

## New Concepts in Solar and Thermal Radiation Conversion and Reliability

Sunday - Tuesday 19 - 21 August 2018

### Conference Sessions At A Glance

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- 1: Thin-Film PV Materials Reliability
- 2: Field Evaluation for PV Durability
- 3: PV Module Accelerated Stress Testing
- 4: PV Module Packaging  
Sunday Evening Plenary Session
- 5: Thermal Radiation Enhancement
- 6: Novel Phenomena in Thermal Radiation
- 7: Keynote Session  
Posters-Monday
- 8: Novel Concepts in Solar Energy Conversion
- 9: High Efficiency Sunlight to Power
- 10: Photon Management for Solar Power

### Important Dates

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Abstract Due:  
7 February 2018

Author Notification:  
16 April 2018

Manuscript Due Date:  
25 July 2018

### Conference Committee

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#### Conference Chairs

Jeremy N. Munday, Univ. of Maryland, College Park (United States)  
[Peter BermeL](#), Purdue Univ. (United States)  
[Michael D. Kempe](#), National Renewable Energy Lab. (United States)

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[Jia Zhu](#), Nanjing Univ. (China)

**SUNDAY 19 AUGUST**[Show All Abstracts](#)

### Session 1: Thin-Film PV Materials Reliability

Sunday 19 August 2018  
 8:40 AM - 10:00 AM  
 Location: Conv. Ctr. Room 29D


Session Chair: [Michael D. Kempe](#), National Renewable Energy Lab. (United States)

#### Optical properties of lead iodide (PbI<sub>2</sub>) and lead halide perovskite (CH<sub>3</sub>NH<sub>3</sub>PbI<sub>3</sub>)

Paper 10759-9

Time: 8:40 AM - 9:00 AM

Author(s): Philip Otieno Nyawere, Rongo Univ. (Kenya); Christopher M. Maghanga, Kabarak Univ. (Kenya); Maurice Mghendi Mwamburi, Univ. of Eldoret (Kenya)


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#### Reducing permeability of indium tin oxide contacts to improve thermal stability in perovskite solar cells

Paper 10759-10

Time: 9:00 AM - 9:20 AM


Author(s): Caleb Boyd, Rongrong Cheacharoen, Kevin A. Bush, Rohit Prasanna, Tomas Leijtens, Michael D. McGehee, Stanford Univ. (United States)

[Add To My Schedule](#) **ZnS/Cu<sub>2</sub>ZnSnS<sub>4</sub>/CdTe/In thin film structure for solar cells**

Paper 10759-11

Time: 9:20 AM - 9:40 AM

Author(s): Maarif A. Jafarov, E. F. Nasirov, S. A. Jahangirova, Baku State Univ. (Azerbaijan)

[Add To My Schedule](#) **Outdoor performance of CIGS modules at multiple temperatures over three years**

Paper 10759-39

Time: 9:40 AM - 10:00 AM

Author(s): Afshan Qamar, Rafia Akbar, National Univ. of Sciences and Technology (Pakistan); Ankil Singhvi, Andrey Bednarzhevskiy, Liyuan Liu, Aakash Raj, Sai Tatapudi, Arizona State Univ. (United States); David Metacarpa, Rajalakshmi Sundaramoorthy, SUNY Polytechnic Institute (United States); GovindaSamy TamizhMani, Arizona State Univ. (United States)

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**Coffee Break 10:00 AM - 10:30 AM**

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**Session 2:  
Field Evaluation for PV Durability**

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Sunday 19 August 2018

10:30 AM - 12:20 PM


Location: Conv. Ctr. Room 29D

Session Chair: [Keiichiro Sakurai](#), National Institute of Advanced Industrial Science and Technology (Japan)**Comparison of indoor and outdoor accelerated PID tests on CIGS modules**

Paper 10759-3

Time: 10:30 AM - 10:50 AM


Author(s): Keiichiro Sakurai, National Institute of Advanced Industrial Science and Technology (Japan); Hiroshi Tomita, Darshan Schmitz, Shuuji Tokuda, Solar Frontier K.K. (Japan); Kinichi Ogawa, Hajime Shibata, Atsushi Masuda, National Institute of Advanced Industrial Science and Technology (Japan)

[Add To My Schedule](#) **Risk priority number for PV module defects: influence of climatic condition (Invited Paper)**

Paper 10759-2

Time: 10:50 AM - 11:20 AM


Author(s): Sai Tatapudi, Prasanna Sundarajan, Arizona State Univ. (United States); Cara Libby, EPRI Worldwide (United States); Joseph Kuitche, GovindaSamy TamizhMani, Arizona State Univ. (United States)

[Add To My Schedule](#) **A novel climate-specific field accelerated testing of PV modules**

Paper 10759-40

Time: 11:20 AM - 11:40 AM


Author(s): Sai Tatapudi, Joseph Kuitche, Arizona State University (United States); GovindaSamy TamizhMani, Arizona State Univ. (United States)

[Add To My Schedule](#) **Addressing potential-induced degradation of field-installed PV modules by reducing surface conductivity**

Paper 10759-41

Time: 11:40 AM - 12:00 PM


Author(s): Khuram Shahzad, Muhammad S. Khalid, Ahmad Amin, Kiran Israr, Rahman U. Khan, Univ. of Engineering &amp; Technology, Peshawar (Pakistan); Jaewon Oh, Sai Tatapudi, GovindaSamy TamizhMani, Arizona State Univ. (United States)

[Add To My Schedule](#) **PID testing of PV module with modified testing condition of IEC 62804**

Paper 10759-12

Time: 12:00 PM - 12:20 PM

Author(s): Rajesh Kumar, Birinchi Bora, Gopal Kumar, National Institute of Solar Energy (India)

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**Lunch Break 12:20 PM - 2:00 PM**

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**Session 3:  
PV Module Accelerated Stress Testing**

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Sunday 19 August 2018

2:00 PM - 3:00 PM

Location: Conv. Ctr. Room 29D


Session Chairs: [Michael D. Kempe](#), National Renewable Energy Lab. (United States) ; [Keiichiro Sakurai](#), National Institute of Advanced Industrial Science and Technology (Japan)

#### Acceleration factor for damp heat testing of PV modules

Paper 10759-4

Time: 2:00 PM - 2:20 PM

Author(s): Arun Bala Subramaniyan, Archana Sinha, Shantanu Pore, Hamsini Gopalakrishna, Rong Pan, GovindaSamy TamizhMani, Arizona State Univ. (United States)


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#### Understanding the microenvironment of a PV module for better stress testing

Paper 10759-5

Time: 2:20 PM - 2:40 PM

Author(s): Michael D. Kempe, National Renewable Energy Lab. (United States)


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#### Development of methodology for service life prediction of PV backsheets

Paper 10759-6

Time: 2:40 PM - 3:00 PM

Author(s): Xiaohong Gu, Chen-An Wang, Yadong Lyu, Jae Hyun Kim, Andrew Fairbrother, Lakesha Perry, Deborah Jacob, Tinh Nguyen, Stephanie Watson, National Institute of Standards and Technology (United States)

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### Coffee Break 3:00 PM - 3:30 PM

## Session 4: PV Module Packaging

Sunday 19 August 2018

3:30 PM - 5:20 PM

Location: Conv. Ctr. Room 29D


Session Chair: [Michael D. Kempe](#), National Renewable Energy Lab. (United States)

#### Analysis of glass-glass modules *(Invited Paper)*

Paper 10759-1

Time: 3:30 PM - 4:00 PM

Author(s): Thomas C. Felder, Kaushik Roy Choudhury, DuPont Photovoltaic Solutions (United States); Lucie Garreau-Iles, DuPont de Nemours International S.A. (Switzerland); Steven MacMaster, DuPont Photovoltaic Solutions (United States); Hongjie Hu, DuPont (China) Research & Development and Management Co., Ltd. (China); William Gambogi, DuPont Photovoltaic Solutions (United States); T. John Trout, DuPont (United States)


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#### Degradation analysis of polyamide-based backsheets in field photovoltaic modules under different climatic conditions

Paper 10759-13

Time: 4:00 PM - 4:20 PM

Author(s): Yadong Lyu, Andrew Fairbrother, Jae Hyun Kim, Xiaohong Gu, National Institute of Standards and Technology (United States); Michael Kempe, NREL (United States); Liang Ji, Underwriters Labs. Inc. (United States); Kent Whitfield, Underwriters Laboratories (United States); Kenneth Boyce, Underwriters Labs. Inc. (United States); Greg O'Brien, Arkema (United States); Scott Julien, Kai-Tak Wan, Northeastern Univ. (United States); Yu Wang, Laura Bruckman, Roger French, Case Western Reserve Univ. (United States)

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#### Feasibility and reliability of a single layer polymeric PV backsheet in white, transparent or luminescent solar collector options

Paper 10759-43

Time: 4:20 PM - 4:40 PM

Author(s): Jessica Rosenthal, Soliculture Inc (United States); Glenn Alers, Ingrid Anderson, Soliculture, Inc. (United States); Peter Hacke, David Miller, Kent Terwilliger, National Renewable Energy Lab. (United States)


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#### Optical and thermal analysis of PVB encapsulant polymer functionalized with luminescent organic dyes

Paper 10759-7

Time: 4:40 PM - 5:00 PM

Author(s): Walid Arfi, Ctr. de Recherche en Technologie des Semi-conducteurs pour l'Energétique (Algeria); Adel Khan, A (Algeria); Fatsah Moulay, Kamel Agroui, Ctr. de Recherche en Technologie des Semi-conducteurs pour l'Energétique (Algeria); Chiara Baretta, Gernot Oreski, Polymer Competence Ctr. Leoben GmbH (Austria); Matthias Jaunich, Federal Institute for Materials Research and Testing (Germany)


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#### Determination of glass transition temperature of PVB encapsulant material as host material for nanotechnology application in photovoltaic conversion

Paper 10759-8

Time: 5:00 PM - 5:20 PM

Author(s): George Collins, New Jersey Institute of Technology (United States); Kamel Agroui, Ctr. de Recherche en Technologie des Semi-conducteurs pour l'Energétique (Algeria); Bernd Köll, TROSIFOL (Germany)

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## Session Plen: Sunday Evening Plenary Session

Sunday 19 August 2018

6:00 PM - 7:05 PM

Location: Conv. Ctr. Ballroom 20A

6:00 to 6:05 pm: **Welcome and opening remarks**

6:05 to 6:35 pm: **Attosecond pulses generated in gases and solids**, Paul B. Corkum, Univ. of Ottawa and National Research Council of Canada (Canada)


6:35 to 7:05 pm: **Metasurface flat optics: unifying semiconductor manufacturing and lens making**, Federico Capasso, John A. Paulson School of Engineering and Applied Sciences, Harvard Univ. (United States)

### **Attosecond pulses generated in gases and solids (Conference Presentation) (Plenary Presentation)**

Paper 10753-201

Time: 6:05 PM - 6:35 PM

Author(s): Paul B. Corkum, Univ. of Ottawa (Canada)


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### **Metasurface flat optics: Unifying semiconductor manufacturing and lens making (Conference Presentation) (Plenary Presentation)**

Paper 10719-202

Time: 6:35 PM - 7:05 PM

Author(s): Federico Capasso, Harvard John A. Paulson School of Engineering and Applied Sciences (United States)

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## MONDAY 20 AUGUST

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## Session 5: Thermal Radiation Enhancement

Monday 20 August 2018

8:30 AM - 12:10 PM

Location: Conv. Ctr. Room 29D


Session Chairs: [Peter Bermel](#), Purdue Univ. (United States) ; Owen D. Miller, Yale Univ. (United States) ; [Mowafak M. Al-Jassim](#), National Renewable Energy Lab. (United States)

### **Nanophotonics for thermal management of outdoor structures (Invited Paper)**

Paper 10759-14

Time: 8:30 AM - 9:00 AM

Author(s): Wei Li, Yu Shi, Zhen Chen, Shanhui Fan, Stanford Univ. (United States)


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### **Reconfigurable metasurfaces for dynamic tuning of thermal sources**

Paper 10759-15

Time: 9:00 AM - 9:20 AM

Author(s): Enas Sakr, Peter Bermel, Purdue Univ. (United States)


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### **Design, control, and characterisation of switchable radiative cooling (Invited Paper)**

Paper 10759-16

Time: 9:20 AM - 9:50 AM

Author(s): Angus R. Gentle, Matthew C. Tai, Simon White, Matthew Arnold, Michael Cortie, Geoff B. Smith, Univ. of Technology, Sydney (Australia)


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### **Enhanced radiative heat transfer in structured media via inverse design (Invited Paper)**

Paper 10759-17

Time: 9:50 AM - 10:20 AM

Author(s): Alejandro W. Rodriguez, Princeton Univ. (United States)

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## Coffee Break 10:20 AM - 10:50 AM

### **Thermodynamic limits of energy harvesting from outgoing thermal radiation**

Paper 10759-18

Time: 10:50 AM - 11:10 AM

Author(s): Siddharth Buddhiraju, Parthiban Santhanam, Shanhui Fan, Stanford Univ. (United States)

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### **Pareto optimal spectrally selective emitters for thermophotovoltaics via weak absorber critical coupling (Invited Paper)**

Paper 10759-19

Time: 11:10 AM - 11:40 AM

Author(s): Jonathan Foley, William Paterson Univ. (United States); Nari Jeon, Argonne National Lab. (United States); Alex Martinson, Argonne National Laboratory (United States); Stephen K. Gray, Argonne National Lab. (United States)

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**CPV & CSP on a single thermos-photoluminescent crystal for storable energy at record low costs** (*Invited Paper*)

Paper 10759-38

Time: 11:40 AM - 12:10 PM

Author(s): Nimrod Kruger, Assaf Manor, Carmel Rotschild, Technion-Israel Institute of Technology (Israel)

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**Lunch Break 12:10 PM - 2:00 PM**

## Session 6: Novel Phenomena in Thermal Radiation

Monday 20 August 2018

2:00 PM - 3:00 PM

Location: Conv. Ctr. Room 29D

Session Chairs: [Peter Bermel](#), Purdue Univ. (United States) ; Owen D. Miller, Yale Univ. (United States) ; [Mowafak M. Al-Jassim](#), National Renewable Energy Lab. (United States)

**Conversion of light energy into heat and hot electrons using hybrid nanostructures with plasmonic hot spots** (*Invited Paper*)

Paper 10759-20

Time: 2:00 PM - 2:30 PM

Author(s): Alexander Govorov, Ohio Univ. (United States); Lucas Besteiro, Institute National de la Recherche Scientifique (Canada)


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**A direct confirmation of super-Planckian thermal radiation emitted from a metallic photonic-crystal** (*Invited Paper*)

Paper 10759-21

Time: 2:30 PM - 3:00 PM

Author(s): Shawn-Yu Lin, Rensselaer Polytechnic Institute (United States); Sajeev John, Univ. of Toronto (Canada); Mei-Li Hsieh, National Chiao-Tung Univ. (Taiwan)

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**Coffee Break 3:00 PM - 3:30 PM**

## Session 7: Keynote Session

Monday 20 August 2018

3:30 PM - 5:00 PM

Location: Conv. Ctr. Room 29D

Session Chair: [Peter Bermel](#), Purdue Univ. (United States)



**Gang Chen**




**Myles A. Steiner**

**Using nanostructures to tailor thermal radiation for clean energy and clean water applications** (*Keynote Presentation*)

Paper 10759-22

Time: 3:30 PM - 4:15 PM

Author(s): Svetlana V. Boriskina, Gang Chen, Massachusetts Institute of Technology (United States)


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**Chasing a 50% efficient solar cell, and fun things we've done along the way** (*Keynote Presentation*)

Paper 10759-23

Time: 4:15 PM - 5:00 PM

Author(s): Myles A. Steiner, National Renewable Energy Lab. (United States)


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## Session PMon: Posters-Monday


Monday 20 August 2018  
5:30 PM - 7:30 PM  
Location: Conv. Ctr. Room 20C

Conference attendees are invited to view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, view poster presentation guidelines at <http://spie.org/OPPosterGuidelines>.

### Durability evaluation of PV modules using image processing tools

Paper 10759-36  
Time: 5:30 PM - 7:30 PM  
Author(s): Jiawei Wu, Eric Chan, Raginee Yadav, Hamsini Gopalakrishna, GovindaSamy TamizhMani, Arizona State Univ. (United States)  
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### Study on pointing stability control and photoelectric conversion ratio for wireless laser energy transmission

Paper 10759-37  
Time: 5:30 PM - 7:30 PM  
Author(s): Zhiwei Sun, Bingxin Shi, Guoqiang Huan, Shuang Yan, Bo Liu, Fufei Yang, China Space Sanjiang Group Corp. (China)  
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**TUESDAY 21 AUGUST**


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## Session 8: Novel Concepts in Solar Energy Conversion


Tuesday 21 August 2018  
8:20 AM - 10:00 AM  
Location: Conv. Ctr. Room 29D

Session Chair: [Matthew T. Sheldon](#), Texas A&M Univ. (United States)


### Ultra-high luminescence efficiency as a technology enabler: Solar cells, thermophotovoltaics, and optoelectronic refrigerators *(Invited Paper)*

Paper 10759-24  
Time: 8:20 AM - 8:50 AM  
Author(s): Tianyao P. Xiao, Eli Yablonovitch, Univ. of California, Berkeley (United States)  
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### Wrinkled light harvesting coatings for photovoltaics *(Invited Paper)*

Paper 10759-25  
Time: 8:50 AM - 9:20 AM  
Author(s): Guillaume Gomard, Raphael Schmager, Senta Schauer, Karlsruher Institut für Technologie (Germany); Ruben Hüinig, Zentrum für Sonnenenergie- und Wasserstoff-Forschung Baden-Württemberg (Germany); Kaining Ding, Forschungszentrum Jülich GmbH (Germany); Ulrich W. Paetzold, Bryce S. Richards, Uli Lemmer, Matthias Worgull, Hendrik Hölscher, Karlsruher Institut für Technologie (Germany)  
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### Volume hologram replication system for photovoltaic applications

Paper 10759-26  
Time: 9:20 AM - 9:40 AM  
Author(s): Benjamin D. Chrysler, Raymond K. Kostuk, The Univ. of Arizona (United States)  
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### Coupled spectral-hybridizable-discontinuous-Galerkin modeling of thin-film photovoltaic solar cells

Paper 10759-28  
Time: 9:40 AM - 10:00 AM  
Author(s): Tom H. Anderson, Benjamin J. Civiletti, Peter B. Monk, Univ. of Delaware (United States); Akhlesh Lakhtakia, The Pennsylvania State Univ. (United States)  
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**Coffee Break 10:00 AM - 10:30 AM**

## Session 9: High Efficiency Sunlight to Power

Tuesday 21 August 2018  
10:30 AM - 11:30 AM  
Location: Conv. Ctr. Room 29D


Session Chair: Jeremy N. Munday, Univ. of Maryland, College Park (United States)

**Two for one photon deal: Prospects for singlet fission photovoltaics** *(Invited Paper)*

Paper 10759-30

Time: 10:30 AM - 11:00 AM


Author(s): Timothy W. Schmidt, Shyamal K. K. Prasad, The Univ. of New South Wales (Australia)

[Add To My Schedule](#) **Detailed balance efficiencies for luminescent solar concentrators with aligned semiconductor nanorods** *(Invited Paper)*

Paper 10759-31

Time: 11:00 AM - 11:30 AM

Author(s): Matthew T. Sheldon, Texas A&amp;M Univ. (United States)

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**Lunch/Exhibition Break 11:30 AM - 1:00 PM**

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**Session 10:  
Photon Management for Solar Power**

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Tuesday 21 August 2018

1:00 PM - 3:20 PM

Location: Conv. Ctr. Room 29D

Session Chair: Jeremy N. Munday, Univ. of Maryland, College Park (United States)


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**Resonant coupling for light trapping in colloidal quantum dot photovoltaics** *(Invited Paper)*

Paper 10759-32

Time: 1:00 PM - 1:30 PM


Author(s): Fiona Beck, The Australian National Univ. (Australia); Gerasimos Konstantatos, ICFO - Institut de Ciències Fotòniques (Spain)

[Add To My Schedule](#) **Two-layer anti-reflection coatings with optimized sub-bandgap reflection for solar modules** *(Invited Paper)*

Paper 10759-33

Time: 1:30 PM - 2:00 PM


Author(s): Ian Slauch, Univ. of Minnesota, Twin Cities (United States); Michael G. Deceglie, Timothy J. Silverman, National Renewable Energy Lab. (United States); Vivian E. Ferry, Univ. of Minnesota, Twin Cities (United States)

[Add To My Schedule](#) **Managing the solar spectrum at sub-wavelength scales: Nanowire enabled new PV concepts** *(Invited Paper)*

Paper 10759-34

Time: 2:00 PM - 2:30 PM

Author(s): Nasim Tavakoli, AMOLF (Netherlands); Pablo Romero, Ecole Polytechnique Fédérale de Lausanne (Switzerland); Mark Aarts, AMOLF (Netherlands); Anna Fontcuberta i Morral, Ecole Polytechnique Fédérale de Lausanne (Switzerland); Esther Alarcon-Llado, AMOLF (Netherlands)

[Add To My Schedule](#) **Switchable photovoltaic windows based on metal halide perovskites** *(Invited Paper)*

Paper 10759-35

Time: 2:30 PM - 3:00 PM

Author(s): Lance Wheeler, National Renewable Energy Lab. (United States)

[Add To My Schedule](#) **Radial junction crystalline silicon solar cells with an efficiency of over 20% using vertically aligned microwires**

Paper 10759-42

Time: 3:00 PM - 3:20 PM

Author(s): Kwanyong Seo, UNIST (Korea, Republic of); Inchan Hwang, Ulsan National Institute of Science and Technology (Korea, Republic of)

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