

13th DOE/NREL Hands-On PV Experience (HOPE)

National Renewable Energy Laboratory | Golden, CO, USA

July 14-19, 2024



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Office of Energy Efficiency and Renewable Energy, operated by the Alliance for Sustainable Energy, LLC.**

SCHEDULE FOR DOE/NREL HANDS-ON PV EXPERIENCE (HOPE)

Sunday, July 14, 2024

1pm - 10pm: Room check-in Colorado School of Mines (CSM), Maple Hall, 1733 Maple St., Golden, CO 80401.

Dinner on your own. There are many restaurants within a 10- to 20-minute walk. There is a Safeway within a 10-minute walk.

7:00 Introductions and expectations for the week (Spruce Hall, Level 5 lounge; Silvana Ovaite & Rachael Arnold)

Monday, July 15, 2024

7:00 Breakfast

7:35 Board shuttle bus CSM, from next to cafeteria

7:40 Shuttle bus will be departing

7:55 Shuttle drop-off at NREL RSF
Check-in - NREL (RSF)

SERF Auditorium (C108)

8:00 Welcome & Safety Orientation (Silvana Ovaite, Leeroy Cienega, Environment, Safety, Health and Quality Office)

8:30 Nancy Haegel "The US PV Goals for a Manufacturing Ecosystem"

9:30 Teresa Barnes "Research in Commercial Technologies: CdTe and Si"

10:30 Break (15 mins)

10:45 Joe Berry "Next Gen PV: Perovskites"

11:45 Discussion of Morning Sessions, Working Lunch (SERF Solarium)

12:45 Divide groups into two groups of 10 students at random
Group A to take Shuttle to OTF

12:45 Group A: PV Module Certification (Nikos Kopidakis, [OTF 105](#))

Group B: PV Cell Certification (Tao Song, [SERF E221](#))

1:25 **Shuttle shift for teams at mid-point, with group A going from OTF to SERF, and group B going from SERF to OTF**

1:35 Group B: PV Module Certification (Nikos Kopidakis, [OTF 105](#))

Group A: PV Cell Certification (Tao Song, [SERF E221](#))

2:20 **Group B to take Shuttle from OTF to SERF**

2:30 Break (15 min)

2:45 Bill McMahon "Tandems"

3:45 **Break and transition to RSF Main Entrance Courtyard**

4:00 Poster Session (RSF's Main Entrance Courtyard)

5:00 Shuttle bus (meet at RSF) to returns to CSM

Dinner on your own

Tuesday, July 16, 2024

7:00 Breakfast

7:40 Shuttle bus will be departing CSM, from next to cafeteria

7:55 Arrive at NREL - SERF C108

Break into groups:

Group 1 (CdTe)

Group 2 (III-V)

Group 3 (Perovskites A)

Group 4 (Perovskites B)

Group 5 (Systems)

8:00 Group 1: CdTe Fabrication Session I (Eric Colegrove, Joel Duenow, Robert Morrissey, Andrea Matthew, [S&TF 138, 204, 205, 203B](#))

Group 2: III-V Fabrication Session I (Myles Steiner, Michelle Young, Kevin Schulte, [SERF W128](#) for MOVPE, [S&TF 203](#) for HVPE)

Group 3: Perovskites Fabrication A I (Marc Migliozi, [SERF C212, W129](#))

Groups 4 & 5: Modules, Reliability and Field Hands-On Experience (Timothy Silverman, Rachael Arnold, Jimmy Newkirk, [SERF W214, VTIF 106, OTF 110](#))

9:30 Break (10 mins) – to be taken whenever convenient for each group

12:00 Continuing discussion of Morning Sessions, Working Lunch (SERF Solarium)

1:00 Break into groups:

Group 1: CdTe Fabrication Session II (Eric Colegrove, Joel Duenow, Robert Morrissey, Joshua Brown, [S&TF 204, 205, 203B, 137](#))

Group 2: III-V Fabrication Session II (Myles Steiner, Michelle Young, Sarah Collins, [SERF Cleanroom, C113](#))

Group 3: Perovskites Fabrication A II (Marc Migliozi, [SERF C212, W129](#))

Group 4: Perovskites Fabrication B I (Melissa Davis, [SERF C212, C215, W212](#))

Group 5: Si Fabrication Session (San Theingi, Marcus Kaupa, Bill Nemeth, Thien Truong, [SERF C117 PDIL Bay 3](#))

2:30 Break (10 mins) – to be taken whenever convenient for each group

5:00 Shuttle bus (meet at SERF) returns to CSM.

6:30 Panel Discussion and Pizza on "Professional Career and Postdoc Opportunities" at [CSM, Spruce Treehouse Community Room](#)

Dr. Anna Berseneva (Director Fellowship at NREL)

Dr. Tito Busani (UNM Faculty)

Dr. Ashley Gauding (NREL Early Career Researcher)

Dr. Mike Kempe (NREL Senior Research Staff)

Moderators: Rachael Arnold

Pizza will be provided at the panel for dinner

8:00 Panel Ends

Wednesday, July 17, 2024

7:00 Breakfast

7:40 Shuttle bus will be departing CSM, from next to cafeteria

7:55 Arrive at NREL - SERF C-108)

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- 8:00 Break into groups:
Groups 1, 2, 3: Modules, Reliability and Field Hands-On Experience (Timothy Silverman, Rachael Arnold, Jimmy Newkirk, [SERF W214](#), [OTF 110](#))
Group 4: Perovskites Fabrication B II (Melissa Davis, [SERF C212](#), [C215](#), [W212](#))
Group 5: PV Systems Session (Byron McDanold, Bill Sekulic, [C111](#), [BARN](#), [C106](#))
- 12:00 Summary Discussion of Fabrication Sessions Working Lunch (SERF Solarium)
- 1:00 PV in Space panel: Kaitlyn VanSant (NREL/NASA), Ian Sellers (U Buffalo), and M. Kelzenberg (Caltech)
- 2:30 Life Cycle Assessment and Environmental Product Declarations for PV: Jasmina Burek (UML)
- 3:15 Break (15 mins)
- 3:30 Measurement & Characterization Lab Sessions:
1. SEM/CL/EBIC with Harvey Guthrey (SERF E004/5)
 2. PL, EL, DLIT imaging with Darius Kuciauskas & Dana Kern (S&TF - & SERF E217)
 3. SIMS Characterization with Steve Harvey & Matt Young (SERF E002)
 4. UV-Vis/Ellipsometry Characterization with Paul Ndione (SERF & FTLB)
- 5:00 Shuttle bus (meet at SERF C-108) will return to CSM

Dinner on your own

Thursday, July 18, 2024

- 7:00 **Breakfast**
- 7:40 **Shuttle bus will be departing CSM, from next to cafeteria**
- 7:55 **Arrive at NREL Cafeteria in front of BARN Field**
- 8:00 AgriPV Research at NREL, Jordan MacNick (InSPIRE)
- 8:30 "US Industry Perspectives", Paolo Macario (Silfab CEO)
- 9:30 "PV second life", Rich Stromberg (Equitable PV Solutions)
- 10:15 Break (15 mins)
- 10:00 Measurement & Characterization Lab Sessions:
1. Scanning Kelvin Probe with Chun-Sheng Jiang (S&TF 141)
 2. PV Packaging Failures (Hi-Pot) with Jimmy Newkirk & Rachael Arnold (OTF)
 3. X-ray/ultraviolet photoelectron spectroscopy (XPS/UPS) with Craig Perkins (S&TF 140)
 4. CV, DLCP, DLTS, admittance with Steve Johnston (S&TF 135)
- 12:00 Discussion of M&C Sessions Working Lunch (SERF Solarium)
- 1:00 "Siting and Installation in the Practice" Prof. Randy Ellingson and Prof. Deidra Hodges
- 2:15 Afternoon Tea with NREL MCCC Center
- 3:15 Break (15 mins)
- 3:30 Measurement & Characterization Lab Sessions:
1. SEM/CL/EBIC with Harvey Guthrey (SERF E004/5)
 2. SIMS Characterization with Steve Harvey & Matt Young

- (SERF E002)
3. MJ Characterization with Myles Steiner (SERF C125, C211)
 4. X-Rays with Dennice Roberts (S&TF 127, 137 & SERF C211)
- 5:00 Shuttle bus (meet at SERF C-108) returns to CSM

Dinner on your own

Friday, July 19, 2024

- 7:00 **Breakfast**
- 7:40 **Shuttle bus will be departing CSM, from next to cafeteria**
- 7:55 **Arrive at NREL - SERF C-108**
- 8:00 PV Device Characterization:
Group 1,3,4: Perovskites A/B & CdTe (Rosie Bramante [SERF C215](#), Matt Reese, Eric Colegrove, [S&TF 137](#), [SERF C209](#))
Group 2: III-V (Myles Steiner, [SERF C125](#), [C211](#))
Group 5: Silicon (Dirk Steyn, [SERF C121](#) & San Theingi & Thien Truong, [S&TF 135](#))
- 10:15 Break (15 mins)
- 10:30 Solar Industry Panel
Tanner Scott, Silicon Ranch
Benjamin Lee, QCells
Mahisha Amarashinghe, First Solar
Moderator: Aubrey Jackson
- 12:00 Discussion of Solar Industry Panel and Summary of Characterization and M&C Sessions Working Lunch (SERF Solarium)
- 1:00 "c-Si supply Chain & SETO Fellowships" Larkin Sayre (ORISE Fellow, SETO)
- 2:00 Meet with NREL scientists (arranged in advance)
- 3:00 Break (15 mins)
- 3:15 Student closing presentations: takeaways to share with home institution (5 min. each)
- 4:00 Review of HOPE and student survey – SERF C-108 (Silvana Ovaitt)
- 5:00 Shuttle bus (meet at SERF C-108) returns to CSM

Dinner on your own

Saturday, July 20, 2024

- Check out (by 10:00 AM)**
Students are welcome to coordinate hikes or other activities before returning home.