



Monday, May 30th 2022

08:30 - 09:00 Opening Session

08:30 Welcome to tandemPV Workshop 2022
Stefan Glunz, *Fraunhofer ISE*

09:00 - 10:20 Perovskite Materials for Tandem Solar Cells

- 09:00 Nanostructured Perovskite/Silicon Tandem Solar Cells Achieving Certified Efficiency of 29.80%
Philipp Tockhorn¹, Johannes Sutter¹, Alexandros Bournazou¹, Klaus Jäger¹, Felix Lang², Max Grischek¹, Philipp Wagner¹, Danbi Yoo¹, Martin Stolterfoht², Bernd Stannowski¹, Steve Albrecht¹, Christiane Becker¹
¹ *Helmholtz-Zentrum Berlin für Materialien und Energie*; ² *Universität Potsdam - Physik weicher Materie*
- 09:20 Perovskite Interfaces for the Long-term Stability of Perovskite Solar Cell Devices
Marion Dussouillez¹, Soo-Jin Moon¹, Christian M. Wolff², Yongpeng Liu³, Jun-Ho Yum³, Brett A. Kamino¹, Arnaud Walter¹, Florent Sahli¹, Gabriel Christmann¹, Kevin Sivula³, Quentin Jeangros¹, Christophe Ballif¹, Sylvain Nicolay⁴, Adriana Paracchino¹
¹ *CSEM*; ² *EPFL, PVlab*; ³ *EPFL, LIMNO*; ⁴ *Institut Interdisciplinaire d'Innovation Technologique (3IT)*
- 09:40 New Interface Design for Large Area Perovskite-Si Tandem
Anita Ho-Baillie, *University of Sydney*
- 10:00 Revealing Efficiency Losses Due to Mobile Ions in Perovskite Solar Cells
Martin Stolterfoht, *University of Potsdam*

10:20 - 10:50 Coffee Break

10:50 - 12:10 Alternative Cell Materials

- 10:50 Highly Efficient Pb/Sn Perovskite Solar Cells with Band-gap 1.2-1.3eV
Maria Antonietta Loi, *University of Groningen*
- 11:10 III-V on Si Tandems
Frank Dimroth, *Fraunhofer ISE*

Online Program



11:30 Perovskite/Organic Tandem Solar Cells Reaching 24% - Circumventing Tin Perovskites

Kai Brinkmann¹, Tim Becker¹, Florian Zimmermann¹, Tobias Gahlmann¹, Cedric Kreusel¹, Manuel Theisen¹, Tobias Haeger¹, Selina Olthof², Manuel Günster¹, Timo Maschwitz¹, Fabian Göbelsmann¹, Christine Koch², Dirk Hertel², Pietro Caprioglio³, Lorena Perdigon-Toro⁴, Amran Al-Ashouri⁵, Lena Merten⁶, Alexander Hinderhofer⁶, Frank Schreiber⁶, Leonie Gomell⁷, Siyuan Zhang⁷, Steve Albrecht⁵, Klaus Meerholz², Dieter Neher⁸, Martin Stolterfoht⁴, Thomas Riedl¹, Francisco Peña-Camargo⁹, Christian Tückmantel¹

¹ University of Wuppertal; ² University of Cologne; ³ Oxford University; ⁴ University of Potsdam; ⁵ Helmholtz-Zentrum Berlin; ⁶ University of Tübingen; ⁷ Max-Planck-Institut für Eisenforschung.; ⁸ University of Potsdam, Institute of Physics and Astronomy; ⁹ Potsdam University

11:50 Perovskite/CuInSe₂ Tandem Solar Cells
Erik Ahlswede, ZSW

12:10 - 13:30 Lunch Break

13:30 - 15:00 Poster Session 1

MON 01

Boosting the Performance of Perovskite/Si Tandem Cells in 2T Mechanically Stacked Configuration: The Role of 2D Materials

Antonio Agresti¹, Sara Pescetelli¹, Fabio Matteocci¹, Erica Magliano¹, Elisa Nonni¹, Giuseppe Bengasi², Carmelo Connelly², Cosimo Gerardi², Hanna Pazniak³, Sebastiano Bellani⁴, Francesco Bonaccorso⁴, Fabrizio Bizzarri², Marina Foti², Aldo Di Carlo⁵
Presented by Erica Magliano¹

¹ University of Rome Tor Vergata; ² Enel Green Power (EGP) SpA; ³ Université Grenoble Alpes, CNRS; ⁴ BeDimensional Spa.; ⁵ Istituto di Struttura della Materia (CNR-ISM) National Research Council

MON 02

Optimization of Semitransparent Perovskite Solar Cells for Use in Tandem Stacks

Erik Ahlswede¹, Tina Wahl¹, Nepomuk Zieske¹, Thomas Schnabel¹, Jan-Philipp Becker¹
¹ ZSW Zentrum für Sonnenenergie- und Wasserstoff-Forschung Baden-Württemberg

MON 03

n-i-p Architecture Perovskite/Silicon Tandem Solar Cells: Challenges and Solutions

Erkan Aydin¹, Jiang Liu¹, Esmâ Ugur¹, Randi Azmi¹, George T. Harrison¹, Yi Hou², Bin Chen², Shynggys Zhumagali¹, Michele De Bastiani¹, Mingcong Wang¹, Waseem Raja¹, Thomas G. Allen¹, Atteq ur Rehman¹, Anand S. Subbiah¹, Maxime Babics¹, Furkan H. Isikgor¹, Aslihan Babayigit¹, Kai Wang¹, Emmanuel Van Kerschaver¹, Leonidas Tsetseris¹, Edward H. Sargent², Frédéric Laquai¹, Stefaan De Wolf¹

¹ KAUST; ² University of Toronto

MON 04

Impact of Different TCO-based Recombination Layers on Perovskite on Silicon Tandem Solar Cells

Elise Bruhat¹, Perrine Carroy¹
Presented by Perrine Carroy¹

¹ CEA INES

- MON 05 Light-Soaking, Photo-Damage and Self-Healing in Halide Perovskites
 Davide Raffaele Ceratti¹, Gary Hodes², David Cahen², Philip Schulz¹, Jean Francois Guillemoles¹
¹ CNRS; ² Weizmann Institute
- MON 06 The Importance of Proton Chemistry in Halide Perovskites
 Davide Raffaele Ceratti¹, Gary Hodes², David Cahen², Philip Schulz¹, Jean Francois Guillemoles¹
¹ CNRS; ² Weizmann Institute
- MON 07 Epitaxial Growth of Cu(In,Ga)S₂ Layers on GaP/Si(001) Pseudo-Substrates for Tandem Cu(In,Ga)S₂/Si Solar Cells
 Eugène Bertin, *INSA Rennes*
- MON 09 Investigation of the Limitations of Electron Selective Single Layer Made of ALD Grown Tin Oxide for Perovskite Based Solar Cells
 Félix Gayot¹, Elise Bruhat¹, Matthieu Manceau¹, Eric De Vito², Denis Mariolle³, Stéphane Cros¹
¹ CEA Liten - INES; ² CEA Liten; ³ CEA Leti
- MON 10 Two-Step Dry-Wet Sequential Deposition of Double Cation Mixed Halide Perovskite Film
 Javid Hajhemati¹, Van-Son Nguyen², Nitin Mallik¹, Frederique Donsanti³, Jean Rousset³, Damien Aureau⁴, Philip Schulz¹
¹ CNRS, École Polytechnique, IPVF, UMR 9006; ² IPVF, Institut Photovoltaïque d'Ile-de-France; ³ EDF R&D, IPVF; ⁴ Université Paris-Saclay, UVSQ, CNRS, UMR 8180, Institut Lavoisier de Versailles
- MON 11 On the Chemical Robustness of Commercial Stainless-steel Foil Substrates for Chalcogenide-based Absorber Layers
 Sarallah Hamtaei¹, Guy Brammertz¹, Jef Poortmans¹, Tom Aernouts¹, Bart Vermang¹
¹ imec-imomec
- MON 12 Highly Efficient Monolithic Perovskite/Silicon Tandem Solar Cells without Atomic Layer Deposited Buffer Layer by Damage-free Sputter Deposition
 Marlene Härtel¹, Bor Li², Philipp Wagner², Steve Albrecht², Bernd Szyszka²
¹ Technische Universität Berlin; ² Young Investigator Group - Perovskite Tandem Solar Cells / Helmholtz-Zentrum Berlin;
- MON 13 Nano-Textured Silicon Surfaces for Perovskite Silicon Tandem Solar Cells
 Angelika Harter¹, Silvia Mariotti², Alexandros Cruz¹, Bor Li², Stefan Janke¹, Lars Korte², Rutger Schlatmann¹, Steve Albrecht², Bernd Stannowski¹
¹ Helmholtz Zentrum Berlin - PVcomB; ² Helmholtz Zentrum Berlin - SE NPET
- MON 14 Surface and Interface Study of Metal Halide Perovskite-based Top Cell Stacks for Tandem Photovoltaics
 Elif Hüsam¹, Marlene Sophie Härtel¹, Claudia Hartmann¹, Roberto Felix Duarte¹, Lars Korte¹, Regan George Wilks¹, Steve Albrecht¹, Marcus Bär¹
¹ Helmholtz-Zentrum Berlin für Materialien und Energie

- MON 15 **Solvents for Processing Stable Tin Halide Perovskites**
 Mahmoud Hussein¹, Jorge Pascual¹, Diego Di Girolamo¹, Zafar Iqbal¹, Silver Hamill
 Turren Cruz¹, Guixiang Li¹, Meng Li¹, Giuseppe Nasti¹
¹ *Helmholtz Center Berlin for Energy and Materials*
- MON 16 **Ambient Stability and Photo-Accelerated Degradation of Cs₂AgBiBr₆**
 Dennis Michael Jöckel
Fraunhofer IWKS
- MON 17 **How to Design Silicon Surfaces for Efficient Si/perovskite Tandem?**
 Gurleen Kaur¹, Marion Provost², Alexandre Blaizot², Antonio J Olivares³, Dmitry
 Daineka³, Jean Rousset⁴, Pere Roca i Cabarrocas²
 Presented by Pere Roca i Cabarrocas²
¹ *Institut Photovoltaïque d'Ile-de-France*; ² *Institut Photovoltaïque d'Ile-de-France (IPVF)*; ³
Laboratoire de Physique des Interfaces et des Couches Minces (LPICM), CNRS - École
polytechnique - I; ⁴ *Électricité de France R&D (EDF)*
- MON 18 **Radiation Tolerance of Perovskite Tandem PV**
 Felix Lang
Institute of Physics and Astronomy, Soft Matter Physics
- MON 19 **Wide Bandgap Cu(In,Ga)Se₂ Solar Cells with Different Front Contacts for
 Tandem Applications**
 Jackson Lontchi Jiole¹, Alexandre Crossay², Amelle Rebai², Nathanaelle Schneider²,
 Damien Coutancier², Baptiste Berenguier², Jean-François Guillemoles², Negar Naghavi²,
 Daniel Lincot², Polyxeni Tsoulka³, Nicolas Barreau³
¹ *Institut Photovoltaïque d'Ile-de-France*; ² *CNRS UMR 9006 IPVF*; ³ *Institut des matériaux Jean*
Rouxel (IMN) UMR 6502, Université de Nantes, CNRS
- MON 20 **Influence of Cs Cation in Ultrafast Carrier Dynamics of Mixed-Cation
 Perovskites**
 Mahmoud M. Elshanawany
Institute of Physical Chemistry / Goethe University
- MON 21 **Semi-Transparent Perovskite Solar Cells with Ultrathin Protective Buffer
 Layers for Tandem Applications**
 Erica Magliano¹, Antonio Agresti¹, Sara Pescetelli¹, Paolo Mariani¹, Fabio Matteocci¹,
 Antonio Cricenti², Marco Luce², Aldo Di Carlo³
¹ *CHOSE, University of Rome "Tor Vergata"*; ² *CNR-ISM Istituto di Struttura della Materia,*
National Research Council; ³ *CHOSE, University of Rome "Tor Vergata", and CNR-ISM*
- MON 22 **Tuneable Optical and Thermochemical Properties of Cs₃Sb₂I₉ Synthesized
 in Various Solvents**
 Samuel Meles Neguse¹, Songhak Yoon¹, Benjamin Balke¹, Anke Weidenkaff¹, Alex
 Frebel¹, Marc Widenmeyer², Dennis M. Jöckel¹
¹ *Fraunhofer IWKS*; ² *TU Darmstadt*

- MON 23 Energy Level Alignment and Defect Formation at the Voc-limiting Perovskite/C60 Interface in Highly Efficient Perovskite Solar Cells Revealed by Near-UV Photoelectron Spectroscopy
Dorothee Menzel¹, Alvaro Tejada¹, Amran Al-Ashouri¹, Igal Levine¹, Jorge Andrés Guerra², Bernd Rech¹, Steve Albrecht¹, Lars Korte¹
¹ Helmholtz-Zentrum Berlin für Materialien und Energie GmbH; ² Pontificia Universidad Católica del Perú
- MON 24 Monolithic Perovskite/Silicon-Heterojunction Tandem Solar Cells with (p)nc-Si/(n)nc-SiO_x Tunnel Junction
Lucia V Mercaldo¹, Eugenia Bobeico¹, Antonella De Maria¹, Marco Della Noce¹, Manuela Ferrara¹, Vera La Ferrara¹, Laura Lancellotti¹, Gabriella Rametta¹, Gennaro V Sannino¹, Iurie Usatii¹, Paola Delli Veneri¹, Erica Magliano²
Presented by Erica Magliano²
¹ ENEA; ² CHOSE, University of Rome "Tor Vergata"
- MON 26 Degradation Induced Defect and Passivation of MAPbI₃Br_{3-x} Perovskite Solar Cell: A Numerical Analysis
Hossein Movla¹, Zhila Alipanah¹
¹ University of Tabriz
- MON 27 The Role of High Energy Radiation on the Passivation of MAPbI₃Br_{3-x} Perovskite Solar Cells
Hossein Movla¹, Nesa Majidzadeh¹, Zhila Alipanah¹
¹ University of Tabriz
- MON 28 Opto-electrical Simulations and Optimization of Two Terminal Perovskite / CIGS Tandem Solar Cells
Paul Procel¹, Jelle Knobbe¹, Nasim Rezaei², Valerio Zardetto³, Nga Phung⁴, Mike Ma⁵, Marcel Simor³, Mariadriana Creatore⁴, Sjoerd Veenstra³, Rudi Santbergen¹, Olindo Isabella¹
¹ TU Delft; ² University of Twente; ³ TNO; ⁴ Eindhoven University of Technology; ⁵ MiaSole
- MON 29 Insights Into Perovskite Film Formation Using the HybridEvaporation/Spincoating Route: An In-situ XRD Study
Oussama Er-raji¹, Lina Rustam¹, Oliver Schultz-Wittmann¹, Stefan Glunz¹, Patricia S. C. Schulze
¹ Fraunhofer ISE
- MON 30 Fully Textured Monolithic Perovskite/Silicon Tandem Solar Cells Enabled by Co-Evaporation
Marcel Roß¹, Stefanie Severin¹, Amran Al-Ashouri¹, Eike Köhnen¹, Philipp Tockhorn¹, Philipp Wagner¹, Jona Kurpiers¹, Bernd Stannowski¹, Steve Albrecht¹
¹ Helmholtz-Zentrum Berlin für Materialien und Energie

- MON 31 A Perovskite-based Tandem Solar Cells Database: Predicting Guidelines from Recent Publication Trends
 Marco A. Ruiz-Preciado¹, Jesper Jacobsson², Steve Albrecht³, Eva Unger³, Ulrich W. Paetzold¹
¹ Karlsruhe Institute of Technology; ² Nankai University; ³ Helmholtz-Zentrum Berlin für Materialien und Energie
- MON 32 n++ Gas Immersion Laser Doping of p++ Emitters in POCl₃ Atmosphere: Dopant Concentration Profiling by SIMS and Dopant Electrical Activity by ECV
 Filipe Serra¹, Guilherme Gaspar¹, Ana Viana², Ivo Costa¹, David Pêra¹, José Silva¹, Giso Hahn³, Lasse Vines⁴, João Serra¹, Killian Lobato¹
¹ Instituto Dom Luiz (IDL), Faculdade de Ciências, Universidade de Lisboa; ² Centro de Química Estrutural, Faculdade de Ciências (CQE), Universidade de Lisboa; ³ Department of Physics, University of Konstanz; ⁴ Department of Physics, Center for Materials Science and Nanotechnology, University of Oslo
- MON 33 Zr-doped Indium Oxide as Broadband Transparent Electrode for Tandem Photovoltaics
 Yury Smirnov¹, Pierre-Alexis Repecaud¹, Mehrdad Najafi², Dong Zhang², Sjoerd Veenstra², Monica Morales-Masis¹
¹ University of Twente; ² TNO/Solliance
- MON 34 Single-Source Vapor-Deposited MA_{1-x}FA_xPbI₃: From Mechanochemical Synthesis to Thin Films.
 Tatiana Soto Montero¹, Suzana Kralj¹, Wiria Soltanpoor¹, Junia Solomon¹, Kassio Zanoni², Abhyuday Paliwal², Chris Baeumer¹, Henk Bolink²
¹ University of Twente; ² University of Valencia
- MON 35 Periodic Inverted Micro Pyramids for Fully Textured Solution-Processed Perovskite/Silicon Tandem Solar Cells
 Johannes Sutter¹, Philipp Tockhorn¹, Steve Albrecht¹, Christiane Becker¹
¹ Helmholtz-Zentrum Berlin
- MON 36 High-Current Output Bifacial Perovskite/Silicon Tandem Solar Cells
 Esma Ugur¹, Erkan Aydin¹, Michele De Bastiani¹, George T. Harrison¹, Bumin Kagan Yildirim¹, Thomas G. Allen¹, Sam Teale², Bin Chen², Philip Schulz³, Maxime Babics¹, Randi Azmi¹, Akmaral Seitkhan¹, Mingcong Wang¹, Jiang Liu¹, Anand S. Subbiah¹, Atteq ur Rehman¹, Edward H. Sargent², Frédéric Laquai¹, Stefaan De Wolf¹
¹ KAUST; ² University of Toronto; ³ CNRS
- MON 37 Characterization of Cu₂O Thin Films as Potential Hole Transporting Layer for 2-Terminal Perovskite / SHJ Tandem Solar Cells
 Pia Vasquez¹, Abderrahime Sekkat², Delfina Munoz¹, Muriel Matheron¹, David Munoz-Rojas²
¹ Université Grenoble Alpes, CEA Liten, Campus INES; ² Université Grenoble Alpes, CNRS, Grenoble INP, LMGP

- MON 38 Refined Model for the Growth Mechanism of Perovskite Absorber Films from Vacuum Deposition
 Sascha Wolter¹, Verena Barnscheidt², Marvin Diederich¹, Michael Rienaecker³, Tobias Wietler¹, Sarah Kajari-Schröder¹
 Presented by Verena Barnscheidt²
¹ Institute for Solar Energy Research Hamelin; ² Institute for Solar Energy Research in Hamelin (ISFH); ³ ISFH
- MON 39 Slot-die Coated Triple-halide Perovskite for Efficient and Scalable Perovskite/Silicon Tandem Solar Cells
 Ke Xu¹, Amran Al-Ashouri¹, Zih-Wei Peng¹, Eike Köhnen¹, Hannes Hempel¹, Fatima Akhundova¹, Jose Marquez¹, Philipp Tockhorn¹, Oleksandra Shargaieva¹, Daniel Abou-Ras, Florian Ruske¹, Bernd Stannowski¹, Thomas Unold¹, Eva Unger¹, Lars Korte¹, Steve Albrecht¹
¹ Helmholtz-Zentrum Berlin für Materialien und Energie GmbH
- MON 40 Reducing Energy Losses in Narrow-bandgap Solar Cells by Bulk and Surface Passivation
 Kaicheng Zhang
i-MEET Institute Materials for Electronics and Energy Technology

15:15 - 15:30 Coffee Break

15:30 - 16:50 Pero/Pero Tandems

- 15:30 Perovskite/Perovskite Tandems vs Pero/Silicon Tandems
 Tomas Leijtens, *Swift Solar*
- 15:50 Toward Efficient and Stable All-Perovskite Tandem Solar Cells and Modules
 Hairen Tan, *Nanjing University*
- 16:10 Upscaling of All-Perovskite PV
 Ulrich Paetzold, *KIT*
- 16:30 Understanding and Minimizing VOC Losses in All-Perovskite Tandem Photovoltaics
 Jarla Thiesbrummel¹, Francisco Peña-Camargo², Martin Stolterfoht², Felix Lang², Henry Snaith¹
¹ University of Oxford; ² Potsdam University

Tuesday, May 31st 2022

08:30 - 09:50 **Device Concepts and Processing**

- 08:30 From Three Terminal Tandem Solar Cells to Two Terminal Modules: Requirements and Potentials
Henning Schulte-Huxel, *ISFH*
- 08:50 Stable Architectures and Scalable Processes for Semi-transparent Modules and Tandem Top Cells
Anurag Krishna, *imec*
- 09:10 Lamination: A Novel Fabrication Route for Monolithic Perovskite/Silicon Tandem Solar Cells
Julie Roger¹, Luisa Schorn¹, Thomas Feeney¹, Ahmed Farag¹, Paul Fassl¹, Matthias Worgull¹, Ulrich Paetzold¹
¹ *Karlsruhe Institute of Technology*
- 09:30 Vacuum Processing of Metal-halide Perovskites
Juliane Borchert, *University of Cambridge*

09:50 - 10:20 **Coffee Break**

10:20 - 11:40 **Device Fabrication and Processing**

- 10:20 From Solution to Vapour Processing of Perovskite Films for Tandems
Quentin Jeangros, *CSEM*
- 10:40 Highly Efficient Monolithic Tandem Solar Cells with Metal-Halide Perovskites
Steve Albrecht, *Helmholtz-Zentrum Berlin*
- 11:00 Slot-die Coating of Wide Bandgap Perovskites
Valerio Zardetto, *TNO*
- 11:20 Building Blocks for Scalable Large-area Pero/Si Tandem Solar Cells
Hariharsudan Sivaramakrishnan Radhakrishnan, *imec*
- 11:40 The Versatility of Perovskite Materials for Optoelectronics
Michael Saliba, *University of Stuttgart*

12:00 - 13:30 **Lunch Break**

13:30 - 16:30 Poster Session 2

- TUE 01 Monolithic Perovskite/Silicon Tandem Solar Cell with above 28% Efficiency using Industrial Silicon Bottom Cells.
Kári Sveinbjörnsson
Helmholtz-Zentrum Berlin
- TUE 02 Performance Loss Analysis of Tandem PV Modules under Realistic Operating Conditions
Youri Blom¹, Malte Vogt¹, Rudi Santbergen¹, Miro Zeman¹, Olindo Isabella¹
¹ *TU Delft*
- TUE 03 Up to 1.94 V open circuit voltage in highly efficient perovskite/silicon tandem solar cells using polymeric interlayers in the top contact
Bor Li
Helmholtz-Zentrum Berlin
- TUE 04 Using LED Based Solar Simulators for Tandem Solar Cell Measurements – The Challenge of Spectral Adjustment
David Chojniak¹, Jochen Hohl-Ebinger¹, Kasimir Reichmuth¹, Michael Schachtner¹, Alexandra Schmid¹, Martin Schubert¹, Gerald Siefert¹
¹ *Fraunhofer ISE*
- TUE 05 Nano-patterned Back-reflector for Enhanced Light Management in III–V-on-Silicon Solar Cells
Andrea Cordaro¹, Ralph Mueller², Stefan Tabernig¹, Nico Tucher², Benedikt Blaesi², Albert Polman¹
Presented by Benedikt Blaesi²
¹ *AMOLF*; ² *Fraunhofer ISE*
- TUE 06 From SHJ to Perovskite-Silicon Tandem: Adaptation and Optimization of the Front Electrode
Alexandros Cruz¹, Zih-Wei Peng¹, Ke Xu¹, Jona Kurpiers¹, Rutger. Schlatmann¹, Steve Albrecht¹, Bernd Stannowski¹
¹ *Helmholtz-Zentrum Berlin*
- TUE 07 Reverse-bias Studies of Semitransparent Perovskite Cells, and Model Evaluation of Tandem Submodule Designs.
Bart Geerligs¹, Mehrdad Najafi², Klaas Bakker², Dong Zhang², Gianluca Coletti¹, Sjoerd Veenstra²
Presented by Gianluca Coletti¹
¹ *TNO Solar Energy*; ² *TNO Solar Technology and Applications*
- TUE 08 Subcell Coupling in Tandem Solar Cells: Measurements and Modeling
John Geisz¹, William McMahon¹, Jeronimo Buencuerpo², Michael Rienäker³, Adele Tamboli¹
Presented by Jeronimo Buencuerpo²
¹ *NREL*; ² *Institut Photovoltaïque d'Île-de-France*; ³ *Institute for Solar Energy Research Hamelin*

- TUE 10 Efficient and Stable All-Perovskite Tandem Solar Cells via 2D Engineering
in Sn-Pb Narrow-bandgap Perovskite
Qi Jiang¹, Kai Zhu¹
¹ NREL
- TUE 11 Highly-efficient Perovskite/CIGS Tandem Solar Cells with Optical
Optimization for 30% Efficiency and High Energy Yield
Marko Jošt¹, Eike Koehnen², Amran Al-Ashouri², Tobias Bertram³, Spela Tomsic⁴,
Artiom Magomedov⁵, Ernestas Kasparavicius⁵, Tim Kodalle³, Benjamin Lipovsek⁴,
Vytautas Getautis⁵, Rutger Schlatmann³, Christian Kaufmann³, Steve Albrecht², Marko
Topic⁴
¹ Univerza v Ljubljani; ² Helmholtz-Zentrum Berlin; ³ Pvcomb; ⁴ Univerza v Ljubljani, Fakulteta za
elektrotehniko; ⁵ Kaunas University of Technology
- TUE 12 Mitigating the JSC Loss in Narrow Bandgap Pb-Sn Perovskite Solar Cells
for Highly Efficient Flexible All-Perovskite Tandem Cells
Johnpaul K P¹, Huagui Lai¹, Yannick Zwirner¹, Ayodhya Nath Tiwari¹
¹ Empa – Swiss Federal Laboratories for Materials Science and Technology
- TUE 13 Minimizing Electro-Optical Losses of ITO Layers for Monolithic Perovskite
Silicon Tandem Solar Cells
Özde Ş. Kabaklı¹, Jakob Kox¹, Leonard Tutsch¹, Mohamed A. A. Mahmoud¹, Patricia S.C.
Schulze¹, Jan Christoph Goldschmidt², Martin Bivour¹, Stefan M. Glunz¹, Martin
Hermle¹
¹ Fraunhofer ISE; ² University of Marburg
- TUE 14 Integration of Rough RTP Absorbers into CIGS-Perovskite Monolithic
Tandems by NiO_x(:Cu)+SAM HTL Bi-layers
Ivona Kafedjiska¹, Guillermo Farias Basulto¹, Pablo Reyes-Figueroa¹, Tobias Bertram¹,
Amran Al-Ashouri², Christian Kaufmann¹, Robert Wenish¹, Steve Albrecht², Rutger
Schlatmann¹, Iver Lauermaann¹
¹ Helmholtz-Zentrum Berlin, Competence Centre Photovoltaics (PVcomB); ² Helmholtz-Zentrum
Berlin, Young Investigator Group - Perovskite Tandem Solar Cells
- TUE 15 Influence of Spectral Mismatch and Shunts Deduced from Equivalent
Circuits
Reiner Klenk¹, Ivona Kafedjiska¹, Guillermo Farias-Basulto¹, Amran Al-Ashouri¹, Rutger
Schlatmann¹
¹ Helmholtz-Zentrum Berlin für Materialien und Energie
- TUE 16 Advanced Subcell Analysis of Monolithic Perovskite/Silicon Tandem Solar
Cells
Eike Köhnen¹, Amran Al-Ashouri¹, José A. Márquez¹, Bor Li¹, Anna Belen Morales
Vilches¹, Philipp Wagner¹, Stefan Janke¹, Tobias Hänel¹, Thomas Unold¹, Lars Korte¹,
Bernd Stannowski¹, Steve Albrecht¹
¹ Helmholtz-Zentrum Berlin

- TUE 17 **Laser Patterned Flexible Perovskite-CIGS Tandem Mini-Modules with over 16% Efficiency**
 Radha Krishnan Kothandaraman¹, Huagui Lai¹, Abdessalem Aribia¹, Shiro Nishiwaki¹, Severin Siegrist¹, Maximillian Krause¹, Yannick Zwirner¹, Galo Torres Sevilla¹, Romain Carron¹, Ayodhya Nath Tiwari¹, Fan Fu¹
¹ *Empa, Swiss Federal Laboratories for Materials Science and Technology*
- TUE 18 **All-Perovskite Flexible Tandem Solar Cells with 22.6% Efficiency**
 Huagui Lai
Empa-Swiss Federal Laboratories for Materials Science and Technology
- TUE 19 **Admittance Spectroscopy and Deep-Level Transient Spectroscopy in Multijunction: A Tutorial to Characterize the Entire Cell**
 Cyril Leon¹, Sylvain Le Gall², Marie-Estelle Gueunier-Farret², Jean-Paul Kleider²
¹ *IM2NP (Institut Matériaux Microélectronique Nanosciences de Provence)*; ² *GeePs (Laboratoire de génie électrique de Paris)*
- TUE 20 **Perovskite/crystalline Silicon Two-Terminal Tandem Solar Cells Prepared by Two-Step Methods**
 Yucheng Li
Institute of Photoelectronic Thin Film Devices and Technology, Nankai University
- TUE 21 **Highly-efficient Monolithic Perovskite/Silicon Tandem Solar Cells with Improved Phase Stability on Double-side Textured Substrate**
 Jiang Liu
King Abdullah University of Science & Technology
- TUE 22 **From Silicon Based TRJ Developments on Passivated Contacts to Tandem Integration into Perovskite / Silicon Devices**
 Baptiste Marteau¹, Thibaut Desrues¹, Quentin Rafhay², Anne Kaminski¹, Sébastien Dubois¹
¹ *CEA INES*; ² *IMEP LAHC*
- TUE 23 **Development of c-Si Bottom Cells Based on Carrier-Selective Passivating Layers for Demonstrating High-Efficiency 4T Perovskite/c-Si Solar Cells**
 Luana Mazzarella¹, Yifeng Zhao¹, Manvika Singh¹, Can Han¹, Guangtao Yang¹, Dong Zhang², Valerio Zardetto³, Mehrdad Najafi³, Maria Adriana Creatore⁴, Rene Janssen⁴, Sjoerd Veenstra³, Glanluca Coletti³, Arthur Weeber⁵, Miro Zeman¹, Olindo Isabella¹
¹ *Delft University of Technology*; ² *TNO, partner of Solliance & Eindhoven University of Technology*; ³ *TNO, partner of Solliance*; ⁴ *Eindhoven University of Technology*; ⁵ *Delft University of Technology & TNO, partner of Solliance*
- TUE 24 **Imaging-Based Detection of Defects in Perovskite-Silicon Tandem Solar Cells**
 Oliver Fischer¹, Jonas Dalke¹, Oussama Er-raji¹, Patricia S. C. Schulze¹, Oliver Schultz-Wittmann¹, Martin Schubert¹, Stefan Glunz¹, Florian Schindler¹
¹ *Fraunhofer ISE*

- TUE 25 Development and Application of Low-Cost Si IBC Solar Cell Processes for Three Terminal Perovskite Tandem Devices
Valentin Mihailetschi¹, Razvan Roescu¹, Haifeng Chu¹, Hiroyuki Kanda², Mohammad Khaja Nazeeruddin², James Connolly³, Radovan Kopecek¹
¹ International Solar Energy Research Center Konstanz e.V.; ² Group for Molecular Engineering of Functional Materials (GMF), EPFL-VALAIS WALLIS; ³ Laboratoire de Génie Electrique et Electronique de Paris, Université Paris-Saclay, Centrale Supélec
- TUE 26 In Situ Monitoring of As-P Exchange on Ge(100) Surfaces in GaAs-rich CVD Reactors for Low-defect III-V Multijunction Solar Cells
Manali Nandy
Technische Universität Ilmenau (TU Ilmenau)
- TUE 27 Two-Terminal Perovskite/Silicon Tandem Based on Double Cation Formulation
Elisa Nonni¹, Fabio Matteocci¹, Erica Magliano¹, Aldo Di Carlo², Luca Serenelli³, Mario Tucci³
¹ C.H.O.S.E., Electronic Engineering Department, University of Rome "Tor Vergata"; ² Istituto di Struttura della Materia (CNR-ISM) National Research Council; ³ ENEA, Casaccia Research Center
- TUE 28 Looking into the Expiry Date of Perovskite/Silicon Tandems
Yahuitl Osorio Mayon¹, Christopher Jones¹, Leiping Duan¹, Naeimeh Mozaffari¹, Heping Shen¹, Hieu Nguyen¹, Klaus Weber¹, Kylie Catchpole¹, Thomas White¹
¹ Australian National University
- TUE 29 Developing a GaAs/Silicon Micro Concentrator Module
Yahuitl Osorio Mayon¹, Christopher Jones¹, Matthew Stocks¹, Andrew Blakers¹
¹ Australian National University
- TUE 31 Evaluation of Screen-Printed Ultra-Low-Temperature Metallization for Silicon-Perovskite Tandem Solar Cells
Sebastian Pingel¹, Denis Erath¹, Timo Wenzel¹, Martin Bivour¹, Florian Clement¹
¹ Fraunhofer ISE
- TUE 32 Monolithic 2-Terminal Perovskite/CuInSe₂ Tandem Solar Cells with Efficiency Approaching 25%
Marco A. Ruiz-Preciado¹, Fabrizio Gota¹, Ihtezaz Hossain¹, Paul Fassi¹, Felix Laufer¹, Fabian Schackmar¹, Thomas Feeney¹, Ahmed Farag¹, Isabel Allegro¹, Hang Hu¹, Saba Gharibzadeh¹, Bahram Abdollahi Nejand¹, Tina Wahl², Thomas Schnabel², Erik Ahlswede², Veronique S. Gevaerts³, Marcel Simor³, Pieter J. Bolt³, Ulrich W. Paetzold¹
¹ Karlsruhe Institute of Technology; ² Zentrum für Sonnenenergie- und Wasserstoff-Forschung Baden-Württemberg; ³ TNO partner in Solliance
- TUE 33 Monolithic Perovskite/Silicon Tandem Solar Cells: Progress on Upscaling, Encapsulation, and Reliability Testing
Florent Sahli¹, Soo-Jin Moon¹, Brett A. Kamino¹, Arnaud Walter¹, Adriana Paracchino¹, Marion Dussouillez¹, Gabriel Christmann¹, Antoine Descoedres¹, Jonas Geissbühler¹, Xin Yu Chin², Deniz Türkay², Sylvain Nicolay¹, Christian M. Wolff², Bertrand Paviet-Salomon¹, Christophe Ballif¹, Quentin Jeangros¹
¹ CSEM; ² EPFL

- TUE 34 Printed and Plated Front Side Metal Contacts for III-V/Si Tandem Solar Cells: Evaluation of Scalable Metallization Approaches
 Jörg Schube¹, Thibaud Hatt¹, Gabriele Mikolasch¹, Mike Jahn¹, Carlos Alvarado¹, Felix Predan¹, Jonas Bartsch¹, Roman Keding¹
¹ *Fraunhofer ISE*
- TUE 35 Evaluation of Laser-Based Patterning Processes for Low-Loss Monolithic Series Interconnection of CIGSe-Perovskite Tandem Solar Cells
 Christof Schultz¹, Guillermo Farias-Basulto², Nico Hansen¹, Tobias Bertram², Janardan Dagar³, Rutger Schlatmann¹, Christian Kaufmann², Eva Unger³, Bert Stegemann¹
 Presented by Bert Stegemann¹
¹ *HTW- University of Applied Sciences*; ² *PVcomB / Helmholtz-Zentrum Berlin für Materialien und Energie*; ³ *Helmholtz-Zentrum Berlin für Materialien und Energie*
- TUE 36 Maximizing Current Density in Monolithic Perovskite Silicon Tandem Solar Cells
 Minasadat Heydarian¹, Alexander J. Bett¹, Maryamsadat Heydarian¹, Özde Ş. Kabaklı¹, Leonard Tutsch¹, Martin Bivour¹, Jan Christoph Goldschmidt², Martin Hermle¹, Stefan Glunz¹, Patricia S. C. Schulze¹
¹ *Fraunhofer ISE*; ² *University of Marburg*
- TUE 37 High-rate Spatial Atomic Layer Deposition of SnO₂ Buffer Layers for Perovskite Solar Cells
 Bas van de Loo¹, Silke Peeters², Erwin Kessels²
¹ *SALD BV*; ² *Eindhoven University of Technology*
- TUE 38 Validation of Energy Yield Model for Bifacial Solar Cells and Prediction of Perovskite/silicon Tandem Solar Cell Performance
 Peter Tillmann¹, Klaus Jäger¹, Asher Karsenti², Lev Kreinin²
¹ *Helmholtz-Zentrum Berlin*; ² *SolAround Ltd*
- TUE 39 Recent Progress in Three-Terminal Perovskite/Silicon Tandem Solar Cells
 Philipp Wagner¹, Philipp Tockhorn¹, Sebastian Hall¹, Steve Albrecht¹, Lars Korte¹
 Presented by Philipp Tockhorn¹
¹ *Helmholtz-Zentrum Berlin für Materialien und Energie*
- TUE 40 Fabrication of Monolithic Perovskite/Silicon Tandem Solar Cells with POLO/PERC Bottom Cell
 Tobias Wietler¹, Silvia Mariotti², Klaus Jäger², Marvin Diederich¹, Marlene Härtel², Bor Li², Kari Sveinbjörnsson², Eike Köhnen², Rolf Brendel¹, Sarah Kajari-Schröder¹, Robby Peibst¹, Steve Albrecht², Lars Korte²
 Presented by Lars Korte²
¹ *Institute for Solar Energy Research (ISFH)*; ² *Helmholtz-Zentrum Berlin für Materialien und Energie GmbH*
- TUE 41 Large Area Perovskite-Silicon Tandem Modules: A New Strategy Toward Stability
 Narges Yaghoobi Nia¹, Mahmoud Zendeheel¹, Harshavardhan Reddy Sathy¹, Luigi Schirone², Enrico Leonardi³, Aldo Di Carlo¹
¹ *University of Rome Tor Vergata*; ² *University of Rome Sapienza*; ³ *Greatcell Solar Italia*

TUE 42 **Optical Coupling of Internal Radiation in Perovskite-Silicon Tandem Cells and its Impact on Optoelectronic Device Characteristics**
Simon Zeder¹, Beat Ruhstaller², Urs Aeberhard³
¹ Fluxim AG, EPFL PV-Lab; ² Fluxim AG, ZHAW; ³ Fluxim AG, ETH Zürich

15:15 - 15:30 Coffee Break

15:30 - 17:00 Device Characterisation and Modelling

15:30 **How Useful are Conventional I-Vs for Performance Calibration of Tandem Perovskite Solar Cells and Modules?**
Tao Song¹, Charles Mack¹, Rafell Williams¹, Daniel J Friedman¹, Nikos Kopidakis¹
¹ NREL

15:50 **Efficient 3D Tandem Cell Simulation by Coupling Equivalent-circuit and Drift-diffusion Models**
Andreas Fell, *Quokka*

16:10 **Bandgap and Temperature Dependent Modelling of Perovskite/Silicon Tandem Solar Cells**
Thomas Allen, *KAUST Solar Center (KSC)*

16:30 **Photon Recycling and Luminescent Coupling in All-perovskite Tandem Solar Cells Assessed by Full Opto-electronic Simulation**
Urs Aeberhard¹, Simon J. Zeder¹, Beat Ruhstaller²
¹ Fluxim AG; ² Zurich University of Applied Sciences – ZHAW

17:00 Lab Tour at Fraunhofer ISE

18:30 Workshop Dinner

Wednesday, June 1st 2022

08:30 - 09:50 **Module Fabrication and Stability**

- 08:30 Outdoor Stability of Perovskite/Silicon Tandem Solar Cells
Stefaan De Wolf, *KAUST*
- 08:50 Improving Stability in Perovskite Solar Cells
Sam Johnson and Michael McGehee, *University of Colorado*
- 09:10 Production of Full-size Perovskite Silicon Heterojunction Tandem PV Modules with more than 23% Efficiency and more than 430 Wp
Torsten Rößler¹, Thomas Sébastien², Daniel Kirk², Veronika Nikitina¹, Sebastian Birnkammer¹, Karl Lappe¹, Alexandra Schmid¹, Angelika Beinert¹, Marc Steiner¹, Stewart Hooper², Achim Kraft¹, Holger Neuhaus¹
¹ *Fraunhofer ISE*; ² *Oxford PV*
- 09:30 Consensus Statement for Stability Assessment and Reporting for Perovskite Photovoltaics Based on ISOS Procedures
Mark Khenkin¹, Quiterie Emery¹, Marko Remec¹, Ulas Erdil¹, Hans Köbler¹, Jinzhao Li¹, Antonio Abate¹, Eva Unger¹, Rutger Schlatmann¹, Iris Visoly-Fisher², Eugene Katz², Carolin Ulbrich¹
¹ *Helmholtz-Zentrum Berlin für Materialien und Energie GmbH*; ² *Ben-Gurion University of the Negev*

09:50 - 10:20 **Coffee Break**

10:20 - 12:10 **Industrial Processes**

- 10:20 Production of 4T Tandem Modules
Olle Lundberg, Evolar
- 10:40 Production of 2T Pero/Si Tandem Modules
Daniel Kirk, Oxford PV
- 11:00 Towards a Perovskite Tandem PV Future
Michael D. Irwin, CubicPV Inc
- 11:20 Developments Towards Large Area Perovskite/Silicon Tandem Solar Cells
Muriel Matheron, Université Grenoble Alpes, CEA Liten, Campus INES
- 11:40 From Research and Mini-Module Development to High-Volume Manufacturing – VON ARDENNE Equipment for High-Efficiency Cells
René Köhler, ARDENNE GmbH

12:00 - 13:15 **Lunch Break**

13:15 - 14:45 Panel Discussion: Upscaling and Market Entry of Tandem Technologies

Moderators: Erkan Aydin and Thomas Allen, *KAUST*

Panelists:

Steve Albrecht, *Helmholtz-Zentrum Berlin*

Stefaan De Wolf, *KAUST*

Stefan Glunz, *Fraunhofer ISE*

Michael Irwin, *CubicPV Inc.*

Daniel Kirk, *Oxford PV*

Ulrich Paetzold, *KIT*

14:45 - 15:15 Coffee Break

15:15 - 16:35 Upscaling, Sustainability and Bankability

15:15 Upscaling of Perovskite Silicon Tandem Devices from Design to Energy Yield
Gianluca Coletti, *TNO Energy Transition - UNSW*

15:35 Process-monitoring to Facilitate Optimization of Scalable Slot-die Coating for Larger Area Perovskite-Tandem Manufacturing
Eva Unger, *Helmholtz-Zentrum Berlin für Materialien und Energie*

15:55 Sustainability Evaluations on Material Consumption for Terawatt Scale Manufacturing of Silicon based Tandem Solar Cells
Li Wang¹, Yuchao Zhang¹, Moonyong Kim¹, Robert Underwood¹, Storm Drury¹, Brett Hallam¹
¹ *School of Photovoltaic & Renewable Energy Engineering/UNSW Sydney*

16:15 ModuReliability: Lessons Learned for Future (or Present?) Smart Tandem Integration
Delfina Munoz, *CEA INES*

16:35 - 17:00 Closing Remarks