Darien J. Morrow

Postdoctoral Appointee at Argonne National Laboratory's Center for Nanoscale Materials

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EDUCATION

University of Wisconsin–Madison 2015 - 2020
PhD: Physical Chemistry. GPA: 4.0/4.0 Madison, WI

- Dissertation title: Development of multidimensional spectroscopies to investigate transition metal dichalcogenide and lead halide perovskite semiconductors
- Adviser: John C. Wright.

Missouri Western State University 2011-2015
BS (Honors): Chemistry; Minors: Mathematics & Physics. GPA: 4.0/4.0 Saint Joseph, MO

RESEARCH & WORK EXPERIENCE

Center for Nanoscale Materials at Argonne National Laboratory 2020 - Present
Postdoctoral Appointee supervised by Xuedan Ma Lemont, IL

- Researching excitonic, polaronic, and electronic properties of low dimensional materials as photonic sources for Quantum Information Science
- Developing cryogenic magneto-optical microscopy techniques

John C. Wright Research Group 2015 - 2020
Graduate Assistant Madison, WI

- Pioneered spectrally resolved harmonic generation as a probe of semiconductor excited state dynamics
- Developed a suite of ultrafast techniques to explore excited state dynamics of thin film semiconductors relevant to photovoltaics (lead halide perovskites and transition metal dichalcogenides)
- Developed open-source software packages for the collection, processing, and modeling of multidimensional spectra (see `github.com/wright-group`)
- Responsible for maintenance and furtherance of custom ultrafast laser systems including construction of new optomechanical & electronic hardware, training new users, and troubleshooting hardware & software

Christopher G. Elles Research Group 2014
REU Fellow Lawrence, KS

- Investigated the excited state dynamics of substituted thiophene photo-rearrangement reactions
- Developed and implemented reaction quantum yield measurement technique
- Used ultrafast transient absorption spectroscopy to probe singlet and triplet excited state manifolds

Michael W. Ducey Research Group 2011 - 2012
Undergraduate Assistant Saint Joseph, MO

- Investigated the solvatochromism of room temperature ionic liquids (RTILs) in common solvents
- Demonstrated that solvents can induce order in the alkyl side chains of methylimidazolium RTILs

Morrow Contracting and Construction LLC 2011 - 2015
Skilled Laborer Saint Joseph, MO

PUBLICATIONS

In preparation: **Morrow, D. J.**; Ma. X. Understanding interlayer exciton trapping in two-dimensional heterostructures with discrete, random-walk simulations

In preparation: **Morrow, D. J.**; Kohler, D. D.; Zhao, Y.; Scheeler, J. M.; Jin, S.; Wright, J. C. Ultrafast, multidimensional pump-probe spectroscopy of atomically thin WS_2-MoS_2 lateral heterostructures

Submitted: Pan, D.; Fu, Y.; Luo, Z.; Zhao, Y.; **Morrow, D. J.**; Roy, C.; Liu, B.; Chen, S.; Wright, J. C.; Pan, A.; Jin, S. Deterministic fabrication of arbitrary 2D Ruddlesden-Popper halide perovskite heterostructures with emergent interlayer properties

1. **Morrow, D. J.**; Kohler, D. D.; Zhao, Y.; Scheeler, J. M.; Jin, S.; Wright, J. C. Quantum interference between the optical Stark effect and resonant harmonic generation in WS_2. *Physical Review B*. DOI: 10.1103/PhysRevB.102.161401. **2020**.
   · Preprint: arXiv:2006.01183.
   · Data and code repository: DOI 10.17605/OSF.IO/sntpc.

2. **Morrow, D. J.**; Hautzinger, M. P.; Lafayette, D. P.; Scheeler, J. M.; Dang, L.; Leng, M.; Kohler, D. D.; Wheaton, A. M.; Fu, Y.; Guzei, I. A.; Tang, J.; Jin, S.; Wright, J. C. Disentangling Second Harmonic Generation from Multiphoton Photoluminescence in Halide Perovskites using Multidimensional Harmonic Generation. *Journal of Physical Chemistry Letters*. DOI:10.1021/acs.jpclett.0c01720. **2020**
   · Preprint: DOI: 10.26434/ChemRxiv.12055440.
   · Data and code repository: DOI 10.17605/OSF.IO/jn24u.

3. Hautzinger, M. P.; Pan, D.; Piggs, A. K.; Fu, Y.; **Morrow, D. J.**; Leng, M.; Kuo, M.; Spitha, N., Lafayette, D. P.; Kohler, D. D.; Wright, J. C.; Jin, S. Band Edge Tuning of 2D Ruddlesden-Popper Perovskites by A Cation Size Revealed through Nanoplates. *ACS Energy Letters*. DOI:10.1021/acsenergylett.0c00450. **2020**
   · Code repository: DOI 10.17605/OSF.IO/m9dnw.

4. **Morrow, D. J.**; Kohler, D. D.; Zhao, Y.; Jin, S.; Wright, J. C. Triple sum frequency pump-probe spectroscopy of transition metal dichalcogenides. *Physical Review B*. DOI: 10.1103/PhysRevB.100.235303. **2019**.
   · Preprint: arXiv:1909.06445.
   · Data and code repository: DOI 10.17605/OSF.IO/UMSXC.

5. Thompson, B. J.; Sunden, K. F.; **Morrow, D. J.**; Kohler, D. D.; Wright, J.C. WrightTools: a Python package for multidimensional spectroscopy *The Journal of Open Source Software*. DOI: 10.21105/joss.01141. **2019**.

6. **Morrow, D. J.**; Kohler, D. D.; Czech, K. J.; Wright, J. C. Communication: Multidimensional Triple Sum-Frequency Spectroscopy of MoS_2 and Comparisons with Absorption and Second Harmonic Generation Spectroscopies. *Journal of Chemical Physics*. DOI: 10.1063/1.5047802. **2018**.
   · Preprint: arXiv:1805.06985.
   · Data and code repository: DOI 10.17605/OSF.IO/2WF6G.

7. **Morrow, D. J.**; Kohler, D. D.; Wright, J. C. Group and phase velocity mismatch fringes in triple sum-frequency spectroscopy. *Physical Review A*. DOI: 10.1103/PhysRevA.96.063835. **2017**.
   · Preprint: arXiv:1709.10476.
   · Data and code repository: DOI 10.17605/OSF.IO/EMGTA.

8. Fu, Y.; Rea, M. T.; Chen, J.; **Morrow, D. J.**; Hautzinger, M. P.; Zhao, Y.; Manger, L. H.; Wright, J. C.; Goldsmith, R. H.; Jin, S. Selective Stabilization and Photophysical Properties of Metastable Perovskite Polymorphs of $CsPbI_3$ in Thin Films. *Chem. Mater.* DOI: 10.1021/acs.chemmater.7b02948. **2017**.

9. Chen, J.; **Morrow, D. J.**; Fu, Y.; Zheng, W.; Zhao, Y.; Dang, L.; Stolt, M. J.; Kohler, D. D.; Wang, X.; Czech, K. J.; Hautzinger, M. P.; Shen, S.; Guo, L.; Pan, A.; Wright, J. C.; Jin, S. Single-Crystal Thin Films of Cesium Lead Bromide Perovskite Epitaxially Grown on Metal Oxide Perovskite ($SrTiO_3$). *J. Am. Chem. Soc.* DOI: 10.1021/jacs.7b07506. **2017**.
   · Data and code repository: DOI 10.17605/OSF.IO/V5KZN.

PATENTS

1. *U.S. Patent filed 2019-06-20* **Morrow, D. J.**; Kohler, D. D.; Wright, J. C. Ultrafast, multiphoton-pump, multiphoton-probe spectroscopy.

POSTERS & PRESENTATIONS

1. Poster. **Darien J. Morrow**, Daniel D. Kohler, John C. Wright. Development of sum-frequency and transient sum-frequency spectroscopies to study transition metal dichalcogenide nanostructures. ACS National Meeting, Philadelphia, PA, March 2020. (meeting was canceled due to COVID-19)
2. Poster. **Darien J. Morrow**, Daniel D. Kohler, John C. Wright. Multi-photon pump, multi-photon probe spectroscopies and their application to MX_2 nanostructures. CMDS 2018, Seoul, South Korea. June 2018.
3. Poster. **Darien J. Morrow**, Jenna M. Wasylenko, Christopher G. Elles. Kinetics and Dynamics of the Photorearrangement Reactions of Aryl-Substituted Thiophenes. ACS National Meeting, Denver, CO. March 2015.
4. Poster. Michael W. Ducey, **Darien J. Morrow**, Bethany Thornton, Varun Lahoti. Conformational behavior and applications of mixed room temperature ionic liquid solvent systems examined with a panel of solvatochromic probes. ACS Midwest Regional Meeting, Columbia, MO. November 2014.
5. Poster. **Darien J. Morrow**, Jenna M. Wasylenko, Christopher G. Elles. Kinetics and Dynamics of the Photorearrangements of Conjugated Thiophenes. Council on Undergraduate Research, Research Experiences for Undergraduates Symposium, Arlington, VA. October 2014.
6. Poster. Melanie Edlin, David J. Freeman, Nathan Harms, Xu Ho, Torin McKinley, Alexander Moore, **Darien J. Morrow**, Christopher Phillips, Jeffrey N. Woodford, Determination of Dimerization Constant of N-(isoquinolin-3-yl)Benzamide and N-(isoquinolin-2-yl)Benzamide. ACS Midwest Regional Meeting, Springfield, MO. October 2013.

TEACHING EXPERIENCE

Physical Chemistry: Thermodynamics — Fall 2016
Teaching Assistant for Prof. Gilbert M. Nathanson — Madison, WI

General Chemistry — Fall 2015 - spring 2016
Teaching Assistant for Prof. Ive Herman and Dr. Paul Hooker — Madison, WI

Organic Chemistry II — Fall 2013
Teaching Assistant for Prof. Steven P. Lorimor — Saint Joseph, MO

FELLOWSHIPS & SCHOLARSHIPS

· Link Foundation Energy Fellowship. July 2018 - June 2020.
  Two year full stipend for *Investigation of Coherent Charge Transfer in Transition Metal Dichalcogenide Heterostructures with Multiresonant Coherent Multidimensional Spectroscopy*.
· Pei Wang Fellowship. Fall 2015 - spring 2016.
· Golden Griffon Honors scholarship. Fall 2011 - spring 2015.
· NSF funded Midwest Apex Project scholarship. Fall 2011 - spring 2015.
· Missouri Bright Flight scholarship. Fall 2011 - spring 2015.

AWARDS & HONORS

- UW–Madison Department of Chemistry, Richard and Joan Hartl Award for Research Excellence in Physical Chemistry. 2020.
- UW–Madison Department of Chemistry, Roger Carlson Memorial Award for Excellence in Analytical Chemistry. 2018.
- NSF Graduate Research Fellowship Program, Honorable mention. 2017.
- MWSU Department of Chemistry, Edgar C. Little Outstanding Student Award. 2015.
- ACS Division of Analytical Chemistry, Undergraduate Award in Analytical Chemistry. 2015.
- ACS Division of Inorganic Chemistry, Undergraduate Award in Inorganic Chemistry. 2013.
- MWSU President's Honor's List. Fall 2011 - spring 2015.

SERVICE ACTIVITIES & COMMUNITY INVOLVEMENT

- Hosted "Detector Building" competition at the Science Olympiad Regional Tournament. Madison, Wisconsin. Winter 2020
- Organized weekly seminar for physical chemistry graduate students to present their research to fellow graduate students. 2018-2019
- Served as a moderator for the annual Wisconsin Middle School Science Bowl (sponsored by the DOE). 2017-present.
- Wisconsin Institute for Discovery volunteer. 2017-present.
- Taught/supervised electronics for a week to high schoolers in the PEOPLE program. Summer 2017.
- Served on panel to talk to REU students about experiences applying to and surviving graduate school. Summer 2017.
- Talked and demonstrated to Institute of Chemical Education summer camp attendees about my research, renewable energy, and how solar cells work. Summer 2017.
- Served as vice-president (2014-2015) and member of Missouri Western State University's ACS affiliated Chemistry club. 2011-2015.
- Aided in the organization and implementation of Super Science Saturday and Chemathon at Missouri Western State University. 2011-2015.

SOFTWARE SKILLS

- Python and the scientific Python software stack (numpy, matplotlib, scipy, h5py)
- Working knowledge: Arduino, Git, Latex, Autodesk Inventor
- Active contributor/maintainer of open source projects:
  - `WrightTools` (library): loading, processing, and plotting of multidimensional spectroscopy data
  - `PyCMDS` (application): orchestrating many hardware into multidimensional spectrometers
  - `attune` (library): tuning/calibrating multidimensional spectrometers

REFERENCES

- Prof. John C. Wright (Doctoral advisor) | wright@chem.wisc.edu | 608-262-0351
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  Argonne National Laboratory
  9700 S. Cass Avenue. Building 440 Rm A242
  Lemont, IL 60439
- Prof. Martin T. Zanni | zanni@chem.wisc.edu | 608-262-4783
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  Madison, WI 53706
- Prof. Gilbert M. Nathanson (Teaching reference) | nathanson@chem.wisc.edu | 608-262-8098
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