Yusong Bai

February 03, 2023

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Affiliations

- **Assistant Professor** Department of Chemistry, Brown University 08/01/2022 – present

Disciplinary Field(s)

- **Experimental Physical Chemistry**: quantum materials, ultrafast spectroscopy, optical microscopy

Education

- **Ph.D.** Physical Chemistry, Duke University 2011-2017
  Advisor: Michael J. Therien

Professional Experiences

- **Postdoctoral Research** Columbia University 2018-2022
  Advisor: Xiaoyang Zhu

Honors and Awards

- OVPR Research Seed Awards (Brown University) 2023
- IOP Outstanding Reviewer Award (Journal: 2D Materials) 2019
- FIP Seminar Student Speaker Award (Fitzpatrick Institute for Photonics) 2017
- Outstanding Student Poster Award (252nd National ACS Meeting, Physical division) 2016
- John Chambers Scholar (Fitzpatrick Institute for Photonics) 2014 – 2016
- Paul M. Gross Fellowship (Duke, Department of Chemistry) 2014
- GPNANO Fellowship (Duke, Department of Chemistry) 2013
- Undergraduate Distinction Award (First four year at Duke) 2011

Publications

28) An exceptioinally large optical spin Hall effect in exciton-polariton condenstates
Xiang, B.; Li, Y.; Spencer, M.; Dai, Y.; **Bai, Y.**; Basov, D.; Zhu, X.-Y.
Proc. Natl. Acad. Sci. U.S.A. 2023, *Under review*

27) Evidence for exciton crystals in a 2D semiconductor heterotrilayer
Bai, Y.; Liu, S.; Guo, Y.; Pack, J.; Dean, C.; Hone, J.; Zhu, X.-Y.
Nat. Mater. 2022, *Under review* (arXiv:2207.09601)

26) Exciton coupled coherent antiferromagnetic magnons in a 2D semiconductor
Bae, Y. J.; Wang, J.; Xu, J.; Chica, D. G.; Diederich, G. M.; Cenker, J.; Ziebel, M. E.; **Bai, Y.**; Ren, H.; Dean, C. R.; Delor, M.; Xu, X.; Roy, X.; Kent, A. D.; Zhu, X.-Y.
Nature 2022, *609*, 282-286

25) Disorder of excitons and trions in monolayer $MoSe_2$
Wang, J.; Manolatou, C.; **Bai, Y.**; Hone, J.; Rana, F.; Zhu X.-Y.
J. Chem. Phys. 2022, *157*, 211101

24) Free trion with near unity quantum in monolayer $MoSe_2$
Kim, B.; Luo, Y.; Rhodes, D.; **Bai, Y.**; Wang, J.; Liu, S.; Cho, Y.; Huang, B.; Li, Z.; Taniguchi, T.; Watanabe, K.; Berkelbach, T. C.; Strauf, S.; Barmak, K.; Zhu, X.-Y.; Hone, J.
ACS Nano. 2021, *16*, 140-147

23) Dissecting interlayer hole and electron transfer in transition metal dichalcogenide heterostructures via two-dimensional electronic spectroscopy
Policht, V.; Russo, M.; Liu, F.; Trovatello, C.; Maiuri, M.; **Bai, Y.**; Zhu, X.-Y.; DalConte, S.; Cerullo, C.
Nano Lett. 2021, *21*, 4738-4743

22) Excitonic Phase Transitions in $MoSe_2/WSe_2$ Heterobilayers
Wang, J.; Shi, Q.; Shih, E.-M.; Zhou, L.; Wu, W.; **Bai, Y.**; Rhodes, D. A.; Barmak, K.; Hone, J.; Dean, C. R.; Zhu, X.-Y.
Phys. Rev. Lett. 2020, *126,* 106804

21) Topology, distance, and orbital symmetry effects on electronic spin-spin couplings in rigid molecular systems: implications for long distance spin-spin interactions
Wang, R.; Ko, C.-H.; Brugh, A. M.; **Bai, Y.**; Forbes, M. D. E.; Therien, M. J.
J. Phys. Chem. A 2020, *124*, 7411-7415.

20) Excitons in strain-induced one-dimensional moiré potentials at transition metal dichalcogenide heterojunctions
Bai, Y.*; Zhou, L.*; Wang, J.; Wu, W.; McGilly, L.; Halbertal, D.; Lo, C.; Liu, F.; Ardelean, J.; Rivera, P.; Finney, N.; Yang, X.-C.; Basov, D. N.; Yao, W.; Xu, X.; Hone, J.; Pasupathy, A.; Zhu, X.-Y. (*equal contribution)
Nat. Mater. 2020, *19*, 1068-1073.

19) Visualization of moiré superlattices

McGilly, L. J.; Kerelsky, A.; Finney, N. R.; Shapovalov, K.; Ghiotto, A.; Shih, E.-M.; Zeng, Y.; Moore, S. L.; Wu, W.; **Bai, Y.**; Watanabe, K.; Taniguchi, T.; Zhou, L.; Hone, J.; Zhu, X.-Y.; Basov, D.; Dean, C. R.; Dreyer, C. E.; Pasupathy A. N.
Nat. Nanotech. 2020, *15*, 580-584.

18) Correlated electronic phases in twisted bilayer transition metal dichalcogenides
Wang, L.*; Shih, E.-M.*; Ghiotto, A.*; Xian, L.; Rhodes, D. A.; Tan, C.; Claassen, M.; Kennes, D. M.; **Bai, Y.**; Kim, B.; Watanabe, K.; Taniguchi, T.; Zhu, X.-Y.; Hone, J.; Rubio, A.; Pasupathy, A.; Dean C. R. (*equal contribution)
Nat. Mater. 2020, *19*, 861-866.

17) Disassembling 2D van der Waals crystals into macroscopic monolayers and reassembling into artificial lattices
Liu, F.; Wu, W.; **Bai, Y.**; Chae, S.; Li, Q.; Wang, J.; Hone, J.; Zhu X.-Y.
Science 2020, *367*, 903-906.

16) Electronic structure and photophysics of a supermolecular iron complex having a long MLCT-state lifetime and panchromatic absorption
Jiang, T.*; **Bai, Y.***; Zhang, P.; Han, Q.; Mitzi, D. B.; Therien, M. J. (*equal contribution)
Proc. Natl. Acad. Sci. U.S.A. 2020, *117*, 20430-20437.

15) Optical generation of high carrier densities in 2D semiconductor hetero-bilayers
Wang, J.*; Ardelean, J.*; **Bai, Y.***; Steinhoff, A.; Florian, M.; Wen, Q.; Jahnke, F.; Xu, X.; Kira, M.; Hone, J.; Zhu, X.-Y. (*equal contribution)
Sci. Adv. 2019, *5,* eaax0145.

14) Quantitative evaluation of optical free carrier generation in semiconducting single-walled carbon nanotubes
Bai, Y.; Bullard, G.; Olivier, J.-H.; Therien, M. J.
J. Am. Chem. Soc. 2018, *140,* 14619-14626. Cover

13) Carrier dynamics engineering for high-performance electron-transport-layer-free perovskite photovoltaics
Han, Q.; Ding, J.; **Bai, Y.**; Li, T.; Ma, J.; Chen, Y.; Zhou, Y.; Liu, J.; Ge, Q.; Chen, J.; Glass, J. T.; Therien, M. J.; Liu, J.; Mitzi, D. B.; Hu, J.-S.
Chem 2018, *4,* 2405-2417.

12) Solvent- and wavelength-dependent photoluminescence relaxation dynamics of carbon nanotube sp^3 defect states
He, X.; Velizhanin, K. A.; Bullard, G.; **Bai, Y.**; Olivier, J.-H.; Hartmann, N. F.; Gifford, B. J.; Kilina, S.; Tretiak, S.; Htoon, H.; Therien, M. J.; Doorn, S. K.
ACS Nano 2018, *12,* 8060-8070.

11) Dynamics of charge excitons in electronically and morphologically homogeneous single-walled carbon nanotubes
Bai, Y.; Olivier, J.-H.; Bullard, G.; Liu, C.; Therien, M. J.
Proc. Natl. Acad. Sci. U.S.A. 2018, *115,* 674-679.

10) Molecular road map to tuning ground state absorption and excited state dynamics of long-wavelength absorbers
Bai, Y.; Olivier, J.-H.; Yoo, H.; Polizzi, N. F.; Park, J.; Rawson, J.; Therien, M. J.
J. Am. Chem. Soc. 2017, *139,* 16946-16958.

9) Additive engineering for high-performance room-temperature-processed perovskite absorbers with micron-size grains and microsecond-range carrier lifetimes
Han, Q.; **Bai, Y.**; Liu, J.; Du, K.-Z.; Li, T.; Ji, D.; Zhou, Y.; Cao, C.; Shin, D.; Ding, J.; Franklin, A. D.; Glass, J. T.; Hu, J.-S.; Therien, M. J.; Liu, J.; Mitzi, D. B.
Energy Environ. Sci. 2017, *10,* 2365-2371.

8) Controlling the excited-state dynamics of low band gap near-infrared absorbers via proquinoidal unit electronic structural modulation
Bai, Y.; Rawson, J.; Roget, S. A.; Olivier, J.-H.; Lin, J.; Zhang, P.; Beratan, D.; Therien, M. J.
Chem. Sci. 2017, *8,* 5889-5901. Cover

7) First-order hyberpolarizabilities of chiral, polymer-wrapped single-walled carbon nanotubes
Depotter, G.; Olivier, J.-H.; Glesner, M. G.; Deria, P.; **Bai, Y.**; Bullard, G.; Kumbhar, A. S.; Therien, M. J.; Clays, K.
Chem. Commun. 2016, *52*, 12206-12209.

6) Unambiguous diagnosis of photoinduced charged carrier signatures in a stoichiometrically controlled semiconducting polymer-wrapped carbon nanotube assembly
Olivier, J.-H.; Park, J.; Deria, P.; Rawson, J.; **Bai, Y.**; Kumbhar, A. S.; Therien, M. J.
Angew. Chem., Int. Ed 2015, *54,* 1-7.

5) Near infrared-to-visible photon upconversion enabled by highly conjugated sensitizers under low-power noncoherent illumination
Olivier, J.-H.; **Bai, Y.**; Uh. Y; Therien, M. J.; Castellano, F. N.
J. Phys. Chem. A 2015, *119,* 5642-5649.

4) A facile way to rejuvenate Ag_3PO_4 as a recyclable highly efficient photocatalyst
Wang, H.; **Bai, Y.**; Yang, J.; Lang, X.; Li, J.; Guo, L.
Chem. Eur. J. 2012, *18,* 5524-5529.

3) The self-assembly of porous microspheres of tin dioxide octahedral nanoparticles for high performance lithium-ion battery anode materials
Wang, H.; Wu, Y.; **Bai, Y.**; Zhou, W.; An, Y.; Li, J.; Guo, L.
J. Mater. Chem. 2011, *21,* 10189-10194.

2) Rutile TiO_2 nano-branched arrays on FTO for dye-sensitized solar cells
Wang, H.; **Bai, Y.**; Wu, Q.; Zhou, W.; Zhang, H.; Li, J.; Guo, L.
Phys. Chem. Chem. Phys. 2011, *13,* 7008-7013.

1) CdS quantum dots-sensitized TiO_2 nanorod array on transparent conductive glass photoelectrodes
Wang, H.; **Bai, Y.**; Zhang, H.; Zhang, Z.; Li, J.; Guo, L.
J. Phys. Chem. C 2010, *114,* 16451-16455.

Patent

- Therien, M. J.; **Bai, Y.**; Olivier, J.-H.; Bullard, G. "Control of trion density in carbon nanotubes for electro-optical and opto-electric devices". *US Patent App.* 12/222, 704, 2019.

- Jiang, T.; **Bai, Y.**; Bullard, G.; Viere, E. J.; Animesh, N.; Zhang, P.; Rosenthal, C.; Therien, M. J. "Iron chromophores for energy conversion". *US Patent App.* 17/384, 603, 2022.

Presentations

- APS March Meeting, Las Vegas, Nevada (Oral) 2023
  Title: Evidence for exciton crystals and quantum phase transitions in a 2D semiconductor trilayer

- Ultrafast Webinar Summer Series (Oral) 2020
  Title: Excitons in strain-induced one-dimensional moiré potentials

- Graphene for US 2020, International Conference, New York, NY (Oral) 2020
  Title: 1D moiré excitons

- Max Planck-New York Center for Nonequilibrium Quantum Phenomena (Oral) 2019
  Title: One-dimensional moiré excitons in transition metal dichalcogenide heterobilayers

- 231st ECS Meeting, New Orleans, LA (Invited Talk) 2017
  Title: Excited-state dynamical studies of positively and negatively charged excitons in polymer-wrapped single-walled carbon nanotube superstructures

- 231st ECS Meeting, New Orleans, LA (Invited Talk) 2017
  Title: Photoinduced charge transfer reactions in chiral, semiconducting polymer-wrapped single-walled carbon nanotube superstructures

- Fitzpatrick Institute for Photonics Special Seminar, Durham, NC (Invited Talk) 2017
  Title: Dynamics of charge excitons in electronically and morphologically homogeneous single-walled carbon nanotubes

- Gordon Research Conferences on Photochemistry, Lewiston, ME (Poster) 2017
  Title: Dynamics of charge excitons in semiconducting single-walled carbon nanotubes

- 252nd National ACS Meeting, Philadelphia, PA (Oral) 2016
  Title: Regulating long-wavelength absorptivity and photophysics of oligo(porphinato)metal(II) chromophores through variation of electronically excited state proquinoidal character

- 252nd National ACS Meeting, Philadelphia, PA (Poster) 2016
  Title: Molecular roadmap to tuning ground state absorption and excited state dynamics of near-infrared chromophores