mapping of Interface Defects in Cu(In,Ga)Se2 Solar Cells Using Photoluminescence-Based Methods

Mr. Jens Czolk
KIT Karlsruher Institut für Technologie, Karlsruhe, Germany

3CO.8.5 Highly Efficient, All-Solution Processed, Mechanically Flexible, Semi-Transparent Organic Solar Modules

Mr. Blaž Kirn
University of Ljubljana UL-FE, Ljubljana, Slovenia

5CO.16.1 Combining Solar Irradiance Databases and PV Performance Model for PV System Performance Analysis

Thursday, 23 June 2016

Mr. Mohsen Goodarzi
ANU - The Australian National University, Canberra, Australia

2DO.4.1 Modelling and Characterization of Multicrystalline Silicon Blocks by Quasi-Steady-State Photoconductance

Mr. Dominic C. Walter
ISFH Institut für Solarenergieforschung GmbH, Emmerthal, Germany

2DO.1.1 Ultrafast Lifetime Regeneration in an Industrial Belt-Line Furnace Applying Intense Illumination at Elevated Temperature

INFORMATION

NETWORKING

Coffee Breaks (for Conference Delegates)

Coffee Breaks are included in the Conference fee. They will be served in hall B0.

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 a dedicated networking area in exclusive ambiance, directly in the ICM Munich. For those who did not include Networking Lunch tickets in their registration, there is a wide range of cafés and restaurants around ICM and numerous snack bars in the exhibition halls.

Welcome Reception

On Monday, 20 June, there will be a Welcome Reception for all Conference participants, from 18:30 in hall B0. Come and meet your colleagues of the PV community and celebrate the EU PVSEC 2016 as a major networking platform for the global PV Solar sector.

EU PVSEC Dinner

The EU PVSEC 2016 Conference Dinner takes place on Wednesday evening, 22 June 2016 in the Restaurant Hirschau which is located in the idyllic landscape of Munich's green lung, the "English Garden". Hirschau is renowned for its upscale traditional cuisine with Bavarian specialities.

You will be welcomed with an aperitif on the big (covered) terrace in this early summer full moon night. Afterwards, a 3-courses-menu will be served in relaxed atmosphere (vegetarian, gluten- or lactosefree menu is possible).

The EU PVSEC Dinner will be a most captivating social event of the EU PVSEC week:

- Meet professionals from the PV world
- Enjoy excellent Cuisine
- Relax and network in pleasant ambiance

Wednesday 22 June from 19:30 - 22:30 at Restaurant Hirschau

Free Bus Shuttle starting at around 18:45 - 19:00 at the ICM and going back at 22:30.

Delegates, Intersolar Europe Exhibitors and Visitors interested are welcome to take part in the EU PVSEC Dinner.

Networking Lunch

A networking lunch will be available for interested delegates from Monday to Thursday, 20 – 23 June in a dedicated networking area in exclusive ambiance, directly in the ICM Munich.

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 can be bought via the Conference registration area and may become subject to availability and need to be paid in advance. Tickets will not be sold on-site. Access to the networking lunch 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.

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 2016. 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.

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 2 right next to the 'delivery of manuscript' desks.

The official Press Conference is scheduled to take place on Monday, 20 June at 12:30.

INSTRUCTIONS FOR AUTHORS AND PRESENTERS

Plenary / Oral Presentations

Speakers of Plenary and Oral presentations **hand in their presentation/s at the Presenters' Desk (room 2, ground floor)**. 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 2, ground floor)

Sun	19 June 2016	16:00 – 18:00
Mon	20 June 2016	07:30 – 19:00
Tue – Thu	21 – 23 June	08:00 – 19:00
Fri	24 June 2016	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, 20 June** and **to take them down on Thursday, 23 June, 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 to 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 2016 Proceedings**, authors need to **deliver their manuscript at the Delivery of Manuscripts Desk (room 2, ground floor)**. 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.

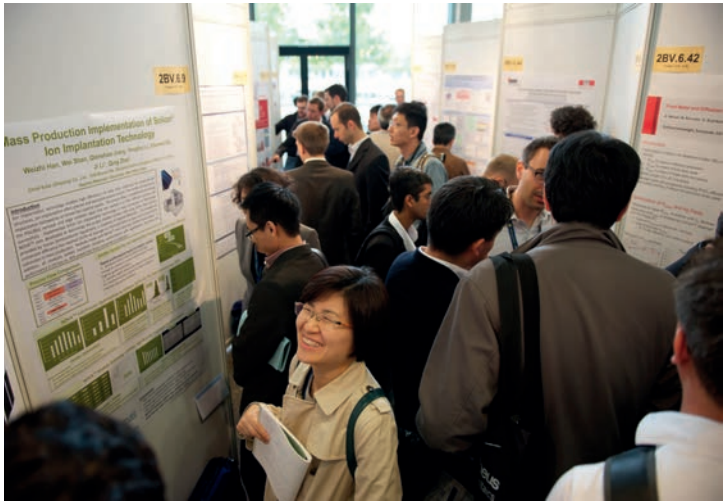
Opening hours of the Delivery of Manuscripts Desk (room 2):

Sun	19 June 2016	14:00 – 18:30
Mon	20 June 2016	07:30 – 19:00
Tue - Thu	21 – 23 June 2016	08:00 – 19:00

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.



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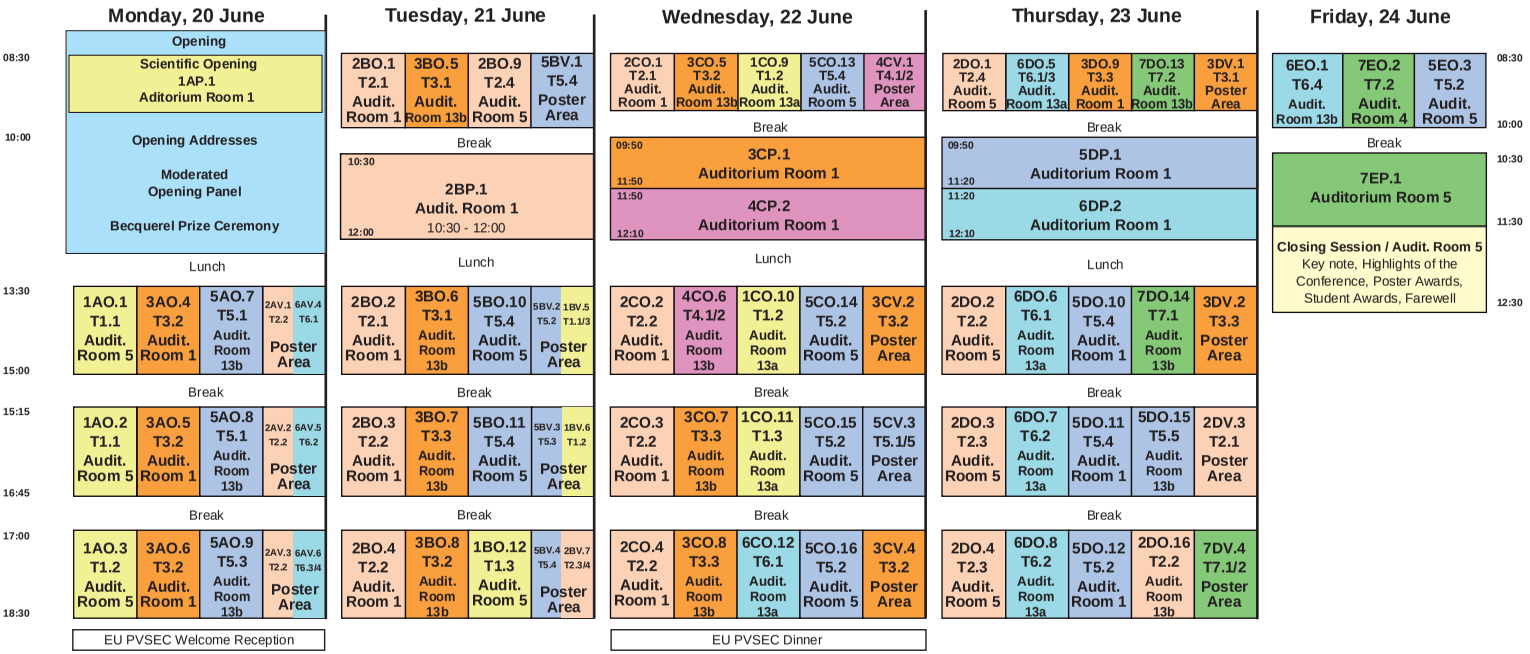
Conference Programme Outline



Topics / Subtopics

1 New Materials and Concepts for Solar Cells and Modules
- T1.1 Fundamental Studies
- T1.2 New Materials and Concepts for Cells
- T1.3 New Materials and Concepts for Modules

2 Wafer-Based Silicon Solar Cell and Materials Technology
- T2.1 Silicon Feedstock, Crystallisation and Wafering
- T2.2 Silicon Solar Cell Improvements and Innovation
- T2.3 Silicon Solar Cell Characterisation and Modelling
- T2.4 Manufacturing and Processing

3 Thin Film Solar Cells and Modules
- T3.1 Silicon-based Thin Film Solar Cells and Modules
- T3.2 CdTe, CIS and Related Thin Film Solar Cells and Modules
- T3.3 Perovskite, Organic and Hybrid devices

4 Concentrator and Space Applications
- T4.1 III-V-based Devices for Terrestrial and Space Applications
- T4.2 Concentrator and Space Systems

5 Operation, Performance, Reliability and Sustainability of PV
- T5.1 Solar Resource and Forecasting
- T5.2 Operation of PV Systems
- T5.3 Balance of System Components
- T5.4 PV Cells and Modules
- T5.5 Sustainability and Recycling

6 PV Applications and Integration
- T6.1 Grid and Energy System Integration
- T6.2 PV in Buildings and the Environment
- T6.3 Utility-Scale PV
- T6.4 PV Applications Without a Centralised Grid

7 PV Economics, Markets and Policies
- T7.1 PV Economics and Markets
- T7.2 PV Global Issues, Policies and Strategies

Session Code

1 A P .1

Day Codes
- A Monday, 20 June 2016
- B Tuesday, 21 June 2016
- C Wednesday, 22 June 2016
- D Thursday, 23 June 2016
- E Friday, 24 June 2016

Session Type
- P Plenary Session
- O Oral Session
- V Visual Session

Session Number

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