Brian S. Rolczynski, Ph.D.

US Naval Research Laboratory
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EDUCATION

Northwestern University, Evanston, IL **2007 – 2013**
Ph.D., Physical Chemistry
Dissertation: "Charge-Transfer Oligomers and Polymers for Organic Photovoltaics: Structure, dynamics, and their implications for solar devices"

University of Washington, Seattle, WA **2002 – 2007**
BS, Chemistry and BA, English (with honors)

FELLOWSHIPS

Jerome and Isabella Karle Distinguished Scholar Fellowship **2021 - 2022**
American Society for Engineering Education Fellowship **2018 - 2021**
Argonne Graduate Fellowship **2010 - 2012**

RESEARCH EXPERIENCE

US Naval Research Laboratory, Washington, DC **2018 - present**
Staff Scientist (Research Chemist), Electronics Science and Technology Division
- Investigated DNA-scaffolded chromophore networks to understand their vibronic properties and energy transport processes.
- Used machine-learning methods on large spectroscopic data sets to develop quantitative models that predict energy transfer efficiencies of DNA-scaffolded chromophore networks.
- Used a genetic algorithm method to deduce the vibronic Hamiltonians of DNA-scaffolded chromophore networks.
- Used the Hierarchical Equations of Motion (HEOM) to model electronic energy transport and heat transport in DNA-scaffolded chromophore networks.

The University of Chicago, Chicago, IL **2013 - 2018**
Postdoctoral fellow, Department of Chemistry and The James Franck Institute
PI: Greg S. Engel
- Developed an approach based on 2D electronic spectroscopy to measure interexcitonic vibrational correlations in photosynthetic pigment-protein complexes. These correlations can extend coherence lifetimes.
- Developed a method to distinguish highly overlapping peaks in optical spectra, and used it to deduce the excitonic Hamiltonian of a pigment-protein complex.
- Built an experiment to measure the transient material response to so-called "twisted" (Laguerre-Gaussian) laser modes, and used it to transcribe the light's orbital angular

momentum to materials. This approach has applications in multiplexed information storage.

Northwestern University, Evanston, IL **2007 – 2013**
and concurrently at **Argonne National Laboratory**, Lemont, IL **2010 – 2013**
Graduate researcher, Department of Chemistry and ANSER Center
PI: Lin X. Chen

- Studied intramolecular and intermolecular exciton dissociation in alternating co-polymers using transient spectroscopies, identifying how electronic push-pull interactions increased power-conversion efficiencies in organic photovoltaic devices.
- Studied aggregate morphologies in neat and bulk-heterojunction alternating co-polymer films using grazing incidence X-ray scattering, demonstrating correlations between π-π stacking distances and bulk-heterojunction device fill factor.
- Studied spontaneous self-assembly in spin-coated photovoltaic oligomer systems using grazing incidence X-ray scattering and atomic force microscopy.
- Studied anisotropic absorption characteristics of organic donor-acceptor co-crystals, as a function of modular chromophore species.

PUBLICATIONS

Google Scholar link

H-index: 20

30. **Rolczynski, B. S.**; Diaz, S. A.; Kim, Y. C.; Mathur, D.; Klein, W. P.; Medintz, I. L.; Melinger, J. S. Determining Interchromophore Effects for Energy Transport in Molecular Networks Using Machine-Learning Algorithms. Phys. Chem. Chem. Phys. 2023, 25, 3651.

*Selected by the editors for the *HOT PCCP article collection of 2023.*

29. Huff, J.; Diaz, S.; Barclay, M.; Chowdhury, A.; Chiriboga, M.; Ellis, G.; Mathur, D.; Patten, L.; Roy, S.; Sup, A.; Biaggne, A.; **Rolczynski, B. S.**; Cunningham, P.; Li, L.; Lee, J.; Davis, P.; Yurke, B.; Knowlton, W.; Medintz, I.; Turner, D.; Melinger, J.; Pensack, R. Tunable Electronic Structure via DNA-Templated Heteroaggregates of Two Distinct Cyanine Dyes. J. Phys. Chem. C 2022, 126(40), 17164.

28. **Rolczynski, B. S.**; Diaz, S. A.; Kim, Y. C.; Medintz, I. L.; Cunningham, P. D.; Melinger, J. S. Understanding Disorder, Vibronic Structure and Delocalization in Electronically Coupled Dimers on DNA Duplexes. J. Phys. Chem. A 2021, 125(44), 9632.

27. **Rolczynski, B. S.**; Yeh, S.-H.; Navotnaya, P.; Lloyd, L. T.; Ginzburg, A. R.; Zheng, H.; Allodi, M. A.; Otto, J. P.; Ashraf, K.; Gardiner, A. T.; Cogdell, R. J.; Kais, S.; Engel, G. S. Time-domain Line-shape Analysis from 2D Spectroscopy to Precisely Determine Hamiltonian Parameters for a Photosynthetic Complex. J. Phys. Chem. B 2021, 125(11), 2812.

26. Mathur, D.; Kim, Y. C.; Diaz, S. A.; Cunningham, P. D.; **Rolczynski, B. S.**; Ancona, M. G.; Medintz, I. L.; Melinger, J. S. Can a DNA Origami Structure Constrain the Position and Orientation of an Attached Dye Molecule? J. Phys. Chem. C 2020, 125, 1509.

25. Klein, W. P.; **Rolczynski, B. S.**; Oliver, S. M.; Zadegan, R.; Buckhout-White, S.; Ancona, M. G.; Cunningham, P. D.; Melinger, J. S.; Vora, P. M.; Kuang, W.; Medintz, I. L.; Díaz, S. A. DNA Origami Chromophore Scaffold Exploiting HomoFRET Energy Transport to Create Molecular Photonic Wires. ACS Appl. Nano Mater. 2020, 3(4), 3323.

*Awarded NRC/ASEE Postdoctoral Research Publications Award in 2021.

24. Allodi, M. A.; Otto, J. P.; Sohail, S. H.; Saer, R. G.; Wood, R. E.; **Rolczynski, B. S.**; Massey, S. C.; Ting, P.-C.; Blankenship, R. E.; Engel, G. S. Redox Conditions Affect Ultrafast Exciton Transport in Photosynthetic Pigment–Protein Complexes. J. Phys. Chem. Lett. 2018, 9, 89.

23. **Rolczynski, B. S.**; Zheng, H.; Singh, V. P.; Navotnaya, P.; Ginzburg, A. R.; Caram, J. R.; Ashraf, K.; Gardiner, A. T.; Yeh, S.-H.; Kais, S.; Cogdell, R. J.; Engel, G. S. Correlated Protein Environments Drive Quantum Coherence Lifetimes in Photosynthetic Pigment-Protein Complexes. Chem 2018, 4, 138.

*Highlighted in: Maiuri, M.; Scholes, G. 2D Spectroscopy Helps Visualize the Influence of Spectral Motion on Chromophore Response. Chem 2018, 4, 20.

*Selected as an editor's top article of 2018

22. Flanagan, M. L.; Long, P. D.; Dahlberg, P. D.; **Rolczynski, B. S.**; Massey, S. C.; Engel, G. S. Mutations to R. sphaeroides Reaction Center Perturb Energy Levels and Vibronic Coupling but Not Observed Energy Transfer Rates. J. Phys. Chem. A. 2016. 120(9), 1479.

21. Cho, S.; **Rolczynski, B. S.**; Xu, T.; Yu, L.; Chen, L. X. Solution Phase Exciton Diffusion Dynamics of a Charge-Transfer Copolymer PTB7 and Homopolymer P3HT. J. Phys. Chem. B. 2015, 119(24), 7447.

20. Blackburn, A. K.; Sue, A. C.-H.; Shveyd, A. K.; Cao, D.; Tayi, A.; Narayanan, A.; **Rolczynski, B. S.**; Szarko, J. M.; Bozdemir, O. A.; Wakabayashi, R.; Lehrman, J. A.; Chen, L. X.; Nassar, M. S.; Stupp, S. I.; Stoddart, J. F. Lock–arm supramolecular ordering: A molecular construction set for cocrystallizing organic charge transfer complexes. J. Am. Chem. Soc. 2014, 136, 17224.

*Over 50 citations.

19. **Rolczynski, B. S.**; Szarko, J. M.; Son, H. J.; Yu, L.; Chen, L. X. Effects of Exciton Polarity in Charge Transfer Polymer/PCBM Bulk Heterojunction Films. J. Phys. Chem. Lett. 2014, 5(11), 1856.

18. Szarko, J. M.; **Rolczynski, B. S.**; Lou, S. J.; Xu, T.; Strzalka, J.; Marks, T. J.; Yu, L.; Chen, L. X. Photovoltaic Function and Exciton/Charge Transfer Dynamics in a Highly Efficient Semiconducting Copolymer. Adv. Funct. Mater. 2014, 24(1), 10.

*Over 150 citations.

17. Zheng, H.; Caram, J. R.; Dahlberg, P. D.; **Rolczynski, B. S.**; Viswanathan, S.; Dolzhnikov, D. S.; Khadivi, A.; Talapin, D. V.; Engel, G. S. Dispersion-free continuum two-dimensional electronic spectrometer. Applied Optics 2014, 53(9), 1909.

16. Caram, J. R.; Zheng, H.; Dahlberg, P. D.; **Rolczynski, B. S.**; Griffin, G. B.; Dolzhnikov, D. S.; Talapin, D. V.; Engel, G. S. Exploring size and state dynamics in CdSe quantum dots using two-dimensional electronic spectroscopy. J. Chem. Phys. 2014, 140(8), 084701.

*Over 50 citations.

15. Griffin, G. B.; Lundin, P. M.; **Rolczynski, B. S.**; Linkin, A.; McGillicuddy, R. D.; Bao, Z.; Engel, G. S. Ultrafast energy transfer from rigid, branched side-chains into a conjugated, alternating copolymer. J. Chem. Phys. 2014, 140(3), 034903.

14. Caram, J. R.; Zheng, H.; Dahlberg, P. D.; **Rolczynski, B. S.**; Griffin, G. B.; Fidler, A. F.; Dolzhnikov, D. S.; Talapin, D. V.; Engel, G. S. Persistent Interexcitonic Quantum Coherence in CdSe Quantum Dots. J. Phys. Chem. Lett. 2014, 5(1), 196.

*Over 50 citations.

13. Singh, V. P.; Fidler, A. F.; **Rolczynski, B. S.**; Engel, G. S. Independent phasing of rephasing and non-rephasing electronic spectra. J. Chem. Phys. 2013, 139(8), 084201.

12. Tayi, A. S.; Shveyd, A. K.; Sue, C.-H.; Szarko, J. M.; **Rolczynski, B. S.**; Sarjeant, A. A.; Stern, C. L.; Cao, D.; Paxton, W. F.; Wu, W.; Dey, S. K.; Fahrenbach, A. C.; Guest, J.; Mohseni, H.; Chen, L. X.; Wang, K. L.; Stoddart, J. F.; Stupp, S. I. Room Temperature Ferroelectricity in Supramolecular Networks of Charge Transfer Complexes. Nature 2012, 488, 485.

*Over 400 citations.

11. **Rolczynski, B. S.**; Szarko, J. M.; Son, H. J.; Liang, Y.; Yu, L.; Chen, L. X. Ultrafast Intramolecular Exciton Splitting Dynamics in Isolated Low-Band-Gap Polymers and Their Implications on Photovoltaic Materials Design. J. Am. Chem. Soc. 2012, 134(9), 4142.

*Over 150 citations.

10. Gothard, N. A.; Mara, M. W.; Huang, J.; Szarko, J. M.; **Rolczynski, B. S.**; Lockard, J. V.; Chen, L. X. Strong Steric Hindrance Effect on Excited State Structural Dynamics of Cu(I) Diimine Complexes. J. Phys. Chem. A 2012, 116(9), 1984.

*Over 100 citations.

9. Carsten, B.; Szarko, J. M.; Son, H. J.; Wang, W.; Lu, L.; He, F.; **Rolczynski, B. S.**; Lou, S. J.; Chen, L. X.; Yu, L. Examining the Effect of the Dipole Moment on Charge Separation in Donor-Acceptor Polymers for Organic Photovoltaic Applications. J. Am. Chem. Soc. 2011, 133(50), 20468.

*Over 400 citations.

8. Murray, I. P.; Lou, S. J.; Cote, L. J.; Loser, S.; Kadleck, C. J.; Xu, T.; Szarko, J. M.; **Rolczynski, B. S.**; Johns, J. E.; Huang, J.; Yu, L.; Chen, L. X.; Marks, T. J.; Hersam, M. C. Graphene Oxide Interlayers for Robust, High-Efficiency Organic Photovoltaics. J. Phys. Chem. Lett. 2011, 2, 3006.

*Over 150 citations.

7. Szarko, J. M.; Guo, J.; **Rolczynski, B. S.**; Chen, L. X. Nanoscale structure, dynamics and power conversion efficiency correlations in small molecule and oligomer-based photovoltaic devices. Nano Rev. 2011, 2, 7249.

6. Szarko, J. M.; Guo, J.; **Rolczynski, B. S.**; Chen, L. X. Current trends in the optimization of low band gap polymers in bulk heterojunction photovoltaic devices. J. Mater. Chem. 2011, 21(22), 7849.

*Over 50 citations.

5. **Rolczynski, B. S.**; Szarko, J. M.; Lee, B.; Strzalka, J.; Guo, J.; Liang, Y.; Yu, L.; Chen, L. X. Length-dependent self-assembly of oligothiophene derivatives in thin films. J. Mater. Res. 2011, 26, 296.

4. Szarko, J. M.; **Rolczynski, B. S.**; Guo, J.; Liang, Y.; He, F.; Mara, M. W.; Yu, L.; Chen, L. X. Electronic Processes in Conjugated Diblock Oligomers Mimicking Low Band-Gap Polymers: Experimental and Theoretical Spectral Analysis. J. Phys. Chem. B 2010, 114, 14505.

3. Szarko, J. M.; Guo, J.; Liang, Y.; Lee, B.; **Rolczynski, B. S.**; Strzalka, J.; Xu, T.; Loser, S.; Marks, T. J.; Yu, L.; Chen, L. X. When Function Follows Form: Effects of Donor Copolymer Side Chains on Film Morphology and BHJ Solar Cell Performance. Adv. Mater. 2010, 22(48), 5468.

*Over 350 citations.

2. Guo, J.; Liang, Y.; Szarko, J.; Lee, B.; Son, H. J.; **Rolczynski, B. S.**; Yu, L.; Chen, L. X. Structure, Dynamics, and Power Conversion Efficiency Correlations in a New Low Bandgap Polymer:PCBM Solar Cell. J. Phys. Chem. B 2010, 114(2), 742.

*Over 150 citations.

1. Szarko, J.; Guo, J.; Liang, Y.; **Rolczynski, B.**; Yu, L.; Chen, L. X. The electron and energy transfer between oligothiophenes and thieno[3,4-b]thiophene units. Proc. of SPIE 2008, 7034, 703403.

PUBLICATIONS (NOT PEER-REVIEWED)

Rolczynski, B. S.; Navotnaya, P.; Sussman, H. R.; Engel, G. S. Cysteine-mediated mechanism disrupts energy transfer to prevent photooxidation. Proc. Nat. Acad. Sci. 2016. 113(31), 8562.

TALKS

19. **Rolczynski, B. S.**; Diaz, S. A.; Kim, Y. C.; Mathur, D.; Medintz, I. L.; and Melinger, J. S. "Understanding Energy-Transport Bottlenecks In Molecular Networks Using Machine-Learning Tools." BRICC Conference. Arlington, VA. 9/8/22.

18. **Rolczynski, B. S.**; Diaz, S. A.; Kim, Y. C.; Medintz, I. L.; Cunningham, P. D.; and Melinger, J. S. "Understanding Energy Levels and Structures in Modular Chromophore Networks Templated by DNA." ACS Meeting Fall 2022. Chicago, IL. 8/24/22.

17. **Rolczynski, B. S.**; Diaz, S. A.; Kim, Y. C.; Mathur, D.; Medintz, I. L.; and Melinger, J. S. "Machine-Learning Methods for Understanding Energy-Transport in Molecular Networks." ACS Meeting Fall 2022. Chicago, IL. 8/21/22.

16. **Rolczynski, B. S.**; Diaz, S. A.; Kim, Y. C.; Mathur, D.; Medintz, I. L.; Cunningham, P. D.; and Melinger, J. S. "Using Machine-Learning Tools to Understand and Optimize Molecular Networks Templated by DNA." Mid-Atlantic DNA Nanotechnology Symposium. Rockville, MD. 5/24/22.

15. **Rolczynski, B. S**.; Kim, Y.; Diaz, S.; Medintz, I.; Cunningham, P.; Melinger, J. "Deducing Energy and Structure in DNA-scaffolded Chromophores using Genetic Algorithms." IEEE NANO 2021 conference. Montreal, Canada. 7/29/21.

14. **Rolczynski, B. S**. "Correlated Protein Environments Prolong Quantum Coherence." Invited talk. NIST, Gaithersburg, MD. 5/14/19.

13. **Rolczynski, B. S.**; Klein, W.; Diaz, S.; Zadegan, R.; Ancona, M.; Kuang, W.; Medintz, I.; Melinger, J. "Understanding energy transport relays using machine-learning tools." FNano conference. Snowbird, UT. 4/16/19.

12. **Rolczynski, B. S.**, and Engel, G. S. "Correlated Protein Environments Prolong Quantum Coherence." Carnegie Mellon University, Pittsburgh, PA. 1/21/19.

11. **Rolczynski, B. S.** and Engel, G. S. "Correlated Protein Environments Prolong Quantum Coherence." US Naval Research Laboratory, Washington, DC. 5/3/18.

10. **Rolczynski, B. S.** and Engel, G. S. "Correlated Protein Environments Drive Prolonged Quantum Coherence." Washington University in St. Louis, St. Louis, MO. 11/30/17.

9. **Rolczynski, B. S.** and Engel, G. S. "Correlated Motion for Prolonged Quantum Coherences in a Photosynthetic Protein." Invited talk. Loyola University, Chicago, IL. 4/20/17.

8. **Rolczynski, B. S.**; Navotnaya, P.; Engel, G. S. "Driving delocalized dynamics using the orbital angular momentum of light." ACS Meeting. San Francisco, CA. 4/5/17.

7. **Rolczynski, B. S.**; Yeh, S.; Navotnaya, P.; Ashraf, K.; Gardiner, A.; Cogdell, R.; Engel, G. S. "Resolving the detailed 2D spectral structure of the Fenna-Matthews-Olson complex." ACS Meeting. San Francisco, CA. 4/5/17.

6. **Rolczynski, B. S.**; Zheng, H.; Singh, V.; Navotnaya, P.; Caram, J.; Ashraf, K.; Gardiner, A.; Cogdell, R.; Engel, G. S. "Correlated vibrational motion in the Fenna-Matthews-Olson complex." ACS Meeting. San Francisco, CA. 4/2/17.

5. **Rolczynski, B. S.** and Engel, G. S. "Correlated exciton environments in the Fenna-Matthews-Olson complex." Photosynthesis conference. Marshall, IN. 11/5/16.

4. **Rolczynski, B. S.** and Engel, G. S. "Transcribing light's orbital angular momentum to materials." Spinos VI conference. Chicago, IL. 10/17/16.

3. **Rolczynski, B. S.** and Engel, G. S. "Long-lived coherences through correlated environments." ACS Meeting. Philadelphia, PA. 8/22/16.

2. **Rolczynski, B. S.** and Engel, G. S. "How Long Does a CdSe Quantum Dot Remember Its Excitation Energy?" Nanotalk Symposium. Chicago, IL. 2/25/14.

1. **Rolczynski, B. S.** and Chen, L. X. "The role of tuning push-pull interactions in small optical gap copolymers." Gordon Research Seminar. Easton, MA. 7/10/11.

TEACHING

The University of Chicago, Chicago, IL

Laboratory research mentor
5 graduate students, 4 undergraduates

Guest lecture, Wave Mechanics and Spectroscopy — Fall 2015

Northwestern University, Evanston, IL

Laboratory research mentor
1 graduate student, 1 undergraduate

TA, Advanced Undergraduate Laboratory — Summer 2009

Super TA, General Physical Chemistry — Spring 2008, Spring 2009
delivered lectures and review sessions, co-wrote and proctored exams and quizzes, wrote homework solutions, and coordinated with lab TAs

Instructor, Gateway Science Workshop — Spring 2008, Spring 2009
instructed a co-curricular honors Chemistry program for undergraduates

TA, General Inorganic Chemistry — Winter 2008

TA, General Chemistry — Fall 2007

SERVICE

Chair, Membership Committee, ACS, Wash. DC Chapter — 2022 - 2023

Board Secretary (elected), ACS, Wash. DC Chapter — 2022 - present

Member, Committee on Minority Affairs, ACS, Wash. DC Chapter — 2020 - present

Instructor, Gateway Science Workshop, Northwestern University — Spring 2008, Spring 2009