

Laura Theresa Schelhas

Associate Staff Scientist

Applied Energy Programs & Stanford Synchrotron Radiation Lightsource

SLAC National Accelerator Laboratory

2575 Sand Hill Rd, M/S 69
Menlo Park, CA 94025

Email: Schelhas@slac.stanford.edu

Office: 650-926-2059

Cell: 231-730-0581

EDUCATION:

University of California, Los Angeles, Los Angeles, CA

Sept 2007 – Dec 2013

Ph.D., Physical Chemistry

Thesis: Using solution phase self-assembly to control the properties of magnetic and magnetoelectric nanostructures

Michigan State University, East Lansing, MI

Sept 2004 – May 2007

BS, B.S. Lyman Briggs Chemistry

RESEARCH EXPERIENCE:

SLAC National Accelerator Laboratory, Menlo Park, CA

Nov 2016 – Current

Applied Energy Programs & Stanford Synchrotron Radiation Lightsource (SSRL)

Associate Staff Scientist

Research Activities:

- DuraMAT Consortium – Energy Materials Network: Multifunctional Coatings project technical lead, plan and run project meetings/calls
- Center for Next Generation of Materials by Design – Energy Frontier Research Center: *In-situ* characterization of metastable materials (e.g. hydrothermal synthesis of MnO_x Polymorphs)
- Hybrid Perovskite Solar Cells collaboration with NREL focused on *Operando* characterization of degradation mechanisms in solar cells
- Mentoring of postdocs and summer undergraduate students

SLAC National Accelerator Laboratory, Menlo Park, CA

Aug 2014 – Nov

2016

Stanford Synchrotron Radiation Lightsource (SSRL)

Postdoctoral Scholar

Advisor: Dr. Mike Toney

Department: Synchrotron Materials Sciences Division

Research Activities:

- Investigation of the structure function relationship in solar cell materials (absorbers, transparent contacts, full photovoltaic devices) using synchrotron x-ray characterization techniques.
- Collection and analysis of x-ray diffraction and x-ray absorption spectroscopy data obtained at SSRL, Advanced Light Source (ALS) at Lawrence Berkeley National Lab, and Advanced Photon Source (APS) at Argonne National Lab.
- Collaborations through Center for Next Generation of Materials by Design – Energy Frontier Research Center, Bay Area Photovoltaic Consortium, and National Renewable Energy Laboratory.
- Development of *in-situ* synchrotron x-ray characterization techniques including crystallization of metal oxides, and *operando* measurements of CH₃NH₃PbI₃ devices.

- Participation in *in-situ* chamber design and implementation.

University of California, Los Angeles, Los Angeles, CA.

Sept 2007 – July 2014

Graduate Student Researcher: Sep 2007 – Dec 2013

Research Assistant Tolbert Lab: Jan 2014 – July 2014

Advisor: Professor Sarah Tolbert

Department: Chemistry and Biochemistry

Research Activities:

- Developed and characterized magnetic and magnetoelectric materials whose properties were controlled through nanoscale architectural engineering.
- This research required knowledge of a number of synthesis techniques, such as nanoparticles, thin film depositions, and block co-polymer templating.
- Characterization of systems through typical materials characterizations (microscopy, XRD, etc.) and magnetic characterization.
- Collaboration with a number of other research groups including participation in Translational Applications of Nanoscale Multiferroic Systems (TANMS) – Engineering research center, as well as collaboration and teamwork within the Tolbert lab.

Michigan State University, East Lansing, MI

Mar 2006 – Jan 2007

Undergraduate Researcher

Research Advisor: Professor Marcos Dantus

Project Title: Selective Two-Photon Biological Imaging and Coherent Ultrafast Imaging (2006 – 2007)

Research Activities:

- Investigated the use of multiphoton intrapulse interference phase scan (MIIPS) shaped laser pulses.
- Pulse shaping allowed for selective excitation of different fluorophores in a stained mouse kidney sample.
- Operation and maintenance of titanium sapphire femtosecond pulsed laser system as well as data collection and analysis.

RESEARCH SKILLS:

Materials synthesis: nanoparticle synthesis, evaporation induced self-assembly (EISA) of mesoporous films, block copolymer directed self-assembly, hydrothermal synthesis

Magnetic characterization: SQUID magnetometry

Materials characterization: TEM, SEM, XRD, XPS, Rietveld Analysis

Clean room experience: STS-AOE etcher, CHA evaporators, ALD, PECVD, RTA

Synchrotron characterization: *in-situ* and *operando* XRD, resonant x-ray diffraction, x-ray absorption spectroscopy.

Software: CasaXPS, Igor Pro, GSASII, Topas Academic, Microsoft Office Suite, Mendeley

FELLOWSHIPS AND AWARDS:

Feb '17: 3rd Place Poster Award: NREL/SNL/BNL PV Reliability Workshop 2017

May '13: Best Poster Presentation: TANMS 1st Annual Review, Los Angeles, CA.

Jan '13: MMM/Intermag Conference Student Travel Award, Chicago, IL.

Oct '13: Dissertation Year Fellowship – University of California, Los Angeles. Award year October 2012- October 2013.

Mar '12: ACS Travel Award Fellowship for ACS Meeting, March 2012

Mar '12: Departmental Travel Grant for ACS Meeting, March 2012

July '09: Best Presentation Award - Nanotechnology Student Summer School, The 6th NIMS/MANA(Japan), Nanoscience Centre, University of Cambridge (UK), UCLA/CNSI (USA) Nanotechnology Students' Summer School, Los Angeles, CA

July 27-31, 2009. Oral Presentation: Magnetic Shape Anisotropy in Nanoscale Ni-Disks and Rods.

Nov '08: Excellence in Teaching – The Department of Chemistry and Biochemistry, University of California, Los Angeles, November 3, 2008.

EDITORIAL DUTIES:

- **Guest Editor:** Journal of Photonics for Energy, Special Series on Perovskite-Based Solar Cells, 2017.
-

PATENT

S.H. Tolbert, L.T. Schelhas, G.P. Carman, H. Kim, J. Hockel, S. Keller, “Magnetolectric Control of Superparamagnetism,” US Patent No. US 9,355,764 B2. May 31st 2016.

PEER-REVIEWED PUBLICATIONS

25 Peer-Reviewed publications (+5 submitted)

1. A practical field guide to thermoelectrics: fundamentals, synthesis, and characterization Jeff Blackburn, Kasper Borup, Michael Chabinyk, Olivier Delaire, Andrew Ferguson, Stephen Kang, Kirill Kovnir, Laura Schelhas, Taylor Sparks, Jeff Snyder, Eric Toberer, Alex Zevalkink – in prep
2. J. E. S. Haggerty, **L. T. Schelhas**, D. A. Kitchaev, J. S. Mangum, L. M. Garten, W. Sun, K. H. Stone, J. D. Perkins, M. F. Toney, G. Ceder, D. S. Ginley, B. P. Gorman, J. Tate, “High-fraction brookite films from amorphous precursors,” **2017**, *submitted to Scientific reports*
3. X. Xu, Y. Liu, S. Shukla, Y. Chen, **L. T. Schelhas**, M. Ting, A. Pan, M. Amani, A. Javey, X. Fang, J. W. Ager, “Charge separation and transport in ZnS/CdS nanocomposite films,” **2017**, *submitted to ACS Nano*.
4. S. Siol, A. Holder, J. Steffes, **L. T. Schelhas**, K. H. Stone, L. Garten, J. Perkins, P. Parilla, M. F. Toney, B. D. Huey, S. Lany, A. Zakutayev, “Applying Negative effective pressure through heterostructural alloys” **2017**, *Submitted to Nature Communications*
5. K.H. Stone, M. Yang, **L. T. Schelhas**, V. L. Pool, E. M. Sanehira, D. Ostrowski, J. D. Perkins, R. R. White, K. Zhu, J. J. Berry, J. M. Luther, M. F. Toney, C. J. Tassone, “Structural Heterogeneity in CH₃NH₃PbI₃ Perovskite Solar Cells: Amorphous Content” **2016**, *Submitted to Nature Materials*.
6. B. E. Matthews, A. M. Holder, **L. T. Schelhas**, S. Siol, J. W. May, M. R. Forkner, D. Vigil-Fowler, M.F. Toney, J.D. Perkins, B. P. Gorman, A. Zakutayev, S. Lany, J. Tate, “Structural, electronic and optical properties of the heterostructural alloy Sn_{1-x}Ca_xSe” **2017**, *Submitted to Journal of Materials Chemistry A. – IN PRESS*
7. S. Lany, P. P. Zawadzki, A.N. Fioretti, **L.T. Schelhas**, E.S. Toberer, A.C. Tamboli, and A. Zakutayev, “Monte-Carlo simulations of disorder in ZnSnN₂ and the effects on the electronic structure” **2017**, *Submitted to Physical Review Materials. – IN PRESS*
8. **L. T. Schelhas**, K. H. Stone, S. Harvey, G. Teeter, I. Repins, M. F. Toney, “Point defects in Cu₂ZnSnSe₄ (CZTSe): Resonant x-ray diffraction study of low temperature order/disorder transition,” **2017**, *Submitted to PSSb. –INPRESS*
9. A. M. Holder, S. Siol, P. F. Ndione, H. Peng, A. M. Deml, B. E. Matthews, **L. T. Schelhas**, M. F. Toney, R. G. Gordon, W. Tumas, J. D. Perkins, B. P. Gorman, J. Tate, A. Zakutayev, S. Lany,

“Novel Phase Diagram Behavior and Materials Design in Heterostructural Semiconductor Alloys” *Science Advances* **2017**, 3 (6), e1700270.

10. R. L. Z. Hoye, P. Schultz, **L. T. Schelhas**, A. Holder, K. H. Stone, J. D. Perkins, D. Vigil-Fowler, S. Siol, D. O. Scanlon, A. Zakutayev, A. Walsh, I. C. Smith, B. C. Melot, R. C. Kurchin, Y. Wang, J. Shi, F. C. Marques, J. J. Berry, B. Tumas, S. Lany, V. Stevanovic, M. F. Toney, T. Buonassisi, “Perovskite-inspired photovoltaic materials: Toward best practices in materials characterization and calculations,” *Chemistry of Materials* **2017**, 29 (5), 1964-1988.
11. **L. T. Schelhas***, J. Christians*, J. J. Berry, M. F. Toney, C. J. Tassone, J. M. Luther, K. H. Stone, “Monitoring a Silent Phase Transition in $\text{CH}_3\text{NH}_3\text{PbI}_3$ Solar Cells via *Operando* X-Ray Diffraction,” *ACS Energy Letters* **2016**, 1 (5), 1007-1012.
12. Y. Liu, Y. Guo, **L. T. Schelhas**, M. Li, J. W. Ager III, “Undoped and Ni-doped CoO_x Surface Modification of Nanoporous BiVO_4 Photoelectrode for Water Oxidation,” *Journal of Physical Chemistry C* **2016**, 120 (41), 23449-23457.
13. J. Domann, W.-Y. Sun, **L. T. Schelhas**, G. P. Carman, “Strain-Mediated Magnetoelectric Control of Spontaneous Exchange Bias in Ni-NiO Thin Films” *Journal of Applied Physics* **2016**, 120 (14), 143904.
14. D. Chien, A. N. Buditama, **L. T. Schelhas**, H. Kang, J. P. Chang, S. H. Tolbert, “Magnetoelectric Effect in Multiferroic Nanocomposites of Atomic Layer Deposition $\text{Pb}(\text{Zr},\text{Ti})\text{O}_3$ Coupled with Templated Mesoporous CoFe_2O_4 ,” *Applied Physics Letters* **2016**, 109 (11), 112904.
15. K. Lim, **L. T. Schelhas**, S. C. Siah, R. E. Brandt, A. Zakutayev, S. Lany, B. Gorman, C. Sun, D. Ginley, T. Buonassisi, M. F. Toney, “The Origins of the Non-Transparency in Sn-doped Ga_2O_3 ,” *Applied Physics Letters* **2016**, 109 (14), 141909.
16. W. Gao, R. dos. Reis, **L. T. Schelhas**, V. L. Pool, M. F. Toney, K. M. Yu, W. Walukiewicz, “Formation of Nanoscale Composites of Compound Semiconductors Driven by Charge Transfer,” *Nanoletters*, **2016**, 16 (8) 5247-5254.
17. **L. T. Schelhas***, K. H. Stone*, L. M. Garten, B. Shyam, A. Mehta, P. F. Ndione, D. S. Ginley, M. F. Toney, “Influence of Amorphous Structure on Polymorphism in Vanadia,” *Applied Physics Letters Materials*, **2016** 4, 076103.
18. R. Wood-Robinson, J. K. Cooper, A. Faghaninia, **L. T. Schelhas**, V. L. Pool, M. F. Toney, C. C. Lo, I. D. Sharp, J. W. Ager III, “Room temperature deposition of Copper-alloyed ZnS: a highly conductive p-type transparent material” *Advanced Electronic Materials* **2016**, 1500396.
19. X. Xu, J. Bullock, **L. T. Schelhas**, E. Z. Stutz, J. J. Fonseca, M. Hettick, V. L. Pool, K. F. Tai, M. F. Toney, X. Fang, A. Javey, L. H. Wong, J. W. Ager, “Chemical Bath Deposition of p-type transparent, highly conducting $(\text{CuS})_x:(\text{ZnS})_{1-x}$ nanocomposite thin films and fabrication of Si heterojunction solar cells” *Nanoletters* **2016** 16, 1925-1932.
20. S. C. Siah, R. E. Brandt, K. Lim, **L. T. Schelhas**, R. Jaramillo, M. D. Heinemann, D. Chua, J. Wright, C. U. Segre, R. Gordon, M. Toney, T. Buonassisi, “Dopant activation in Sn-doped Ga_2O_3 investigated by synchrotron-based X-Ray absorption spectroscopy” *Applied Physics Letters*, **2015** 107, 252103.
21. G. Zhang, S. A. Hawks, C. Ngo, **L. T. Schelhas**, D. T. Scholes, H. Kang, A. S. Ferreira, J. C. Aguirre, S. H. Tolbert, B. J. Schwartz, “Extensive Penetration of Evaporated Electrode Metals

into Fullerene Films: Intercalated Metal Nanostructures and Influence on Device Architecture" *Applied Materials and Interfaces*, **2015** 7 (45), 25247.

22. **L. T. Schelhas***, T. E. Quickel*, R.A. Farrell, N. Petkov, V. H. Le, S. H. Tolbert, "Mesoporous Bismuth Ferrite with Electric Field Amplified Ferromagnetism" *Nature Communications*, **2015** 6, 6562.
23. **L. T. Schelhas***, M. J. Banholzer*, C. A. Mirkin, S. H. Tolbert, "Magnetic Confinement and Coupling in Narrow-Diameter Au-Ni Nanowires" *Journal of Magnetism and Magnetic Materials*, **2014** 379, 239-243.
24. **L. T. Schelhas**, R.A. Farrell, U. Halim, S. H. Tolbert, "Directed Self-Assembly as a Route to Directed Ferromagnetic and Superparamagnetic Nanoparticle Arrays" *Advanced Functional Materials*, **2014** 24 (44), 6956-6962.
25. I. E. Rauda, V. Augustin, L. C. Saldarriaga-Lopez, X. Chen, **L. T. Schelhas**, G. W. Rubloff, B. Dunn, S. H. Tolbert, "Nanostructured Pseudocapacitors Based on Atomic Layer Deposition of V₂O₅ onto Conductive Nanocrystal-Based Mesoporous ITO Scaffolds" *Advanced Functional Materials*, **2014** 24 (42), 6717-6728.
26. S. A. Hawks, J. C. Aguirre, **L. T. Schelhas**, R. Thompson, R. Huber, A. Ferreira, G. Zhang, R. A. Street, A. A. Herzing, S. H. Tolbert, B. J. Schwartz, "Comparing Matched Polymer:Fullerene Solar Cells Made by Solution-Sequential Processing and Traditional Blend Casting: Nanoscale Structure and Device Performance" *Journal of Physical Chemistry: C*, **2014** 118 (31), 17413-17425.
27. **L. T. Schelhas***, H. Kim*, J. Hockel, S. Keller, S. H. Tolbert, G. P. Carman, "Magnetoelectric Control of the Superparamagnetic Limit" *Nano Letters*, **2013** 13 (3), 884-888.
28. I. E. Rauda, L.C. Saldarriaga-Lopez, Helms, B.A., **L. T. Schelhas**, D. Membreno, D.J. Milliron, S. H. Tolbert, "Nanoporous Semiconductors Synthesized Through Polymer Templating of Ligand-Stripped CdSe Nanocrystals" *Advanced Materials*, **2013** 25 (9), 1315-1322.
29. I. E. Rauda, R. Buonsanti, L. C. Saldarriaga-Lopez, K. Benjauthrit, **L. T. Schelhas**, M. Stefik, V. Augustyn, J. Ko, B. Dunn, U. Wiesner, D. J. Milliron, S. H. Tolbert "General Method for the Synthesis of Hierarchical Nanocrystal-Based Mesoporous Materials" *ACS Nano* **2012** 6 (7), 6386-6399.
30. **L. T. Schelhas**, J. Shane, M. Dantus "Advantages of ultrashort phase-shaped pulses for selective two-photon activation and biomedical imaging" *Nanomedicine-Nanotechnology Biology and Medicine* **2006** 2, 177-181.

*Co-first Author

LEADERSHIP AND MENTORING EXPERIENCE:

Ongoing: Numerous Career Panels:

- National Lab Career Panel, Stanford Chemistry Department, June 20th, 2017
- Girls Advancing in STEM (GAINS) Conference, April 4th, 2017
- Gordon Research Seminar – February 26th, 2017
- AWWEE – Path to power – October 20th, 2016

July '17 – Current: Summer Undergraduate Laboratory Internship (SULI) – Summer Mentor

July '16 – Current: Tech Trek Camp Curie's Professional Women's Night (PWN): Volunteer Panelist

- STEM Career Panel for middle school age young women

Mar '16 – Current: SLAC Public Tours: Tour Guide

- Helping restart the public tour program at SLAC
- Volunteer tour guide to teach the public and community about the research of SLAC National Accelerator Laboratory.

Jan '16 – Jan '17: DOE EFRC early career network, CNGMD Representative

- Plan 2-4 virtual events for EFRC Students/Postdocs per year.
- Serve as the point of contact between the early career network and members of my EFRC.

Jun '15 – Aug '15: Raising Interest in Science and Engineering Internship Program (RISE), mentor.

- Mentored a high school student in a synchrotron based experiment during a 6 week program with a poster presentation at the end

Sep '12 – Oct '13: NSF Nano Engineering Research Center – Translational Application of Nanoscale Multiferroic Systems (TANMS), student leadership council president.

- *Responsibilities:* Organizing all TANMS students for the annual meeting and SWOT analysis, including meeting with NSF site review team and TANMS industry advisory board
- Participating in bi-weekly meetings with TANMS leadership
- Organizing the student budget, meetings, research meetings, and website information.

Sep '11 – Dec '13: Super-user: STS-AOE Etcher, UCLA Nanoelectronics Research Facility.

- *Responsibilities:* Training and qualifying users on equipment in the clean room facility

Sep '11 – July '14: California Nanosystems Institute, High school Nanoscience Program

- Position: Program Lead for the Bio toxicity Experiment
- *Responsibilities:* Teaching high school teachers an experiment focusing on nano to take back to their classrooms and organizing and running a summer camp for high school students

Sep '10 – June '14: PEERS Chemistry Workshop, UCLA

- Position: Workshop facilitator
- *Responsibilities:* Making worksheets, and leading a class of 10 – 25 students in a collaborative learning environment to study general chemistry

MEETINGS AND SYMPOSIA:

Jun '17: IEEE PVSC-44, Washington DC, June 28th **Oral Presentation:** “Operando X-ray Diffraction for Characterization of Photovoltaic Materials”

Apr '17: SLAC Photon Science Seminar, **Invited Talk:** “Operando X-ray Diffraction for Characterization of Photovoltaic Materials”

Feb '17: Nanomaterials for Applications in Energy Technology, Gordon Research Conference, Ventura, CA **Poster:** “Operando X-ray Diffraction for Characterization of Photovoltaic Materials”

Oct '16: Colorado School of Mines, Metallurgical and Materials Engineering Department **Invited Talk:** “Operando X-ray Diffraction of CH₃NH₃PbI₃ Solar Cells”

July '16: Thermoelectrics Summer School **Instructor:** “Advanced Characterization”

May '16: European Materials Research Society (EMRS) Spring Meeting, Lille, France, May 2 – 6, 2016, **Invited Talk:** *Operando* X-Ray Diffraction of CH₃NH₃PbI₃ Solar Cells, **Oral Presentation:** Point defects in Cu₂ZnSnSe₄ (CZTS): Resonant x-ray diffraction study of low temperature order/disorder transition

Mar '16: Silicon Valley Women in Engineering Conference, San Jose State University, **Invited Talk:** “Understanding the Structure Function Relationship in Photovoltaic Materials”

Nov '15: Materials Research Society (MRS) Fall Meeting, Nov 29 – Dec 4, 2015, **Poster:** *Operando* X-Ray Diffraction of CH₃NH₃PbI₃ Solar Cells.

- Oct '14:** Advanced Light Source (ALS) User Meeting, CAMERA-SHARP real-time robust ptychographic imaging, October 8, 2014. **Oral Presentation:** X-ray Imaging on Materials for Sustainable Energy at SSRL.
- Aug '14:** XXIII International Materials Research Congress (MRS), Cancun, Mexico, August 17-21, 2014 **Invited Talk:** TANMS Nanostructured Magnetoelectric Materials.
- Jan '13:** 12th Joint MMM/Intermag Conference, Chicago, IL, Jan 14 – 18, 2013. **Oral Presentation:** Magnetoelectric Control of the Superparamagnetic Limit.
- Mar '12:** 243rd ACS National Meeting & Exposition, San Diego, CA March 25- 29, 2012. **Oral Presentation:** 1D Ferromagnetic Nanoparticle Arrays Using Block Copolymer Directed Self-Assembly.
- Nov '11:** **Poster:** Using Solution Phase Assembly to Control the Properties of Magnetic Nanostructures, Seaborg Symposium, CNSI, Los Angeles, November 5, 2011.
- Oct '10:** **Poster:** Self-Assembled Magnetic Nanostructures, WIN 5th Annual Review, Los Angeles, CA October 7th, 2010.
- Oct '09:** **Poster:** Self-Assembled Magnetic Nanostructures, WIN 4th Annual Review, Los Angeles, CA October 8th, 2009.
- July '09:** Nanotechnology Student Summer School, The 6th NIMS/MANA(Japan), Nanoscience Centre, University of Cambridge (UK), UCLA/CNSI (USA) Nanotechnology Students' Summer School, Los Angeles, CA July 27-31, 2009. **Oral Presentation:** Magnetic Shape Anisotropy in Nanoscale Ni-Disks and Rods.

TEACHING EXPERIENCE (TEACHING ASSISTANTSHIPS):

General and Organic Chemistry Lab I: Winter '08, Winter '09, Fall '10, Winter '12

General and Organic Chemistry Lab II: Winter '10, Summer '08

General Chemistry Laboratory II: Fall '07, Spring '08, Summer '09

Physical Chemistry: Chemical Thermodynamics: Fall '08