MAGNITUDE INSTRUMENTS™

Founder's CV

John B. Asbury

Co-founder, Chief Scientific Officer
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Professor of Chemistry
Associate Chair for Graduate Education
The Pennsylvania State University
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Education

Post-doctoral Scholar – Advisor: Michael D. Fayer
Stanford University, Department of Chemistry
2001 – 2005

PhD Chemistry – Advisor: Tianquan (Tim) Lian
Emory University, Department of Chemistry
1996 – 2001

BS Chemistry
University of Tennessee, Knoxville
1992 – 1996

Research and Experience

- Development of ultrafast and nanosecond-millisecond time-scale infrared transient absorption spectroscopy techniques to examine electronic processes in emerging photovoltaic and optoelectronic materials including colloidal quantum dots, halide perovskites and organic semiconductors. Insights about how molecular structure, morphology and surface chemistry affect the properties of these materials have emerged from this work that inform ongoing efforts to understand and control their properties and devices.
- Development of ultrahigh sensitivity transient absorption spectroscopy methods based on new noise suppression technology. This technology was accidentally discovered in the Asbury lab because John proposed experiments to the U.S. Department of Energy that could not be done with existing technology. Out of desperation, his graduate students and co-founders of Magnitude had to reimagine what transient absorption spectroscopy should be to achieve the program goals. That work, and the innovations that followed, are now opening new areas of research and development ranging from in-situ electrochemical spectroscopy for catalyst discovery, in-line process control and quality assurance.
- Participated in Ben Franklin Technology Partners TechCelerator workshop on how to jumpstart a technology company.

Honors and Awards

Editorial Advisory Board, *Chem. Phys.* (2015-2018)
Editorial Advisory Board, J*. Phys. Chem.* (2014-2016)
Priestly Teaching Award Finalist (2013, 2019)
U.S. DOE CAREER Award (2012)
U.S. NSF CAREER Award (2009)
3M Non-Tenured Faculty Grant (2008-2010)
Eli Lilly Analytical Chem. New Faculty Award (2007)
Camille and Henry Dreyfus New Faculty Awd (2005)

Publications

Web of Science H-Index = 40, 88 Peer Reviewed Publications, >7000 Total Citations (as of May 2020)

Research Funding

~$3.0M since 2018 from DOE-Solar Photochemistry, NSF-CSDM-A, NSF-MRI, ONR, DURIP

Research Group

1 post-doc, 6 graduate students, 3 undergraduate students

Select Publications

1) Eric R. Kennehan, Kyle T. Munson, Grayson S. Doucette, Ashley R. Marshall, Mathew C. Beard, and John B. Asbury, "Dynamic Ligand Surface Chemistry of Excited PbS Quantum Dots", *JPC Lett*. (2020) 11, 2291-2297. **DOI**: 10.1021/acs.jpclett.0c00539

   First demonstration of the ability to probe changes in ligand surface chemistry on quantum dots in their excited excitonic states by direct probing of ligand vibrational modes using an inspIRe transient absorption spectrometer.

2) Kyle. T. Munson, John R. Swartzfager, Jianing Gan, and John B. Asbury, "Does Dipolar Motion of Organic Cations Affect Polaron Dynamics and Bimolecular Recombination in Halide Perovskites?", *JPC Lett*. (2020) 11, 3166-3172. **DOI**: 10.1021/acs.jpclett.0c00762

   Direct measurement of large polarons in halide perovskite photovoltaic materials with transient carrier densities closely matching steady-state carrier density in devices under one-sun illumination. The investigation clarified controversy regarding the role that dipolar organic cations play in the remarkable electronic properties of these materials.

3) Christopher Grieco, Grayson S. Doucette, Kyle T. Munson, John R. Swartzfager, Jason M. Munro, John E. Anthony, Ismaila Dabo, and John B. Asbury, "Vibrational Probe of the Origin of Singlet Exciton Fission in TIPS-Pentacene Solutions", *JCP* (2019) 151, 154701. **DOI**: 10.1063/1.5116586

   Singlet fission among TIPS-Pentacene molecules in solution probed through the native vibrational modes of the TIPS side groups using an inspIRe. Resolved earlier reports that singlet fission could occur by diffusive encounter in solution.

4) Kyle T. Munson, Eric R. Kennehan, and John B. Asbury, "Structural Origins of the Electronic Properties of Materials via Time-Resolved Infrared Spectroscopy", *J. Mater. Chem. C* (2019) 7, 5889-5909. **DOI**: 10.1039/C9TC01348B

   Review of recent examples of using mid-IR transient absorption spectroscopy to investigate the electronic properties of optoelectronic materials and correlation of those properties with underlying molecular structural information. Insights from these studies help inform the development of design rules about how structure influences function in emerging electronic materials.

5) Kyle T. Munson, Eric R. Kennehan, Grayson S. Doucette, and John B. Asbury, "Dynamic Disorder Dominates Delocalization, Transport, and Recombination in Halide Perovskites", *Chem*. (2018) 4, 2826-2843. **DOI**: 10.1016/j.chempr.2018.09.001

   First illustration of infrared transient absorption measurement using an inspIRe transient absorption spectrometer at excitation conditions many orders of magnitude lower than previously possible. Capability was central to the realization that dynamic disorder leads to order of magnitude longer carrier lifetimes in halide perovskite photovoltaics.

6) Eric R. Kennehan, Grayson S. Doucette, Ashley R. Marshall, Christopher Grieco, Kyle T. Munson, Matthew C. Beard, and John B. Asbury, "Electron−Phonon Coupling and Resonant Relaxation from 1D and 1P States in PbS Quantum Dots", *ACS Nano*. (2018) 12, 6263-6272. **DOI**: 10.1021/acsnano.8b03216

   First discovery of formally forbidden 1S-1D excitonic transitions in PbS quantum dots using combined spectra from inspIRe and enVISion transient absorption spectrometers. The ability to measure small spectral features of forbidden transitions with high fidelity was central to revealing resonant relaxation pathways that bypass the phonon bottleneck.

7) Christopher Grieco, Eric R. Kennehan, Adam Rimshaw, Marcia M. Payne, John E. Anthony, and John B. Asbury, "Harnessing Molecular Vibrations to Probe Triplet Dynamics during Singlet Fission", *JPC Lett*. (2017) 8, 5700-5706. **DOI**: 10.1021/acs.jpclett.7b02434

   Utilization of molecular vibrations to interrogate the mechanism of triplet exciton formation during singlet fission. Infrared spectra collected on an inspIRe transient absorption spectrometer were used to track vibrational signatures present on ultrafast timescales through the entire singlet fission mechanism.

8) Christopher Grieco, Melissa P. Aplan, Adam Rimshaw, Youngmin Lee, Thinh P. Le, Wenlin Zhang, Qing Wang, Scott T. Milner, Enrique D. Gomez, and John B. Asbury, "Molecular Rectification in Conjugated Block Copolymer Photovoltaics", *JPCC*. (2016) 120, 6978-6988. **DOI**: 10.1021/acs.jpcc.6b00103

   Demonstration of selective, directional charge transfer in the first efficient fully conjugated block copolymer photovoltaic material. The ability to seamlessly connect ultrafast and nanosecond time scale infrared transient absorption measurements using a prototype of the inspIRe was key to demonstrating the selectivity for charge transfer that underpinned the high performance of the system.