9. International Conference on
Concentrator Photovoltaic Systems

Program

April 15-17, 2013
Miyazaki, Japan

www.cpv-9.org
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Meals Venue

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<td>April 14</td>
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Chairperson’s Message

Welcome to CPV-9, the 9th Conference on Concentrator Photovoltaics on April 15-17, 2013 in Miyazaki, Japan! We look forward to sharing not only information, science, technology and data, but also a wonderful time in the beautiful city of Miyazaki.

The global CPV environment is rapidly changing, like direct irradiance and its spectrum. Some may see uncertainty where others see great potential. However, there is one thing that is reliable in the CPV world.

This is CPV-9 international conference.

You will see many CPV friends with most recent information about technology advancement and business opportunities. You will see varieties of people with strong interests in CPV. You will have a great chance of expanding business, solving specific technological problems and exploiting new horizons of CPV-related science.

Today, we sometimes complain there are too many conferences, and, to be sure, some do not offer us much of great interest. But CPV-9 is different. CPV-9 is the great exception. You will find most of the major CPV players and scientists. You will be attracted by the high-quality, friendly atmosphere and deep discussions. I dare say you will be a repeater – next CPV-10 conference.

This time, we have a conference in Miyazaki, Japan. We return once more to the Asia-Pacific region, ten years after the Alice Springs conference in Australia. The conference will be held in a resort area along the beach and surrounded by forests and golf courses. Actually, it was the venue for the G8 Summit Meeting in 2000.

I think the atmosphere is like the Palm Springs conference. In this slightly isolated paradise, you will have concentrated discussions like at the Alice Springs conference, where we were packed into a hotel surrounded by desert. We will keep the tradition and base program structure established at the El Escorial conference. Miyazaki is also known as the town of gourmet cuisine. You will see varieties of dishes and drinks downtown – just ten minutes away. Enjoy good foods and drinks with your CPV friends like at the Toledo, Las Vegas and Freiburg conferences. April is too early there for the swimming that we enjoyed at the Scottsdale conference, but we will have the Onsen Hot Springs beside the venue.

In case you regret missing some of the past CPV-x conferences, do not worry. Miyazaki has everything, and will more than make up for it!

I am looking forward to a wonderful time at the CPV-8. I am confident that the CPV-9 conference will be a great opportunity for each of you to meet interesting colleagues and learn the latest technical trends. Glad to see you here in Miyazaki!

Kenji Araki
Daido, Japan
April 2013

Committees

Chair and Co-Chair
Chair: K. Araki, Daido, Japan
Co-chairs:
A. Bett, Fraunhofer ISE, Germany
N. Hartsch, CPV Consortium, USA
G. S. Kinsey, Fraunhofer CSE, USA
S. Kurtz, NREL, USA
F. Rubio, Soitec, Germany

Scientific Committee
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K. Araki, Daido, Japan
A. Bett, Fraunhofer ISE, Germany
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S. Fafard, CYRIUM, Canada
M. Finot, Skyline Solar, USA
G. Kinsey Fraunhofer CSE USA
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F. Rubio, Soitec, Germany
G. Sala, IES-UPM, Spain
P. Verlinden TRINA China
B. McConnell, AMONIX, USA

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P. Benilez, UPM, Spain
F. Dimroth, Fraunhofer ISE, Germany
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V. Everett, ANU, Australia
A. Gombert, SOITEC, Germany
W. Guter, AZUR SPACE, Germany
I. Luque-Heredia, BSQ, Spain
K. Nishioka, U. MIYAZAKI, Japan
Y. Okada, Univ. Tokyo, Japan
G. Siefer, Fraunhofer ISE, Germany

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V. Andreev, IOFFE, Russia
P. Banda, ABENGOA, Spain
A. Dollet, PROMES, France
V. Diaz, ISOFOTON, Spain
D. Faiman, University Ben Gurion, Israel
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L. Ji, UL, USA
R. R. King, SPECTROLAB, USA
R. Leutz, CONCENTRATOR OPTICS, Germany
B. MacDonald, SKYLINE, USA
Y. Okada, Univ. Tokyo, Japan
G. Strobl, AZUR SPACE, Germany
M. Symko-Davies, NREL, USA
M. Yamaguchi, Toyota Techn. Inst., Japan
Sunday, April 14, 2013
7:00 pm – 10:00 pm Pre-Registration (4F Foyer)
and Welcome Reception (4F Rangyoku)

Monday, April 15, 2013
Starting 7:00 am Conference Registration (4F Tenzui)

8:30 am – 10:15 am Oral Session 1: Opening Session (4F Tenzui)
(Chairs: K. Araki, G. Kinsey)

8:30 am Introduction of the conference
K. Araki (Daido)

8:35 am History of CPV-x
R. McConnell (Amonix)

8:45 am Welcome Address
S. Kouno (Governor of Miyazaki Prefecture)

8:50 am Information of the conference
K. Nishioka (University of Miyazaki)

9:00 am 44%-Efficiency Triple-junction Solar Cells
V. Sabnis, M. Wiemer, H. Yuen (Solar Junction)

9:15 am Triple-Junction Quantum-Well Solar Cells in Commercial Production
B. Browne (JDSU)

9:30 am More than Four Years of CPV Power Plant Performance Data: The Proof of CPV Reliability in the Field
T. Gerstmaier, A. Gombert, M. Röttger, S. Wichert (Soitec)

9:45 am Performance Profiles of the World’s Largest CPV Power Plant
V. Garboushian, W. Bagienski, R. Gordon, M. Liu, A. Plesniak (Amonix)

10:00 am Design, Manufacture, and Operating Results of World’s Largest LCPV Systems
D. Shugar, K. Gibson (Solaria)

10:15 am Coffee Break (4F Foyer)

11:00 am – 1:00 pm Oral Session 2: Characterization of Cells, Modules and System Components (4F Tenzui)
(S. Kurtz, Y. Hishikawa)

11:00 am Invited Talk:
Novel Concentrating Hybrid System to Produce Both Solar Photovoltaic Electricity and Thermal Energy and Its Applications
T. Tomita, H. McClure (The University of Tokyo)

11:30 am Tuning the Current Matching Ration of a CPV System to Maximize the Energy Harvesting in a Particular Location
M. Victoria, I. Antón, S. Askins, C. Dominguez, R. Herrero, R. Nuñez, G. Sala (UPM-IES)

11:45 am Procedural Consideration for CPV Outdoor Power Ratings Per IEC 62670
M. Muller, S. Kurtz (NREL)

12:00 am Method for Direct Measurements of Luminescent Coupling Efficiency in Concentrator MJ SC
M. Shvarts, V. Emelyanov, N. Timoshina (Ioffe Physical-Technical Institute)

12:15 pm Photovoltaic Characteristics of GaInNAsSb Solar Cells under Concentrated Light Source
N. Miyashita, Y. Okada, K. Watanabe (The University of Tokyo)

12:30 pm Investigations on 3-dimensional Temperature Distribution in a FLATCON-type CPV Module
M. Wiesenfarth, A. Bett, H. Kraus (Fraunhofer ISE)

12:45 pm Evaluating Misalignments and Angular Transmission Function by the Luminescence Inverse Method
R. Herrero, I. Antón, K. Araki, S. Askins, C. Dominguez, H. Nagai, G. Sala (UPM-IES)
1:00 pm – 2:00 pm  Lunch Break (4F Rangyoku)

2:00 pm – 4:00 pm  Poster Session 1 (4F Juyo)

P1  Optical DLTS for the Study of Recombination Centers in GaAsN Grown by Chemical Beam Epitaxy

P3  Analysis for the Current-Voltage Characteristics of the InGaAs/GaAsP Super-Lattice Solar Cell under Optical Concentration
K. Watanabe, Y. Nakano, H. Sodabanlu, M. Sugiyama, Y. Wang (The University of Tokyo)

P5  Ga$_2$Se$_3$ and (InGa)$_2$Se$_3$ as Novel Buffer Layers in the GaAs on Si System
N. Kojima, C. Morales, Y. Ohshita, M. Yamaguchi (Toyota Technological Institute)

P7  N-H Peak Shift in GaAsN by Band Gap Excitation
K. Ikeda, M. Inagaki, N. Kojima, Y. Ohshita, M. Yamaguchi, A. Yamakata (Toyota Technological Institute)

P9  Study of the Microstructure of Nitrogen-Related Localized State in GaAsN
G. Morikoa (The University of Tokyo)

P11  Chemical Beam Epitaxy Growth Tuning of Vertically Stacked InAs/GaAs Quantum Dots for Intermediate Band Solar Cell
J. Zribi, R. Arès, A. Boucherif, B. Ilahi, D. Morris, B. Paquette (Université de Sherbrooke)

P13  Novel Low Current, Low Heat Flux Multijunction Solar Cell Design to Maximize Concentration and Reduce Costs
B. Paquette, V. Aimez, R. Arès, A. Boucherif (Université de Sherbrooke)

M. Fuhrer, N. Ekina-Daukes, D. Farrell (Imperial College London)

P17  Reducing the Cost of CPV
H. Helava, A.A. Antipov, S.Y. Kurin, Y.N. Makarov, B.A. Papchenko (Nitride Crystals)

P19  Flash Xenon CPV Simulator with Low-Cost Elastic Bent Trough Mirrors
N. Yamada (Nagaoka University of Technology)

P21  Modelling of Multijunction Cell Temperature Distributions Subject to Realistic Operating Conditions
A.M. Sharpe, I. Cole (Loughborough University)

P23  Outdoors Measurement of Every Subcell Photocurrents in a Multijunction Cell
E. Munoz Ceron, G. Almon acid Puche, P. Benitez, J.C. Minano Dominguez (University of Jaen)

P25  Power Generation of Series and Series/Parallel Triple Tandem Solar Cells Derived from Measured Spectra in Japan
S. Naito, Y. Okada (The University of Tokyo)

P27  Simulation Method for Concentrator Photovoltaic Module under Outdoor Operation using Spice Diode Model
N. Sawano, K. Araki, H. Nagai, K. Nishioka, Y. Ota (University of Miyazaki)

P29  Approach to Precise Indoor Characterization of Multi-Junction CPV Cells Using Reference Component Cells
D. Nishi, Y. Hishikawa, T. Ueda (AIST)

P31  LED Illumination: A New Way to Characterize Cells and Modules at Low and Medium Concentration
P. Voirino (CEA INES)

P33  ABENGOA Solar Photovoltaic Laboratory: Testing and Characterization of HCPV Modules and Cells
K. Kiriluk (Abengoa Solar)

P35  Uncertainty Estimation of Indoor PV Cell Measurements under High Concentration
M. Norton, R. Kenny, M. Pravettoni (European Commission)

P37  Influence of Metal Grid Patterns on the Performance of III-V Concentration Solar Cell
H. Hong (INER)

P39  Development of the High Thermal Management and Highly Reliable CPV Receiver with the Numerical Simulations
Y.H. Kim, J. Kang, Y. Kim (Korea Photonics Technology Institute)

P41  The Effect of Low Shunt Resistances to the Spectral Response Measurements of Concentrating Photovoltaic Cells Without Bias Light
M. Pravettoni, G. Georghiou, M. Hadjipanayi, V. Paraskeva (University of Applied Sciences and Arts of Southern Switzerland)
P43 Indoor Characterization of Reflective Concentrator Optics
T. Schmid, M. Frick, T. Hornung, P. Nitz (Fraunhofer ISE)

P45 Experimental Confirmation of FK Concentrator Insensitivity to Chromatic Aberrations

P47 Investigation of the Temperature Dependence of the Optical Properties of Thermal Transfer Fluids for Hybrid CPV-T Systems
Y. Wu, A. Blakers, V. Everett, E. Thomsen (Australian National University)

P49 Polishing Acrylic Lens Materials after Sand Impact
T. Arndt, P. Battenhausen, P. Killian, R. Saettler (Evonik Industries)

P51 Effects of Silicone Curing on SOG Lens Optical Properties
Y. Tanguy, H.P. Annen, R. Leutz, N. Malik (Concentrator Optics)

P53 Performance of UV-enhanced PMMA Fresnel Lenses and Impact on LCOE

P55 Optical and Thermal Performance Evaluation of a Window System including Point Focus Fresnel Lens PV Concentrators
P. Eames (CREST)

P57 Production of Large, Curved Glass Mirrors for CPV and CSP
R. Angel (University of Arizona)

P59 Tunnel Junctions for Ultra-High Concentrator Solar Cells
E. Barrigon (Solar Energy Institute)

A. Haga (University of Miyazaki)

P63 Double-Mayer Step Formation on Si(100) in CVD Ambient for Growing III-V Solar Cells on Silicon
S. Brueckner, A. Dobrich, H. Doescher, T. Hannappel, P. Kleinschmidt, O. Supplie (Technische Universität Ilmenau)

P65 CdTe Solar Cell Performance under High-intensity Light Irradiance
D. Wang (University of Science and Technology of China)

P67 Real-time Observation of Crystallographic Tilting in InGaAs Layers on GaAs Offcut Substrates
T. Nishi, T. Sasaki (Toyota Technological Institute)

P69 Real-time Observation of GaAs Growth on Si(001) and Si(111) by Three-dimensional Reciprocal Space Mapping during Molecular Beam Epitaxial Growth
H. Suzuki, K. Ikeda, Y. Nakata, Y. Ohshita, M. Takahasi (University of Miyazaki)

P71 Reduction of Rotation Twin in GaAs/Si (111) by Irradiation of In to Si Surface
D. Ito (University of Miyazaki)

P73 Estimation of Miniband in InGaAs/GaAsP Strain-Balanced Superlattice Solar Cell by using Piezoelectric Photothermal Technique
Y. Yokoyama (University of Miyazaki)

P75 Self-consistent Fitting of Electrical Parameters for InGaAs/Ge Dual Junction Solar Cells from Bias-dependent Spectral Response
A. Ogura (The University of Tokyo)

P77 Si-Rich Silicon Nitride Films for ARC Coatings of III-V Multi-Junctions Solar Cells
A. Jaouad, V. Aimez, R. Arés, P. Charette, R. Homier, P. Zermatten (Université de Sherbrooke)

P79 First Demonstration of InAs/GaAs Quantum Dot CPV Module
T. Sogabe (The University of Tokyo)

P81 CPV Infant Mortality and Indoor Characterization for High Efficiency, Reliable Solar Cells
R. Campesato, G. Gori (CESI)

P83 Thermal Transfer Simulation for Concentrator Photovoltaic Receiver under Concentration Condition
Y. Ota, K. Araki, H. Nagai, K. Nishioka (University of Miyazaki)

P85 Determining Passive Cooling Limits in CPV using an Analytical Thermal Model
O. Arenas, V. Aimez, R. Arés, A. Dollet, F. Gualdi, A. Vossier (Université de Sherbrooke)

4:00 pm – 4:30 pm  Coffee Break (4F Foyer)
4:30 pm – 6:30 pm Oral Session 3: Market Development, Manufacturing Aspects and Reliability of CPV Systems and Components (4F Tenzui)
(P. Banda, S. Burroughs)

4:30 pm
System Cost and Learning Curve Analysis of CPV
J. Haysom, H. Anis, K. Hinzer, O. Jafarieh (University of Ottawa)

4:45 pm
China’s CPV Development & Trends during the 12th Five-Year-Plan (2011-2015)
F. Haugwitz (Asia Europe Clean Energy (Solar) Advisory)

5:00 pm
The Importance of Manufacturing Processes and Their Control for the Reliability of CPV Modules
A. Gombert (Soitec)

5:15 pm
Evaluation of the Reliability of Commercial Concentrator Triple-Junction Solar Cells by Means of Accelerated Life Test (ALT)
P. Espinet (UPM-IES)

5:30 pm
Modeling the Thermal Run-Away Effect in CPV-Modules
M. Steiner, A. Bett, G. Siefer (Fraunhofer ISE)

5:45 pm
When will new IEC CPV Standards and Specifications be Available?
R. McConnell (Amonix)

6:00 pm
High Intensity Light-Cycling of HCPV Cell Assemblies using the XT-30 Solar Simulator
R. Beal, F. Asselin-Guay, E. Graf, J. Haysom, K. Hinzer, J. Wheeldon (University of Ottawa)

6:15 pm
Accelerated Laboratory Weathering of Acrylic Lens Materials
T. Amidt, M. Pasierb, S. Richter (Evonik Industries)

6:30 pm – 7:30 pm Break

7:30 pm – 9:30 pm Industry Session (4F Rangyoku)
(A. Bett, F. Rubio)

Introduction of CPV Consortium, N. Hartsoch (CPV Consortium)
Presentations from CPV-9 Sponsors
CPV Market in China, Bruce Wang (Suntrix)
Tuesday, April 16, 2013

8:30 am – 10:15 am Oral Session 4: Advanced Cells and their Materials that can be applied to CPV Cells (4F Tenzui)  
(S. Fafard, TBD)

8:30 am  Characteristics of GaAsN Solar Cell Fabricated by Chemical Beam Epitaxy  

8:45 am  Experimental and Modeling Analysis of Internal Luminescence in III-V Solar Cells  
M. Steiner, D. Friedman, I. Garcia, J. Geisz, S. Kurtz (NREL)

9:00 am  The Inverted Growth and Characterizations of InGaP Top Cells with Different Window Layers  
J. Bi, W. Cai, J. Ding, G. Lin, Z. Lin, J. Liu, M. Song, Z. Wu, W. Xiong (Xiamen Sanan Optoelectronics)

9:15 am  Chemical Beam Epitaxy Growth of AlGaAs/GaAs Tunnel Junctions Using Trimethyl Aluminium for Multijunction Solar Cells  

9:30 am  Dual-Junction Solar Cells with Multiple-Quantum-Well Top Cell  
K. Lee, K. Barnham, N.J. Ekins-Daukes, M. Führer, J. Roberts (Imperial College London)

9:45 am  Single Bandgap Solar Converters Unbound by the Shockley Queisser Limit  
G. Seggev, A. Kribus, Y. Rosenwaks (Tel Aviv University)

10:00 am  Analysis of Defects in GaAsN Grown by Chemical Beam Epitaxy on High Index GaAs Substrates  
B. Bouzazi, N. Kijima, Y. Ohsita, M. Yamaguchi (Toyota Technological Institute)

10:15 am – 11:00 am Coffee Break (4F Foyer)

11:00 am – 1:00 pm Oral Session 5: Concentrator Solar Cells, Cell Assemblies and Related Materials (4F Tenzui)  
(A. Bett, TBD)

11:00 am  Development of InGaP/GaAs/InGaAs Inverted Triple Junction Concentrator Solar Cells  
K. Sasaki, T. Takamoto (Sharp)

11:15 am  About 42%-class CPV Cells and Pathways Beyond  
M. Meusel (Azur Space Solar Power)

11:30 am  Optimization of III-V Multi-Junction Solar Cell Design for Optimum CPV Module-Level Performance  
D. Bhusari, H. Cotal, R. Jones, R. King, A. Ly (Boeing-Spectrolab)

11:45 am  In Situ Control of the Ge(100) Surface Domain Structure for III-V Multi-Junction Solar Cells  
S. Brueckner, E. Barigón, A. Dobrich, H. Doeschter, T. Hannappel, P. Kleinschmidt, C. Loebel, J. Luczkak, I. Rey-Stolle, O. Supple (Technische Universität Ilmenau)

12:00 pm  Performance of Monolithic Integrated Series-connected GaAs Solar Cells under Concentrated Light  
M. Seno, Y. Nakano, M. Sugiyama, K. Watanabe (The University of Tokyo)

12:15 pm  Overview of Europe-Japan Collaborative Research on Concentrator Photovoltaics  
M. Yamaguchi, A. Luque (Toyota Technological Institute)

12:30 pm  Design and Characterization of a Standardized Fully Encapsulated CPV Receiver  
V. Khorenko, G. Strobl, I. Zrinscak (Azur Space Solar Power)

12:45 pm  Introduction of 150mm Wafer Platform for Multijunction Cell Manufacturing at Spectrolab  
B. Stone, R. Jones (Boeing-Spectrolab)

1:00 pm – 2:00 pm Lunch Break (4F Rangyoku)
### 2:00 pm – 4:00 pm Poster Session 2 (4F Juyo)

**P2**
The Potential of Cost Reduction of CPV Systems  
E. Rodriguez (Soltune CPV)

**P4**
CPV Research and Development (R&D) Projects in Brazil  
H. Marina (Abengoa Brasil)

**P6**
Sunbeams from Mirrors in Dawn-Dusk Orbit for Earth Solar Power Fields  
L. Fraas (JX Crystals)

**P56**
Lightweight Hybrid Battery Backpack with LCPV Solar Charger  
L. Fraas, P. Uppal (JX Crystals)

**P8**
Design and Characterization of a Linear Fresnel Lens Concentrating Photovoltaic and Thermal System  
D. Jaffre, G. Baud, F. Guadàl, D. Martin, A. Perona (CNRS - PROMES laboratory)

**P10**
Small-Scale Concentrating Solar Prototype for Heat & Power Distributed Cogeneration  
M. Cozzini (Fondazione Bruno Kessler)

**P12**
Rooftop Micro-Concentrator Domestic use Demonstrator  
R. Middleton (Centre for sustainable energy systems)

**P14**
A Simplified Finite Element Model for Uncoupled Thermal Analysis in PV and CPV Heat Sink Design to Reduce Lead Time  
A.J. Orpez, F. Cruz Peragon, A. García (Teknia Energy)

**P16**
A Grid-connected HCPV Pilot Plant based on the InPhoCUS Technology  
T. Cooper, G. Ambrosetti, M. Barbato, A. Pedretti, M. Pravettoni, A. Steinfield (ETH Zurich)

**P18**
CPV vs. PV: A Side-by-Side Comparison  
W. Bagienski (Amonix)

**P22**
Adaptive Modeling Techniques for Prediction of Utility-scale Power Plant Energy Production with Amonix Solar Power Generators  
A. Plesniak, W. Bagienski, V. Garboussian, R. Gordon, M. Liu (Amonix)

**P24**
Shading Losses Calculation for CPV Power Plants  
O. de la Rubia, C. Alamillo (ISFOC)

**P26**
On-Line Diagnosis for HCPV System  
I. Lung, H. Lin, C. Ma (INER)

**P28**
Loss of Load Probability for Concentrator Photovoltaic Systems in Off-Grid Applications – A Case Study for High Solar Potential Indian Locations  
N.L.A. Chan, N. Ekins-Daukes (Imperial College London)

**P30**
Short-Term Cloud Forecasting Based on Total Sky Images and Geostationary Satellite Data  
A. Los, M. Mazalevskis, T. Zinner (EKO Instruments Europe BV)

**P32**
CPV Power Generation Estimation Based on Weather Forecast Information  

**P34**
Pros and Cons of Employing Monthly-Average Hourly Utility Data for Grid-Matching CPV Systems  
D. Faiman, G. Meron, E. Strobach (Ben-Gurion University of the Negev)

**P36**
Ultra-High CPV System Development in Saudi Arabia  
H. Khonkar (KACST)

**P38**
VENTANATM Power Train Features and Performance  

**P40**
Performance and Advantages of Active Cooling for CPV Systems  
T. Stalcup, R. Angel, B. Coughenour, J. Elliott, B. Wheelwright (Rehnu)

**P42**
Concentrator Based on Fresnel Lens with Spherical Sections  
A. Moseshvili (ConSunEnergy Group)

**P44**
Design and Optical Performance Analysis of a Reflective Type High Concentrating Photovoltaic System  
N. Sarmah, T.K. Mallick, L. Micheli, K.S. Reddy, K. Shank (Heriot-Watt University)

**P46**
ECOSOLE: Low Cost, High Efficiency, Large Scale Production Capabilities of HCPV Systems  
D. De Nardis, G. Borelli, M. Carpanelli (Becar)

**P48**
ISOFOTON Solution for the HCPV Market  
J. Lopez (ISOFOTÓN)

**P50**
Low Concentration Solar Louvers for Building Integration  
D. Vincenzi, F. Aldegheri, S. Baricordi, P. Bernardoni, G. Calabrese, V. Guidi, L. Pozzetti (Ferrara University)
P52 Low Concentrator Argentum Free Crystalline Silicon Solar Cells based on ARC of TCO and Current Collecting Grid of Copper Wire
G. Untila, A. Chebotareva, T. Kost, M. Shvarts (Lomonosov Moscow State University Skobeltsyn Institute of Nuclear Physics)

P54 Compound Semiconductor Solar Cells on Si Substrate for Medium Concentrator Photovoltaic Applications
S. Oh (Korea Advanced Nano Fab Center)

P58 Improved ATIR Concentrator Photovoltaic Module
P. Adriani, E. Mao (Banyan Energy)

P60 Study of a Solar Concentrator for Space based on a Diffractive/Refractive Optical Combination
C. Michel, S. Habraken, F. Languy, J. Loicq, A. Mazzoli (Centre Spatial de Liège – Ulg)

L. Mabille (CEA INES)

P64 Beyond the IEC Standards: The Importance of Reliability as a Step Forward in Testing
J.R. Gonzales (ISOFOTÓN)

P66 Accelerated Degradation Test Analysis of Solar Receiver
Z. Shih (INER)

P68 Analysis of a Thermal Stress on CPV Receiver with the Numerical Simulations
Y. Kim, J. Kang, Y.H. Kim (Korea Photonics Technology Institute)

P70 Comparison Analysis of Self-Shading Loss in Pedestal and Carousel Tracker System
N. Yamada (Nagaoka University of Technology)

P72 High Accuracy Sun-Tracking Using CCD and Field Test for PV System
J. Wu (National Central University, Taiwan)

P74 Development of a new Integrated Instrument for Sun Tracking Accuracy Assessment and DNI Measurement
D. Vincenzi, F. Aldegheri, S. Baricordi, G. Calabrese, V. Guidi, L. Pozzetti (Ferrara University)

P76 Sun Tracking Control Algorithm for Improved Reliability and Performance
M. Engin (Ege Universitests)

P78 Analysis of Structural Deformation and Concentrator Misalignment in a Roll-Tilt Solar Tracker
C. Lin, J. Fang (National Central University, Taiwan)

P80 High Resolution Shading Modeling and Performance Simulations of Suntracking Photovoltaic Systems
H. Capdevila, M. Herreras, A. Marola (HCapdevila Independent Advisory Services)

P82 The Development of Image-based Solar Tracking System
H. Yeh (INER)

P84 New Applications and Control Strategies for Large-Scale CPV Plants
P. Benoit, S. Fey, D. George, A. Gombert, G. Rohbogner, J. Wüllner (Fraunhofer ISE)

P86 Solar Energy Research and Development (R&D) Projects in Brazil: ABENGOA BRASIL High Concentrating Photovoltaic (HCPV) Pilot Plant
A. Mattos, M. Helal, J.A. de Castro (Abengoa Brasil)

P88 Analysis of Amonix 7000-series CPV Systems in Alamosa Plant
M. Liu, W. Bagienski, V. Garboushian, R. Gordon, A. Plesniak (Amonix)

4:00 pm – 4:30 pm Coffee Break (4F Foyer)

4:30 pm – 6:30 pm Oral Session 6: Development of HCPV Module Technology (4F Tenzui)
(K. Nishioka, N. Hartsoch)

4:30 pm CPV Module with Heat Dissipation Performance
K. Saitou (Sumitomo Electric Industries)

4:45 pm Field Experiment of 800x Off-Axis XR-Köhler Concentrator Module on Carousel Tracker
N. Yamada (Nagaoka University of Technology)

5:00 pm Progress in Developing HCPV Modules of SMALFOC-Design
V. Rumyantsev, V. Andreev, A. Chekalin, N. Davidyuk, O. Im, E. Khazova, N. Sadchikov (Ioffe Physical-Technical Institute)
5:15 pm  Efficiency of Dense-Array CPVT Module with Front-Side Interconnected Cells
A. Kribus, A. Bett, H. Helmers, G. Polonsky, M. Wiesenfarth (Tel Aviv University)

5:30 pm  Opsun Technologies Demonstrated a HCPV Acceptance Angle of ±3.2° Degrees
A. Yavrian (Opsun Technologies)

5:45 pm  Development of HOR-CON Solar Concentrator Module
O. Selimoglu, R. Turan (The Center for Solar Energy Research and Applications, GUNAM, Turkey)

6:00 pm  HCPVT Receiver Package Using Advanced Liquid Cooling for High Energy Efficiencies

6:15 pm  Development and Operation of a Hybrid Lighting-CPV Prototype
R. Nuñez, I. Antón, G. Sala (UPM-IES)

7:00 pm – 9:30 pm Conference Dinner with special session of "Japanese Imperial Court Music" (4F Rangyoku)
(M. Imaizumi)

The dinner fee is not included in the conference fee. If interested please register at our website or onsite at the conference.

Wednesday, April 17, 2013

8:45 am – 10:30 am Oral Session 7: Concentrating Optics and Related Materials
(J.C. Miñano)

8:45 am  9-Fold Fresnel-Köhler Concentrator for Increased Uniform Radiance on High Concentrations
J. Mendes-Lopes, P. Benitez, J.C. Miñano, P. Zamora (Cedint-UPM)

9:00 am  Relationship Between Electrostatic Potential and Adhesion of Sand on Fresnel Lens of CPV
Y. Ota, M. Yokota, K. Araki, K. Nishioka (University of Miyazaki)

9:15 am  New Design Method for Nonimaging Dome-Shaped Achromatic Fresnel Doublet: Performance Comparison with Flat Fresnel Lenses and Flat Fresnel Doublets
F. Languy, S. Habraken, C. Lenaerts, J. Loicq (University of Liege)

9:30 am  Degradation Mechanisms in Silicone-on-Glass Fresnel Lenses for Solar Applications
N. Malik, H.P. Annen, R. Leutz, Y. Tanguy (Concentrator Optics)

9:45 am  SAVOSIL®, Silica Glass Secondary Optics for High Performing CPV Systems
J. Tsai (Evonik Industries)

10:00 am  PMMA Lens with High Efficiency and Reliability
I. Matsuzaki (Kuraray)

10:15 am  Development of the Concentrator for a CPV Module using the TIR Fresnel Lens Produced by High Precision Injection Molding Technology
S. Kim (AnyCasting)

10:30 am – 11:15 am  Coffee Break (4F Foyer)

11:15 am – 1:00 pm  Oral Session 8: Characterization of Cells, Modules and System Components (4F Tenzui)
(B. Wang, G. Siefer)
11:15 am  A Novel Scanning Lens Instrument for Evaluating Fresnel Lens Performance: Equipment Development and Initial Results  
R. Herrero, I. Antón, S. Kurtz, D. Miller, G. Sala (UPM-IES)

11:30 am  Cell Chips Temperature Measurements in Different Operation Regimes of HCPV Modules  
V. Rumyantsev, A. Chekalin, N. Davidyuk, D. Malevskiy, P. Pokrovskiy, N. Sadchikov (Ioffe Physical-Technical Institute)

11:45 am  Investigations on the Influence of Temperature and Concentration on Solar Cell Performances  
H. Helmers, A. Bett, M. Schachtner (Fraunhofer ISE)

12:00 pm  Cooling Effect of Wind Direction on CPV Module  

12:15 pm  Shutter Technique for Deconvolution of Individual Cell Performance in Multi-cell Performance in Multi-Cell CPV Modules  
M. Yandt (University of Ottawa)

12:30 pm  Comparison of Measurement Techniques for the Determination of Circumsolar Irradiance  
J. Jaus, R. Pitz-Paal, S. Wilbert (Black Photon Instruments)

12:45 pm  Diffuse Light Capture and Incident Angle Response for Low-X CPV  
D. Riley, B. King (Sandia National Laboratories)

1:00 pm – 2:00 pm  Lunch Break (4F Rangyoku)

2:00 pm – 4:15 pm  Panel Discussion: CPV International Standards (4F Tenzui)  
(R. McConnell)

4:15 pm – 4:45 pm  Coffee Break (4F Foyer)

4:45 pm – 6:15 pm  Oral Session 9: Performance of High CPV Modules and Systems (4F Tenzui)  
(F. Rubio, M. Muller)

4:45 pm  Field Experience and Performance of CPV System in Different Climate: Test Study in Colorado, U.S. and in Okayama, Japan  
J. Hashimoto, O. Kenji, S. Kurtz, M. Muller, K. Sakurai (AIST)

5:00 pm  Impact of Spectral Irradiance Distribution and Temperature on Outdoor Performance of Concentrator Photovoltaic System  

5:15 pm  Detailed Effects of Wind on the Field Performance of a 50 kW CPV Demonstration Plant  
C. Domínguez, I. Antón, K. Araki, R. Núñez, G. Sala (UPM-IES)

5:30 pm  A Study on the Impact of High Penetration Distributed Generation Inverters on Grid Operation and Stability  
F. Gu, J. Brouwer, S. Samuelsen (University of California, Irvine)

5:45 pm  Development of Megawatt-Class Power Generation/Storage System  
T. Iwasaki (Sumitomo Electric Industries)

6:00 pm  From Innovation to Mass Production: The Need and Potential of Automation for the CPV Industry  
A. Angermeyer (Grenzebach Maschinenbau)

6:15 pm – 6:45 pm  Closing Remark (4F Tenzui)  
(K. Araki, G. Kinsey)
Social Events & Tours

Conference Dinner and Special session of “Japanese Imperial Court Music”

Another good opportunity to meet and network with colleagues as well as enjoy Japanese lifestyle is the conference dinner, which will take place on Tuesday evening, April 16, 2013. Enjoy an atmospheric evening with fantastic food and entertainment.

During the waiting time of the conference dinner, you will have a chance of attending a Tea Ceremony in Japan. You can learn more about the Tea Ceremony on:

- http://www.japanese-tea-ceremony.net/

During the conference dinner, a special show of Gagaku (classical music) and Bugaku (classical music and dance) will be played.

Gagaku (Bugaku) stands for ancient imperial court music and dance in Japan. It originated from the merger of our ancient heritage music and the dance and music that were introduced from China and Korea 1,400 years ago. It is known as the oldest classical music that is still played in Japan. You can learn more about Gagaku on:

- http://www.kunaicho.go.jp/e-culture/gagaku.html
- https://ccrma.stanford.edu/groups/gagaku/

The Bugaku (dance and music) that will be performed during the conference dinner is “Ranryouou”. It is a master piece of Bugakus and Gagakus. It is said, that the dance of “Ranryouou” came to Japan from ancient China in 9th century and has been passed down from generation to generation under the patronage of Imperial Family.

During the conference dinner, a special session of Gagaku (classical music) and Bugaku (classical music and dance) will be played.

The dinner fee is not included in the conference fee. The conference dinner registration is possible on-site at the registration desk (subject to availability and the dead line is April 16).

Technical Tour

CPV-9 participants will have the opportunity to visit University of Miyazaki on April 18, 2013, one of the centers of CPV research in Japan.

The tour will take place on Thursday, April 18. Buses will be provided to transport participants 8:30 and returning around 6:30 pm. Lunch and cultural exchange program are included in the tour. Pre-registration is required. Tour registration is possible on-site at the registration desk (by April 16).

Please make sure to wear your badge!

Special Conference Bag

We have too many conference bags! Many conference bags are just thrown away in trash boxes in conference hotels. Please use your bag for your next conference you will attend or on other occasions and remember the great CPV conference.

We are thinking of giving attendants a special bag “Japan Blue” made by our traditional recipe, produced with natural fermentation of weeds containing indigo.

We will not print the conference logo and banners of sponsor companies on our bags. However, you will be able to use this bag every day for shopping, carrying documents to your office or use it as a container for small items at home. Thank you for remaining sustainable and economically!

Welcome Reception

All participants including exhibitors are invited to take part in the Welcome Reception, which will take place on Sunday, April 14, 2013, from 7 pm to 10 pm in Rangyoku, 4th floor of Seagaia Convention Center, Phoenix Seagaia Resort.

The Welcome Reception will not only serve as an opening event and initial get-together for social networking in a relaxed atmosphere, it will also give participants the opportunity to register early for the conference.

This will allow you to avoid long waiting times at the registration desks in the morning of the first conference day, and make registration easier for those who arrive later.

During the Welcome Reception, we are happy to serve various wine and spirits of various countries and Miyazaki with Italian finger food prepared by the chefs of the Sheraton.

Industry Session

All participants including exhibitors are invited to take part in the Industry Session, which will take place on Monday, April 15, 2013, from 7:30 pm to 9:30 pm in Rangyoku, 4th floor of Seagaia Convention Center, Phoenix Seagaia Resort.

The Industry Session is a session for industries. You will have the chance of intensive discussions in market and industry activities.

- Session Chairs: Andreas Bett and Francisca Rubio
- Introduction of CPV Consortium: Nancy Hartsoch
- Presentations from CPV-9 Sponsors
- CPV Market in China: Bruce Wang

During the Industry Session, we are happy to serve various wine and spirits of various countries and of Miyazaki in combination with French finger food prepared by the chefs of the Sheraton.

Please note that the food and drink service is supported by sponsors of CPV-9.
AZUR SPACE Solar Power GmbH

AZUR SPACE Solar Power GmbH is a worldwide leading player in development and production of high efficiency solar cells for space and terrestrial CPV applications. AZUR SPACE cells have been successfully tested with all optical concentration systems currently used (Fresnel lenses, parabolic reflectors, systems with spectrum splitting, etc.). The standard CPV products currently offered by AZUR SPACE are solar cells with about 40 % efficiency, solar cells assemblies with or without secondary optics and dense array modules. The next generation of solar cells with about 42 % efficiency under sun concentration is close to get in production. Based on nearly five decades of experiences in space solar cell technology and high commitment to quality, AZUR SPACE brings its latest state-of-the-art know-how from Space to Earth. AZUR SPACE reported a new world record cell for upride grown epi-structures with a champion cell efficiency of 43.3 %.

Contact:
Please visit us at our booth at CPV 9 or at www.azurspace.com to learn more about our company and products or contact us by
P: +49 7131 67-2603
F: +49 7131 67-2727
E: info@azurspace.com

Evonik Industries: Specialities for solar applications

Evonik, the creative industrial group from Germany, is one of the world leaders in specialty chemicals. Its activities focus on the key megatrends health, nutrition, resource efficiency and globalization. The Acrylic Polymers Business Line offers PLEXIGLAS® molding compounds and sheet products for a variety of applications. One of the most important markets is the area of solar applications. The latest development is a new PLEXIGLAS® Solar standard lens panel with Fresnel Kohler concentrator design. Furthermore, the Inorganic Materials Business Unit is presenting SAVOSIL™ for secondary optics. For more information, please visit us at our booth.

Contact:
for PLEXIGLAS®:
Dr. René Kogler
Phone: +49-6151-18 4252
E-Mail: plexiglas-solar@evonik.com

for SAVOSIL™:
Dr. Iordanis Savvopoulos
Phone: +49-6181-5913651
E-Mail: iordanis.savvopoulos@evonik.com

Registration
Each participant must register in person at the registration desk to collect a conference bag and name badge before attending any sessions. Please make sure to wear your badge for admission to all sessions and social events. Participants who have lost their badge must report to the registration desk to get a new one. Registration times are on Sunday, April 15 from 7 pm - 9 pm and during conference hours.

Certificate of Attendance
A certificate of attendance for regular delegates and students will only be available on-site at the registration desk and cannot be issued after the conference. Please visit the registration desk to get your certificate of attendance.

Conference Proceedings
The conference proceedings will be published by the American Institute of Physics (AIP) and will be freely available on the AIP-website. For publication in the proceedings, all authors of accepted abstracts should have uploaded their scientific paper to the conference website as a PDF and Word document. If you failed to upload your paper before the conference, please go to the Media Upload Desk. Our staff will help you with the upload. Shortly after the conference and before publication of the proceedings by AIP, the papers can be obtained in the download area on our website, using your assigned login name and password.

List of Participants
Registered conference participants can download a full list of participants on the conference website, www.cpv-9.org. The login and password sent to you during registration will be required to gain access to the download area.

Shuttle Service
We will revolve the chartered bus. We will revolve every 30min.
FARE : Free of charge
Route : From Miyazaki airport to Phoenix Seagaia Resort directly.
Operation Hours :
April 14th (SUN.) From 8:30am to the last flight from Tokyo (Haneda)
April 15th (MON.) From 8:30am to 4:00pm
We have a information desk at the Miyazaki airport. It is just in front of the arrival gate.
You can see the sign of CPV-9. Please drop in on us. Our staff is waiting for your Information

Speaker Information
All presentations must be handed in at the Media Upload Desk, preferably one day before your presentation.
You will not be able to display your presentation directly from your laptop computer or memory stick! Our technical support team will welcome you at the Media Upload Desk at any time during the conference, starting at 7:30 am. Please meet your chairs and co-chairs inside the conference room at least 10 minutes prior to the beginning of your oral session to familiarize yourself with the technical equipment.
**W-LAN Access**

W-LAN access will be available free of charge during the conference without a password in the whole conference and catering / exhibition area.

**Posters**

The poster area is inside the Juyo Hall. Please mount your poster before the start of the first poster session or during the first break. Do not remove your poster until the end of the conference. The posters are an important part of the scientific program and should be displayed the whole time. Please remove your poster after the closing session on Wednesday, April 17, before you leave. Remaining posters will be discarded.

**About Miyazaki**

Miyazaki plays a prominent part in Japanese mythology, as it is believed to be the home of the Gods who created Japan. There are many places in Miyazaki that have links to these Gods and their deeds that are mentioned in the ancient myths and legends. Many reminders of this distant past, such as the Saitobaru Burial Mounds still remain until today.

It is believed that Japan has 8 million Gods. The most important one is Goddess. She is called “Amaterasu”. It is believed that she is the ancestor of the Imperial Family of Japan. Her property is the sun. She blesses CPV-9 in Miyazaki! As a matter of course, there are reminders of her in several places of Miyazaki. The sun behind Goddess is not the sun with strong irradiance like in a desert area, but the relatively mild one that is often seen in Asian regions.

**Shuttle Bus Information**  
**FARE:**Free of charge

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**Conference Program Overview**

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<td>Conference Dinner</td>
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<tr>
<td>08:30 am</td>
<td>Industry Session</td>
<td>Conference Dinner</td>
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<tr>
<td>08:45 am</td>
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<tr>
<td>09:00 am</td>
<td>Industry Session</td>
<td>Conference Dinner</td>
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• Poster Map (4F JUYO)

• Booth Map (4F JUYO)

1. AZUR SPACE Solar Power GmbH.
2. EVONIK Industries AG
3. Grenzebach Maschinenbau GmbH
4. Soitec Solar GmbH
5. Airlight Energy Manufacturing SA
7. Sumitomo Electric Industries, Ltd.
8. SOLAR ADDED VALUE S.L.
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