

ZACHARY CHARLES HOLMAN

Assistant Professor

School of Electrical, Computer, and Energy Engineering
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APPOINTMENTS

- 10/2016– **Trustees of ASU Professor**
School of Electrical, Computer, and Energy Engineering, Arizona State University
(Tempe, Arizona)
- 03/2013– **Assistant Professor**
School of Electrical, Computer, and Energy Engineering, Arizona State University
(Tempe, Arizona)
- 07/2014–08/2014 **Visiting Professor**
Photovoltaics and Thin-Film Electronics Laboratory, Institute of Microengineering, Ecole
Polytechnique Fédérale de Lausanne (Neuchâtel, Switzerland)
- 10/2010–03/2013 **Postdoctoral Researcher**
Photovoltaics and Thin-Film Electronics Laboratory, Institute of Microengineering, Ecole
Polytechnique Fédérale de Lausanne (Neuchâtel, Switzerland)

EDUCATION

- 10/2010 **Doctor of Philosophy**
Mechanical Engineering; Nanoparticle Science and Engineering (minor), University of
Minnesota (Minneapolis, Minnesota)
Dissertation: *Germanium nanocrystal solar cells*; Advisor: Prof. Uwe Kortshagen
- 05/2005 **Bachelor of Arts**
Physics, Reed College (Portland, Oregon)
Thesis: *Electron transport in amorphous silicon*; Advisor: Prof. John Essick

RESEARCH INTERESTS

Broad research interests span the fields of solar cells, coatings, nanotechnology, semiconductors, plasmas, and aerosols. Specific interests include silicon-based tandem solar cells, contacts to solar cells, light management in silicon solar cells, novel uses of nanoparticles in devices, semiconductor nanoparticles, optical and electronic properties of nanoscale materials, plasma synthesis of powders, and deposition of powders and thin films.

AWARDS & HONORS

- 2019 IEEE Stuart R. Wenham Young Professional Award
- 2019 NSF CAREER Award
- 2018 Gordon and Betty Moore Foundation Inventor Fellowship
- 2018 Fulton Entrepreneurial Professorship
- 2017 ASU Fulton Schools of Engineering Top 5% Teaching Award
- 2016 Trustees of ASU Professorship
- 2016 Joseph C. Palais Distinguished Faculty Scholar Award
- 2016 Fulton Outstanding Assistant Professor Award

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2015	ASU Fulton Schools of Engineering Top 5% Teaching Award
2014	ASU Senior Sustainability Scientist
2013	3 rd International Conference on Crystalline Silicon Photovoltaics top 5% of papers
2010	NSF EAPSI Fellowship at the Tokyo Institute of Technology
2010	University of Minnesota Doctoral Dissertation Fellowship
2008	Particle Society of Minnesota Scholarship
2007	18 th International Symposium on Plasma Chemistry Best Paper Award
2005	NSF IGERT Fellowship at the University of Minnesota

AWARDS WON BY STUDENTS AND POSTDOCS

2018	ASU Dean's Fellowship (Barry Hartweg)
2018	Palais' Outstanding Doctoral Student Award (Jason Yu)
2018	Venture Madness Hardware Tech Winner (Peter Firth)
2017	European PV Solar Energy Conference and Exhibition Student Award (Jason Yu)
2017	IEEE Photovoltaic Specialists Conference Most Outstanding Technical Contribution (Jason Yu)
2017	MRS Graduate Student Silver Award (Jason Yu)
2017	Rice Business Plan Competition Department of Energy Cleantech University Prize (Peter Firth and Jonathan Bryan)
2017	ASU Innovation Open SRP Innovation Award (Peter Firth)
2017	SiliconPV Award (Jason Yu)
2017	SiliconPV Award (Mathieu Boccard)
2017	ASU Graduate and Professional Student Association Research Award (Jason Yu)
2017	ThinkSwiss Research Scholarship (Nathan Rodkey)
2017	ARCS (Achievement Awards for College Scientists) Award (Peter Firth)
2017	Zero Mass Water Materials Award (Peter Firth)
2017	DOE Science Undergraduate Laboratory Internship at NREL (Nathan Rodkey)
2017	Rhodes Scholarship (Ngoni Mugwisi)
2016	Palais Senior Design Prize (Heliovation senior design team)
2016	Arizona Student Energy Conference Distinguished Poster Award (Jason Yu)
2016	IEEE Photovoltaic Specialists Conference Best Paper Award (Mathieu Boccard)
2016	IEEE Photovoltaic Specialists Conference Best Poster Award (Mathieu Boccard)
2016	ASU Dean's Fellowship (Will Weigand)
2016	ASU Dean's Fellowship (Jonathan Bryan)
2016	ASU New Venture Challenge Winner (Peter Firth)
2016	ARCS (Achievement Awards for College Scientists) Award (Peter Firth)
2016	Micron Technology Team Prize (Hall Effect senior design team)
2015	IEEE Photovoltaic Specialists Conference Best Poster Award (Jason Yu)
2015	Harold and Lucille Dunn Memorial Engineering Scholarship (Jason Yu)
2015	Barrett Electronic Materials Fellowship (Peter Firth)
2015	ASU Dean's Fellowship (Peter Firth)
2015	Arizona Student Energy Conference Distinguished Poster Award (Priyaranga Koswatta)
2015	NSF Graduate Research Fellowship (Joe Carpenter)

2014	NSF Integrative Graduate Education and Research Traineeship (Michael Bernstein)
2014	NSF Integrative Graduate Education and Research Traineeship (Joe Carpenter)
2014	University Graduate Fellowship (Salman Manzoor)

PROFESSIONAL ACTIVITIES & OUTREACH

- Co-leader of Thrust 2 of the Quantum Energy and Sustainable Solar Technology ERC (2015–)
- Symposium Organizer for the E-MRS Spring Meeting (2017)
- Symposium Organizer for the IEEE Photovoltaic Specialists Conference (2016, 2017, 2018)
- Lead Symposium Organizer for the MRS Spring Meeting (2016, 2018)
- Symposium Organizer for the MRS Spring Meeting (2015)
- Session Chair for IEEE Photovoltaic Specialists Conference, MRS Spring Meeting, SiliconPV (2013–)
- Member of the Fulton Schools of Engineering Dean’s Research Committee (2017–)
- Member of the ASU Goldwater Materials Science Facility Steering Committee (2014–2016)
- Member of the ASU Leadership Academy Materials Team (2015–2016)
- Member of the ASU University Undergraduates Standards Committee (2015–2017)
- Member of the ASU Instrument Design and Fabrication Board (2016–)
- Member of the ASU Eyring Materials Center Board (2017–)
- Member of the ASU ECEE Faculty Search Committee in photovoltaics (2015, 2018)
- Member of the ASU ECEE Website Design Committee (2015)
- Member of the ASU Faculty Working Group for the MS degree in Innovation and Venture Development
- Designer and instructor of a new course entitled *EEE 598: Manuscript Writing for Engineers*
- Reviewer for funding bodies, including NSF, and journals, including *Journal of Applied Physics*, *ACS Nano*, *Solar Energy Materials and Solar Cells*, *Thin Solid Films*, *Nanotechnology*, *IEEE Journal of Photovoltaics*
- Volunteer Scientist for ASU’s Night of The Open Door, ASU’s Summer Transportation Institute, Cesar Chavez High School, Minnesota FIRST LEGO League, and the Science Museum of Minnesota

FUNDING

03/2019–02/2024	NSF CAREER, “CAREER: Transparent, passivating, and carrier-selective heterojunction contacts for silicon and cadmium telluride solar cells,” (PI)
01/2019–12/2021	DOE SETO, “Diagnosing and overcoming recombination and resistive losses in non-silicon solar cells using a silicon-inspired characterization platform,” (PI)
01/2019–12/2021	DOE SETO, “Bringing high-efficiency silicon solar cells with heterojunction contacts to market with a new, versatile deposition technique,” (PI)
01/2019–06/2020	DOE SETO, “Wide-bandgap polycrystalline III-Vs as transparent, carrier-selective heterojunction contacts for silicon photovoltaics,” (Co-PI)
01/2019–12/2020	NREL, “ASU-NREL joint silicon solar cell research: passivated contacts, metallization, and bulk defects,” (PI)
01/2019–12/2021	ARPA-E DAYS, “Solid state thermal battery,” (Co-PI)
10/2018–09/2020	Fulton Entrepreneurial Professors Program, “Aerosol impaction-driven assembly of functional nanomaterial coatings,” (PI)

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- 10/2018–09/2021 Moore Foundation Inventor Fellowship, “Aerosol impaction-driven assembly of functional nanomaterial coatings,” (PI)
- 10/2018–09/2019 FSE/CLAS/AMI Seed, “Diamond and III-nitride integration for ultra-gap devices (PI)
- 06/2018–05/2019 NSF SBIR, “Non-thermal plasma source for functional metal-oxide nanoparticle coatings,” (Co-PI)
- 02/2018–09/2018 NREL, “PERC and SHJ silicon solar modules with high infrared reflectance,” (Co-PI)
- 01/2018–01/2021 ARENA, “Hydrogenated and hybrid heterojunction p-type silicon PV cells R&D project,” (Co-PI)
- 10/2017–09/2020 DOE PVRD-II, “Perovskite-on-silicon tandem solar cells,” (Co-PI)
- 10/2017–09/2019 DOE DuraMAT, “Silicon IBC modules with copper foil electrodes: Failure mechanisms of electrically conductive adhesive bonds between cells and foil,” (PI)
- 10/2017–09/2018 BAPVC, “Low capex solar manufacturing enabled by perovskite semiconductors,” (Co-PI)
- 08/2017–01/2019 ACAP, “P-type hybrid heterojunction solar cells,” (Co-PI)
- 05/2017–04/2019 NSF EAGER, “Collaborative research: 30%-efficient, stable perovskite/silicon monolithic tandem solar cells,” (PI)
- 02/2017–04/2017 NSF SBIR, “The aerosol-spray deposition of photoluminescent quantum-dot coatings on substrates,” (Co-PI)
- 01/2017–12/2019 ARPA-E SHIELD, “Single-pane windows with insulating sprayed particulate coatings,” (PI)
- 12/2016–11/2017 NSF SBIR, “Low damage sputter magnetron for silicon heterojunction PV production,” (Co-PI)
- 11/2016–10/2018 DOE NextGen-III, “Developing efficient silicon cells for perovskite/silicon tandem devices,” (Co-PI)
- 09/2016–08/2017 American Jobs Project, “Arizona’s advanced energy landscape,” (PI)
- 08/2016–07/2019 DOE PVRD, “Monolithic silicon module manufacturing at < 0.40 \$/W,” (PI)
- 08/2016–07/2018 DOE PVRD, “15%-efficiency (Mg,Zn)CdTe solar cells with 1.7 eV bandgap for tandem applications,” (PI)
- 08/2016–07/2017 SolarReserve, “Hybrid heliostat development,” (PI)
- 07/2016–01/2017 FSE Technology Innovation Laboratory, “Advanced manufacturing of nanoparticle-based coatings,” (PI)
- 06/2016–05/2017 DOE PVRD SIPS, “A new class of tandems: Optically coupled III-V/silicon module with outdoor efficiency exceeding 30%,” (PI)
- 05/2016–11/2016 FSE Technology Innovation Laboratory, “Hybrid heliostat for combined photovoltaic and solar thermal power plants,” (PI)
- 04/2016–03/2019 NSF REU Site, “Solar energy research for the Terawatt Challenge,” (PI)
- 01/2016–12/2018 DOE SuNLaMP, “Overcoming bottlenecks to low-cost, high-efficiency Si PV and industrially relevant, ion implanted interdigitated back passivated contact cell development,” (Co-PI)
- 09/2015–08/2018 NSF Energy for Sustainability, “Collaborative research: 30%-efficient III-V/silicon tandem solar cells,” (PI)

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- 08/2015–07/2020 NSF ERC, “Nano-Enabled Water Treatment: NEWT,” (Co-PI)
- 06/2015–05/2020 USAID, “U.S.-Pakistan Centers for Advanced Studies in Energy,” (Co-PI)
- 05/2015–04/2016 ARPA-E I-Corps Supplement, “PVMirror: Cost competitive solar with storage,” (PI)
- 02/2015–01/2017 RCSA Scialog, “Scalable tandem architecture for solar water splitting,” (PI)
- 06/2014–05/2017 ARPA-E FOCUS, “PVMirror: A solar concentrator mirror incorporating PV cells,” (PI)
- 09/2013–08/2016 DOE FPACE-II, “Thin silicon solar cells: A path to 35% Shockley-Queisser limits,” (Co-PI)
- 08/2011–07/2021 NSF/DOE ERC, “Quantum Energy and Sustainable Solar Technologies: QESST,” (Co-PI)
- 06/2010–08/2010 NSF EAPSI, “Novel solar cells using silicon nanocrystals synthesized in an atmospheric-pressure plasma,” (PI)

STUDENTS, POSTDOCS, AND STAFF ADVISED

- Ph.D.: Jonathan Bryan (2016–) Joe Carpenter (2014–)
Peter Firth (2015–) Barry Hartweg (2018–)
Ashling Leilaouioun (2013–2018) Salman Manzoor (2014–)
Jianwei Shi (2013–2018) Will Weigand (2016–)
Jason Yu (2014–2018)
- M.S.: Michael Bernstein (2014–2016) Prateek Garg (2013–2015)
Peter Firth (2014–2015) Trent Hoffman (2016–2017)
Alec Jackson (2014–2016) Priyaranga Koswatta (2013–2016)
Salman Manzoor (2013–2014) Sujyot Mony (2018– ; MORE)
- Undergraduate: Claire Block (2017–2018) Joe Carpenter (2013–2014; FURI)
Christopher Chen (2017–) Angelo Delluomo (2015–2016; FURI)
Angelica Guzman (2018– ; FURI) Justin Huxel (2017– ; FURI)
Sanketh Kamath (2013–2015; FURI) Mark Kapron (2017– 2018; FURI)
Ngoni Mugwisi (2016–2017; Barrett) Corbin Ott (2017–2018; FURI)
Marcial Rodarte (2016–2017) Nathan Rodkey (2015–2018; FURI, Barr.)
Kari Sanford (2015–2017; FURI, Barrett) Nicholas Scheenstra (2015–2016; FURI)
Daniel Sinclair (2017–2018; FURI) Marshall Styers (2015–2016)
Brian Wu (2018– ; FURI)
- Postdoc: Mathieu Boccard (2014–2016) Martyn Fisher (2016–2018)
Shalinee Kavadiya (2018–) Arthur Ono (2017–)
Shannon Poges (2018–) Drew Swanson (2016–2017)
- Staff: Kathryn Fisher (2014–) Nathan Rodkey (2018–)
- Research faculty: Jason Yu (2018–)
- REU visitor: Juan Asencio (2018) Ethan Bendau (2015)
Emily Dafflon (2013) Amine El Mahati (2016)
Mateo Estrada (2018) William Firth (2015)
Jewel Haik (2018) Jakob Häusele (2017)
Richelle Javier (2018) Culver McWhirter (2016)
Stefan Mercado (2017) Syeda Mohsin (2017)
Noemi Mundhaas (2017) Tien Ngo (2017)
Yuji Okamoto (2017) Jones Ou (2016)
David Quispe (2017) Matthew Warner (2016)

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- PCASE visitor: Saleem Ahmed (2016) Maham Akhlaq (2017)
Kamran Alam (2017) Asad Ali (2016)
Asghar Ali (2016) Waqar Ali (2016)
Ijaz Husnain (2016) Mahmood Jamil (2016)
Mehwish Javed (2016) Maria Kanwal (2018)
Sundas Khan (2018) Maoz (2017)
Warda Mushtaq (2016) Shah Naveed (2017)
Farah Qazi (2016) Syeda Qudsia (2016)
Hira Rehman (2017) Asma Shamim (2017)
Fazal Subhan (2018)

COURSES TAUGHT

- EEE 352: Properties of Electronic Materials (F15, F16, F17, F18)
- EEE 436/591: Fundamentals of Solid State Devices (F13, F14, S16)
- EEE 465/591: Photovoltaic Energy Conversion (S15)
- EEE 498/591: Solar Energy (S14)
- EEE 536: Semiconductor Characterization (S17)
- EEE 598: Manuscript Writing for Engineers (F14, F15, F17, F18)
- ASU 101: The ASU Experience (F14)

PEER-REVIEWED PUBLICATIONS

(ASU students in red; ASU postdocs and staff in orange)

65. X. Meng, K. Fisher, L. Reinhart, W. Taylor, M. Stuckelberger, Z. Holman, and M. Bertoni, "Lamination of silicon solar cells on curved surfaces and incorporation of polymeric optical films," (under review).
64. A. Basiri, X. Chen, J. Bai, P. Amrollahi, J. Carpenter, Z. Holman, C. Wang, and Y. Yao, "Nature-inspired chiral metasurfaces for circular polarization detection and full-Stokes polarimetric measurement," (under review).
63. S. Fan, Z. Yu, Y. Sun, W. Weigand, P. Dhingra, M. Kim, R. Hool, E. Ratta, Z. Holman, and M. Lee, "20%-efficient epitaxial GaAsP/Si tandem solar cells," (under review).
62. N. Mundhaas, Z. Yu, K. Bush, H.-P. Wang, J. Häusele, S. Kavadiya, M. McGehee, and Z. Holman, "Series resistance measurements of perovskite solar cells using J_{sc} - V_{oc} measurements," *Sol. RRL* 1800378 (2019).
61. D. Chen, M. Kim, J. Shi, B. Vicari Stefani, Z. Yu, S. Liu, R. Einhaus, S. Wenham, Z. Holman, and B. Hallam, "Defect engineering of p-type silicon heterojunction solar cells fabricated using commercial-grade low-lifetime silicon wafers," (under review).
60. A. Atkinson, Y. Bi, P. Firth, O. Alrehaili, P. Westerhoff, and Z. Holman, "Aerosol impaction-driven assembly produces evenly dispersed nanoparticle coating on polymeric water treatment membranes," (under review).
59. A. Leilaieoun, A. Onno, S. Manzoor, J. Shi, K. Fisher, Z. Yu, and Z. Holman, "Power losses in the front transparent conductive oxide layer of silicon heterojunction solar cells: Design guide for single-junction and four-terminal tandem applications," (under review).

58. **Z. Yu**, **K. Fisher**, J. Hyatt, R. Angel, and **Z. Holman**, “GaAs/silicon PVMirror tandem photovoltaic mini-module with 29.6% efficiency with respect to the outdoor global irradiance,” *Prog. Photovoltaics* (in press).
57. **C. Zhang**, **L. Ding**, **M. Boccard**, **T. Nærland**, N. Faleev, S. Bowden, M. Bertoni, C. Honsberg, and **Z. Holman**, “Silicon nitride barrier layers mitigate minority-carrier lifetime degradation in silicon wafers during simulated MBE growth of III–V layers,” *IEEE J. Photovoltaics* **9**, 431–436 (2019).
56. B. Chen*, **Z. Yu***, K. Liu*, X. Zheng, Y. Liu, J. Shi, D. Spronk, **Z. Holman**, and J. Huang, “Grain engineering for perovskite/silicon monolithic tandem solar cells with efficiency of 25.4%,” *Joule* **3**, 1–14 (2019). * Denotes co-first author.
55. K. Bush, **S. Manzoor**, K. Frohna, **Z. Yu**, J. Raiford, A. Palmstrom, H.-P. Wang, R. Prasanna, S. Bent, **Z. Holman**, and M. McGehee, “Minimizing current and voltage losses to reach 25%-efficient monolithic two-terminal perovskite-silicon tandem solar cells,” *ACS Energy Lett.* **3**, 2173–2180 (2018).
54. **S. Manzoor**, **J. Häusele**, K. Bush, A. Palmstrom, **J. Carpenter**, **Z. Yu**, S. Bent, M. McGehee, and **Z. Holman**, “Optical modeling of wide-bandgap perovskite and perovskite/silicon tandem solar cells using complex refractive indices for arbitrary-bandgap perovskite absorbers,” *Opt. Express* **26**, 27441–27460 (2018).
53. C. Sun, D. Chen, **W. Weigand**, R. Basnet, S. Pheng Phang, B. Hallam, **Z. Holman**, and D. Macdonald, “Complete regeneration of BO-related defects in n-type upgraded metallurgical-grade Czochralski-grown silicon heterojunction solar cells,” *Appl. Phys. Lett.* **113**, 152105 (2018).
52. **Z. Yu**, **J. Carpenter**, and **Z. Holman**, “Techno-economic viability of silicon-based tandem photovoltaic modules in the United States,” *Nature Energy* **3**, 747–753 (2018).
51. **P. Firth** and **Z. Holman**, “Aerosol impaction-driven assembly system for production of uniform nanoparticle thin films with independently tunable thickness and porosity,” *ACS Appl. Nano Mater.* **1**, 4351–4357 (2018).
50. **S. Husein**, **M. Stuckelberger**, **B. West**, **L. Ding**, F. Dauzou, M. Morales-Masis, M. Duchamp, **Z. Holman**, and M. Bertoni, “Carrier scattering mechanisms limiting mobility in hydrogen-doped indium oxide,” *J. Appl. Phys.* **123**, 245102 (2018). [Editor’s Pick]
49. **D. Swanson**, C. Reich, A. Abbas, T. Shimpi, H. Liu, F. Ponce, J. Walls, Y.-H. Zhang, W. Metzger, W. Sampath, and **Z. Holman**, “CdCl₂ passivation of polycrystalline CdMgTe and CdZnTe absorbers for tandem photovoltaic cells,” *J. Appl. Phys.* **123**, 203101 (2018). [Editor’s Pick]
48. B. Hallam, D. Chen, **J. Shi**, R. Einhaus, **Z. Holman**, and S. Wenham, “Pre-fabrication gettering and hydrogenation treatments for silicon heterojunction solar cells: A possible path to >700 mV open-circuit voltages using low-lifetime commercial-grade p-type Czochralski silicon,” *Sol. RRL* 1700221 (2018).
47. K. Bush, N. Rolston, A. Gold-Parker, **S. Manzoor**, **J. Häusele**, **Z. Yu**, J. Raiford, R. Cheacharoen, **Z. Holman**, M. Toney, R. Dauskardt, and M. McGehee, “Controlling thin film stress and wrinkling during perovskite film formation,” *ACS Energy Lett.* **3**, 1225–1232 (2018).
46. **J. Becker**, **C. Campbell**, **Y. Zhao**, **M. Lassise**, **X.-H. Zhao**, **M. Boccard**, **Z. Holman**, and Y.-H. Zhang, “Monocrystalline 1.7-eV-bandgap MgCdTe solar cell with 11.2% efficiency,” *IEEE J. Photovoltaics* **8**, 581–586 (2018).
45. **S. Manzoor**, **Z. Yu**, **A. Ali**, **W. Ali**, K. Bush, A. Palmstrom, S. Bent, M. McGehee, and **Z. Holman**, “Improved light management in planar silicon and perovskite solar cells using PDMS scattering layer,” *Sol. Energy Mater. Sol. Cells* **173**, 59–65 (2017).

44. M. Boccard, P. Firth, Z. Yu, K. Fisher, M. Leilaoui, S. Manzoor, and Z. Holman, “Low-refractive-index nanoparticle interlayers to reduce parasitic absorption in metallic rear reflectors of solar cells,” *Phys. Status Solidi A* **214**, 1700179 (2017).
43. J. Carpenter, M. Bailly, A. Boley, J. Shi, M. Minjares, D. Smith, S. Bowden, and Z. Holman, “Substrate-independent analysis of microcrystalline silicon thin films using UV Raman spectroscopy,” *Phys. Status Solidi B* **254**, 1700204 (2017).
42. R. Saive, M. Boccard, T. Saenz, S. Yalamanchili, C. Bukowsky, P. Jahelka, Z. Yu, J. Shi, Z. Holman, and H. Atwater, “Silicon heterojunction solar cells with effectively transparent front contacts,” *Sust. Energy Fuels* **1**, 593–598 (2017).
41. M. Vaisman, K. Nay Yaung, E. Perl, D. Martín-Martín, Z. Yu, M. Leilaoui, Z. Holman, and M. Lee, “15.3%-efficient GaAsP top cells for high-efficiency, low-cost III-V/Si tandem photovoltaics,” *ACS Energy Lett.* **2**, 1911–1918 (2017).
40. J. Becker, M. Boccard, C. Campbell, Y. Zhao, M. Lassise, Z. Holman, and Y.-H. Zhang, “Loss analysis of monocrystalline CdTe solar cells with 20% active-area efficiency,” *IEEE J. Photovoltaics* **7**, 900–905 (2017).
39. K. Bush*, A. Palmstrom*, Z. Yu*, M. Boccard, R. Cheacharoen, J. Mailoa, D. McMeekin, R. Hoyer, C. Bailie, T. Leijtens, I. Peters, M. Minichetti, N. Rolston, R. Prasanna, S. Sofia, D. Harwood, W. Ma, F. Moghadam, H. Snaith, T. Buonassisi, Z. Holman, S. Bent, and M. McGehee, “23.6%-efficient monolithic perovskite/silicon tandem solar cells with improved stability,” *Nature Energy* **2**, 17009 (2017). * Denotes co-first author.
38. J. Becker, C. Campbell, Y. Zhao, M. Boccard, D. Mohanty, M. Lassise, E. Suarez, I. Bhat, Z. Holman, and Y.-H. Zhang, “Monocrystalline CdTe/MgCdTe double-heterostructure solar cells with ZnTe hole contact,” *IEEE J. Photovoltaics* **7**, 307–312 (2017).
37. M. Leilaoui and Z. Holman, “Accuracy of expressions for the fill factor of a solar cell in terms of its open-circuit voltage and ideality factor,” *J. Appl. Phys.* **120**, 123111 (2016).
36. Z. Yu, M. Leilaoui, and Z. Holman, “Selecting tandem partners for silicon solar cells using spectral efficiency,” *Nature Energy* **1**, 16137 (2016).
35. Z.-Y. He, C. Campbell, M. Lassise, Z.-Y. Lin, J. Becker, Y. Zhao, M. Boccard, Z. Holman, and Y.-H. Zhang, “CdTe nBn photodetectors with ZnTe barrier layer grown on InSb substrates,” *Appl. Phys. Lett.* **109**, 121112 (2016).
34. S. Vorndran, B. Chrysler, B. Wheelwright, R. Angel, Z. Holman, and R. Kostuk, “Off-axis holographic lens spectrum splitting system for direct and diffuse solar energy conversion,” *Appl. Opt.* **55**, 7522–7529 (2016).
33. B. Chen, Y. Bai, Z. Yu, T. Li, X. Zheng, Q. Dong, M. Boccard, A. Gruverman, Z. Holman, and J. Huang, “Efficient semi-transparent perovskite solar cells for 23%-efficiency perovskite/silicon four-terminal tandem cells,” *Adv. Energy Mat.* 1601128 (2016).
32. J. Shi, M. Boccard, and Z. Holman, “Plasma-initiated rehydrogenation of amorphous silicon to increase the temperature processing window of silicon heterojunction solar cells,” *Appl. Phys. Lett.* **109**, 031601 (2016).
31. Z. Yu, B. Wheelwright, S. Manzoor, and Z. Holman, “Silicon wafers with optically specular surfaces formed by chemical polishing,” *J. Mater. Sci. Mater. Electron.* **27**, 10270–10275 (2016).

30. Y. Zhao, M. Boccard, S. Liu, J. Becker, X.-H. Zhao, C. Campbell, E. Suarez, M. Lassise, Z. Holman, and Y.-H. Zhang, “Monocrystalline CdTe solar cells with open-circuit voltage over 1 V and efficiency of 17%,” *Nature Energy* **1**, 16067 (2016).
29. M. Boccard and Z. Holman, “Amorphous silicon carbide passivating layers for crystalline-silicon-based heterojunction solar cells,” *J. Appl. Phys.* **118**, 065704 (2015).
28. Z. Yu, K. Fisher, B. Wheelwright, R. Angel, and Z. Holman, “PVMirror: A new concept for tandem solar cells and hybrid solar converters,” *IEEE J. Photovoltaics* **5**, 1791–1799 (2015). [Most downloaded paper in *IEEE J. Photovoltaics* in January and February, 2016]
27. B. Terheiden, T. Ballmann, R. Horbelt, Y. Schiele, S. Seren, J. Ebser, G. Hahn, V. Mertens, M. Koentopp, M. Scherff, J. Müller, Z. Holman, A. Descoedres, S. De Wolf, S. Martin de Nicolas, J. Geissbuehler, C. Ballif, B. Weber, P. Saint-Cast, M. Rauer, C. Schmiga, S. Glunz, D. Morrison, S. Devenport, D. Antonelli, C. Busto, F. Grasso, F. Ferrazza, E. Tonelli, and W. Oswald, “Manufacturing 100- μm -thick silicon solar cells with efficiencies greater than 20% in a pilot production line,” *Phys. Status Solidi A* **212**, 13–24 (2015).
26. J. Seif, A. Descoedres, M. Filipič, F. Smole, M. Topič, Z. Holman, S. De Wolf, and C. Ballif, “Amorphous silicon oxide window layers for high-efficiency silicon heterojunction solar cells,” *J. Appl. Phys.* **115**, 024502 (2014). [Highlighted by *J. Appl. Phys.* as part of the journal’s celebration of the International Year of Light]
25. M. Deceglie, H. Emmer, Z. Holman, A. Descoedres, S. De Wolf, C. Ballif, and H. Atwater, “Scanning laser-beam-induced current measurements of lateral transport near junction defects in silicon heterojunction solar cells,” *IEEE J. Photovoltaics* **4**, 154–159 (2014).
24. Z. Holman, M. Filipič, B. Lipovšek, S. De Wolf, F. Smole, M. Topič, and C. Ballif, “Parasitic absorption in the rear reflectors of silicon solar cells: Simulation and measurement of the sub-bandgap reflectance for common dielectric/metal reflectors,” *Sol. Energy Mater. Sol. Cells* **120**, 426-430 (2014).
23. Z. Holman, A. Descoedres, S. De Wolf, and C. Ballif, “Record infrared internal quantum efficiency in silicon heterojunction solar cells with dielectric/metal rear reflectors,” *IEEE J. Photovoltaics* **3**, 1243–1249 (2013).
22. M. Filipič, Z. Holman, F. Smole, S. De Wolf, C. Ballif, and M. Topič, “Analysis of lateral transport through inversion layer in amorphous silicon/crystalline silicon heterojunction solar cells,” *J. Appl. Phys.* **114**, 074504 (2013).
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