

Curriculum Vitae

Chao (Robert) Luo

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Education

Ph. D. Chemical Engineering, December 2015

University of Maryland, College Park, MD, USA

Faculty Advisor: Prof. Chunsheng Wang

M. S. Organic Chemistry, June, 2011

Technical Institute of Chemistry and Physics, Chinese Academy of Sciences, Beijing, China

B. S. Chemistry, June, 2008

Wuhan University, Hubei, China

Experiences

Assistant Professor of Organic Chemistry, George Mason University, 06/2019-ongoing

- Novel organic materials and polymers for low cost and sustainable multivalent metal (Mg/Al) batteries.
- New carbon/sulfur composites and electrolytes for lithium sulfur batteries under lean electrolyte condition.
- Ultralow temperature rechargeable batteries for extreme condition applications.
- Polymer electrolytes and organic/polymer electrodes for all-solid-state batteries.
- Electrochemical catalysis of nitro compounds for the production of nitroso compounds, azoxy compounds and azo compounds.

Postdoctoral Research Associate, University of Maryland-College Park, 10/2016-06/2019

- Designing and synthesizing oxygen and nitrogen containing organic compounds and polymers for green and sustainable alkali-ion batteries.
- Developing high energy and sustainable lithium sulfur batteries based on polymer precursors as carbon sources and sealed vacuum glass tube synthetic technique.

Developing porous carbon and organic electrolytes for high Coulombic efficiency lithium metal anodes to couple with the sulfur cathode.

- Developing high performance all-solid-state batteries with good safety and high energy density.

Process Engineer III at Lam Research Corporation, Tualatin OR, 02/2016-09/2016

- Developing plasma-enhanced chemical vapor deposition tools for SiO_x/SiN_x layered structure production in semiconductor industry.

Postdoctoral Research Associate, University of Maryland-College Park, 12/2015-02/2016

Project: Sustainable Li-sulfur batteries and Na-ion battery cathodes

- Atomic-layer-deposition functionalized carbonized wood fiber for high sulfur loading Li-sulfur batteries.

Graduate Research Assistant, University of Maryland-College Park, 08/2011-12/2015

Project 1: Sustainable Li/Na-sulfur batteries and Li/Na-selenium batteries

- Synthesizing carbon/sulfur and carbon/selenium microspheres by sealed vacuum glass tube technique, and test the battery performance on Arbin, Gamary and Solartron Potentiostats.
- Fabricating Al₂O₃ coated free-standing sulfur/carbonized woodfiber electrodes for high energy cathode by atomic layer deposition (ALD) and sealed vacuum glass tube synthetic technique.
- Carbonizing polyacrylonitrile stabilized selenium sulfide cathodes for long cycle life and high-power density lithium ion batteries.

Project 2: Organic electrode materials for green and sustainable Li-ion and Na-ion batteries

- Synthesizing organic nanorod electrodes by roll-to-roll fabrication, and deposit a thin layer of Al₂O₃ to protect nanorod from dissolving in the electrolyte by ALD.
- Synthesizing organic nanospheres and graphene oxide wrapped organic nanoflowers for Na-ion battery anodes by aerosol method.
- Fabricating organic nanowires and microwires for high-rate Li batteries by anti-solvent recrystallization method.

Graduate Research Assistant, Chinese Academy of Sciences, 2009-2011

Sensing of Thiol-Containing Amino Acids and Photosensitization of Singlet Oxygen by Squaraines

- Synthesizing squaraine-based chemosensor to detect Hg₂₊ and thiol-containing amino acids in water.

- Synthesizing aniline-based squaraines with high singlet oxygen quantum yield for photodynamic therapy.

Graduate Teaching Assistant, 09/2011-05/2012 & 09/2014-05/2015

- ❖ Conduct weekly discussions, held office hours, graded lab reports and homework, mid-term and final examinations for undergraduate labs and classes including CHEM 232 (Organic Chemistry Lab I), CHEM 242 (Organic Chemistry Lab II), CHBE 301 (Chemical and Biomolecular Engineering Thermodynamics I), CHBE 473 (Advanced Fuel Cell and Batteries).
- ❖ Help undergraduate students develop and improve lab performance.

Specialties

- Energy Storage and conversion. (Alkali-ion Batteries)
- Electrochemical and material Characterization. (Cyclic Voltammograms, Electrochemical Impedance Spectroscopy, Galvanostatic Intermittent Titration Technique, X-Ray Photoelectron Spectroscopy, X-Ray Diffraction, Scanning Electron Microscopy, Transmission Electron Microscopy)
- Organic Synthesis, Characterization and Reaction Engineering. (Column Chromatography, Nuclear Magnetic Resonance, Mass Spectroscopy, Elemental Analysis, Thermal Gravimetric Analysis, Fourier Transform Infrared Spectroscopy, Raman Spectroscopy)
- Inorganic Synthesis. (Ball Milling Method, Hydrothermal Method, Aerosol Method, Atomic Layer Deposition, Chemical Vapor Deposition, Electrospinning Technique, Sealed Vacuum Glass Tube Technique)
- Computer skills. (Microsoft office, ChemBioOffice, OriginLab, Mathcad, C programming Language)

Awards

2015	Dean's Doctoral Research Award Winner at ChBE, University of Maryland
2015	Ann G. Wylie Dissertation Fellowship, University of Maryland
2015	The Third Place Teaching Assistant Award at ChBE, University of Maryland
2014	Chinese Government Award for Outstanding Self-financed Students Abroad
2014	Harry K. Wells Graduate Fellowship, University of Maryland
2011	Non-Resident Alien Fellowship, University of Maryland
2011-2015	Graduate Assistantship, University of Maryland
2009-2011	Institute Chief Award, Chinese Academy of Sciences
2005-2007	Excellent Student Fellowship, Wuhan University

Publications (§Equal contribution; *Corresponding author; Citations: 3927; h-index: 31)

1. M. Mao, **Chao Luo***, T. Pollard, S. Hou, T. Gao, X. Fan, C. Cui, J. Yue, Y. Tong, G. Yang, T. Deng, M. Zhang, J. Ma, L. Suo, O. Borodin*, C. Wang*, A Pyrazine-Based Polymer for Fast-Charge Batteries, *Angew. Chem. Int. Ed.* **2019**, Accepted, DOI: 10.1002/anie.201910916.
2. Y. Liang§, **Chao Luo**§, F. Wang, S. Hou, S. Liou, T. Qing, Q. Li, J. Zheng, C. Cui, C. Wang, An Organic Anode for High Temperature Potassium-ion Batteries, *Adv. Energy Mater.* **2019**, 1802986.
3. **Chao Luo**§, X. Ji§, J. Chen, K.J. Gaskell, X. He, Y. Liang, J. Jiang, C. Wang, Solid-State Electrolyte Anchored with Carboxylated Azo Compound for All-Solid-State Lithium Batteries, *Angew. Chem. Int. Ed.* **2018**, 57, 8567-8571.
4. **Chao Luo**, S. Hou, X. Ji, N. Eidson, X. Fan, Y. Liang, T. Deng, J. Jiang, C. Wang, Azo Compounds Derived from Electrochemical Reduction of Nitro Compounds for High Performance Li-ion Batteries, *Adv. Mater.* **2018**, 1706498.
5. **Chao Luo**, O. Borodin, X. Ji, S. Hou, K.J. Gaskell, X. Fan, J. Chen, T. Deng, R. Wang, J. Jiang, C. Wang, Azo compounds as a family of organic electrode materials for alkali-ion batteries, *Proc. Natl. Acad. Sci. U.S.A* **2018**, 115, 2004-2009.
6. **Chao Luo**, G.-L. Xu, X. Ji, S. Hou, L. Chen, F. Wang, J. Jiang, Z. Chen, Y. Ren, K. Amine, C. Wang, Reversible Redox Chemistry of Azo Compounds for Sodium Ion Batteries, *Angew. Chem. Int. Ed.* **2018**, 57, 2879-2883. (Impact Factor: 12.257)
7. **Chao Luo**, X. Fan, Z. Ma, T. Gao, C. Wang, Self-healing Chemistry between Organic Material and Binder for Stable Sodium Ion Batteries, *Chem* **2017**, 3, 1050-1062. (Impact Factor: 18.205)
8. **Chao Luo**, Y. Zhu, O. Borodin, T. Gao, X. Fan, Y. Xu, K. Xu, C. Wang, Activation of Oxygen-Stabilized Sulfur for Li and Na Batteries. *Adv. Funct. Mater.* **2016**, 26, 745-752. (Impact Factor: 15.621)
9. **Chao Luo**, J. Wang, X. Fan, Y. Zhu, F. Han, L. Suo, C. Wang, Roll-to-Roll Fabrication of Organic Nanorod Electrodes for Sodium Ion Batteries, *Nano Energy* **2015**, 13, 537-545. (Impact Factor: 15.548)
10. **Chao Luo**§, R. Huang§, R. Kevorkyants, M. Pavanello, H. He, C. Wang, Self-Assembled Organic Nanowires for High Power Density Lithium Ion Batteries, *Nano Lett.* **2014**, 14, 1596-1602. (Impact Factor: 12.279)
11. **Chao Luo**, Y. Zhu, Y. Wen, J. Wang, C. Wang, Carbonized Polyacrylonitrile Stabilized SeS_x Cathodes for Long Cycle Life and High Power Density Lithium Ion Batteries, *Adv. Funct. Mater.* **2014**, 24, 4082-4089. (Impact Factor: 15.621)
12. **Chao Luo**§, Y. Xu§, Y. Zhu, Y. Liu, S. Zheng, Y. Liu, A. Langrock, C. Wang, Selenium@Mesoporous Carbon Composite with Superior Lithium and Sodium Storage Capacity, *ACS Nano* **2013**, 9, 8003-8010. (Impact Factor: 13.903)

13. **Chao Luo**, A. Langrock, X. Fan, Y. Liang, C. Wang, P2-Type Transition Metal Oxides for High Performance Na-Ion Battery Cathodes, *J. Mater. Chem. A* **2017**, *5*, 18214-18220. (Impact Factor: 10.733)
14. **Chao Luo**, H. Zhu, W. Luo, F. Shen, X. Fan, J. Dai, Y. Liang, C. Wang, L. Hu, Atomic-Layer-Deposition Functionalized Carbonized Mesoporous Wood Fiber for High Sulfur Loading Lithium Sulfur Batteries, *ACS Appl. Mater. Inter.* **2017**, *9*, 14801-14807. (Impact Factor: 8.456)
15. **Chao Luo**, J. Wang, L. Suo, J. Mao, X. Fan, C. Wang, *In situ* formed carbon bonded and encapsulated selenium composites for Li–Se and Na–Se batteries, *J. Mater. Chem. A* **2015**, *3*, 555-561. (Impact Factor: 10.733)
16. **Chao Luo**, Y. Zhu, Y. Xu, Y. Liu, T. Gao, J. Wang, C. Wang, Graphene Oxide Wrapped Croconic Acid Disodium Salt for Sodium Ion Battery Electrodes, *J. Power Sources* **2014**, *250*, 372-378. (Impact Factor: 6.945)
17. **Chao Luo**, Q. Zhou, W. Lei, J. Wang, B. Zhang, X. Wang, Supramolecular Assembly of A New Squaraine and β -Cyclodextrin for Detection of Thiol-Containing Amino Acids in Water, *Supramol. Chem.* **2011**, *23*, 657-662. (Impact Factor: 1.66)
18. **Chao Luo**, Q. Zhou, G. Jiang, L. He, B. Zhang, X. Wang, The Synthesis and $^{1}O_2$ Photosensitization of Halogenated Asymmetric Aniline-Based Squaraines, *New J. Chem.* **2011**, *35*, 1128-1132. (Impact Factor: 3.069)
19. **Chao Luo**, Q. Zhou, B. Zhang, X. Wang, A New Squaraine and Hg_{2+} -Based Chemosensor with Tunable Measuring Range for Thiol-Containing Amino Acids, *New J. Chem.* **2011**, *35*, 45-48. (Impact Factor: 3.069)
20. G. Xu, H. Sun, **Chao Luo**, L. Estevez, M. Zhuang, H. Gao, R. Amine, H. Wang, X. Zhang, C. Sun, Y. Liu, Y. Ren, S. M. Heald, C. Wang, Z. Chen, K. Amine, Solid-State Lithium/Selenium–Sulfur Chemistry Enabled via a Robust Solid-Electrolyte Interphase, *Adv. Energy Mater.* **2019**, 1802235.
21. H. Tian, Y. Liang, J. Repac, S. Zhang, **Chao Luo**, S. Liou, G. Wang, S. H. Ehrman, W. Han, Rational Design of Core–Shell-Structured Particles by a One-Step and Template-Free Process for High-Performance Lithium/Sodium-Ion Batteries, *J. Phys. Chem. C* **2018**, *122*, 22232-22240.
22. T. Deng, X. Fan, J. Chen, L. Chen, **Chao Luo**, X. Zhou, J. Yang, S. Zheng, C. Wang, Layered P2-Type $K_{0.65}Fe_{0.5}Mn_{0.5}O_2$ Microspheres as Superior Cathode for High-Energy Potassium-Ion Batteries, *Adv. Funct. Mater.* **2018**, *28*, 1800219.
23. X. Fan, F. Wang, X. Ji, R. Wang, T. Gao, S. Hou, J. Chen, T. Deng, X. Li, L. Chen, **Chao Luo**, L. Wang, C. Wang, A Universal Organic Cathode for Ultrafast Lithium and Multivalent Metal Batteries, *Angew. Chem. Int. Ed.* **2018**, *57*, 7146-7150.
24. D. Tao, X. Fan, **Chao Luo**, J. Chen, L. Chen, S. Hou, N. Eidson, X. Zhou, C. Wang, Self-templated Formation of P2-type $K_{0.6}CoO_2$ Microspheres for High Reversible Potassium-ion Batteries, *Nano Lett.* **2018**, *18*, 1522-1529.

25. T. Gao, S. Hou, K. Huynh, F. Wang, N. Eidson, X. Fan, F. Han, **Chao Luo**, M. Mao, X. Li, C. Wang, Existence of Solid Electrolyte Interphase in Mg Batteries: Mg/S Chemistry as an Example, *ACS Appl. Mater. Interfaces* **2018**, *10*, 14767-14776.
26. X. Fan, T. Gao, **Chao Luo**, F. Wang, J. Hu, C. Wang, Superior Reversible Tin Phosphide-Carbon Spheres for Sodium Ion Battery Anode, *Nano Energy* **2017**, *38*, 350-357.
27. H. Tian, T. Gao, X. Li, X. Wang, **Chao Luo**, X. Fan, C. Yang, L. Suo, Z. Ma, W. Han, C. Wang, High Power Rechargeable Magnesium/Iodine Battery Chemistry, *Nat. Comm.* **2017**, *8*, 14083.
28. G. L. Xu, T. Ma, C. J. Sun, **Chao Luo**, L. Cheng, Y. Ren, S. M. Heald, C. Wang, L. Curtiss, J. Wen, D. J. Miller, T. Li, X. Zuo, V. Petkov, Z. Chen, K. Amine, Insight into the Capacity Fading Mechanism of Amorphous Se₂S₅ Confined in Micro/Mesoporous Carbon Matrix in Ether-Based Electrolytes, *Nano Lett.* **2016**, *16*, 2663-2673.
29. F. Han, J. Yue, X. Fan, T. Gao, **Chao Luo**, Z. Ma, L. Suo, C. Wang, Batteries Enabled by Mixed-Conductive Li₂S Nanocomposites, *Nano Lett.* **2016**, *16*, 4521-4527.
30. X. Fan, Y. Zhu, **Chao Luo**, L. Suo, Y. Lin, T. Gao, K. Xu, C. Wang, Pomegranate-Structured Conversion-Reaction Cathode with a Built-in Li Source for High-Energy Li-Ion Batteries, *ACS Nano* **2016**, *10*, 5567-5577.
31. J. Mao, X. Fan, **Chao Luo**, C. Wang, Building Self-Healing Alloy Architecture for Stable Sodium-Ion Battery Anodes: A Case Study of Tin Anode Materials, *ACS Appl. Mater. Inter.* **2016**, *10*, 7147-7155.
32. X. Fan, Y. Zhu, **Chao Luo**, T. Gao, L. Suo, S.-C. Liou, K. Xu, C. Wang, In situ Lithiated FeF₃/C Nanocomposite as High Energy Conversion-Reaction Cathode for Lithium-ion Batteries, *J. Power Sources* **2016**, *307*, 435-442.
33. Y. Zhu, X. Fan; L. Suo, **Chao Luo**, T. Gao, C. Wang, Electrospun FeS₂@Carbon Fiber Electrode as a High Energy Density Cathode for Rechargeable Lithium Batteries, *ACS Nano* **2016**, *10*, 1529-1538.
34. X. Fan, **Chao Luo**, J. Lamb, Y. Zhu, K. Xu, C. Wang, PEDOT Encapsulated FeOF Nanorod Cathodes for High Energy Lithium-Ion Batteries, *Nano Lett.* **2015**, *15*, 7650-7656.
35. L. Suo, O. Borodin, T. Gao, M. Olguin, J. Ho, X. Fan, **Chao Luo**, C. Wang, K. Xu, "Water-in-Salt" Electrolyte Enables High Voltage Aqueous Li-ion Chemistries, *Science* **2015**, *350*, 938-943.
36. T. Gao, M. Noked, A. J. Pearse, E. Gillette, X. Fan, Y. Zhu, **Chao Luo**, L. Suo, M. A. Schroeder, K. Xu, S. B. Lee, G. W. Rubloff, C. Wang, Enhancing the Reversibility of Mg/S Battery Chemistry through Li⁺ Mediation, *J. Am. Chem. Soc.* **2015**, *37*, 12388-12393.
37. X. Fan, J. Mao, Y. Zhu, **Chao Luo**, L. Suo, T. Gao, F. Han, S. Liou, C. Wang, Superior Stable Self-Healing SnP₃ Anode for Sodium-Ion Batteries, *Adv. Energy, Mater.* **2015**, *5*, 1500174.

38. J. Wang, **Chao Luo**, J. Mao, Y. Zhu, X. Fan, T. Gao, A. Mignerey, C. Wang, Solid-State Fabrication of SnS₂/C Nanospheres for High Performance Na-Ion Battery Anode, *ACS Appl. Mater. Interfaces* **2015**, *7*, 11476-11481.
39. J. Mao, **Chao Luo**, T. Gao, C. Wang, Scalable Synthesis of Na₃V₂(PO₄)₃/C Porous Hollow Spheres for Na-Ion Batteries Cathode, *J. Mater. Chem. A* **2015**, *3*, 10378-10385.
40. L. Suo, Y. Zhu, F. Han, T. Gao, **Chao Luo**, X. Fan, Y. Hu, C. Wang, Carbon Cage Encapsulating Nano-cluster Li₂S by Ionic Liquid Polymerization and Pyrolysis for High Performance Li-S Batteries, *Nano Energy* **2015**, *13*, 467-473.
41. Y. Zhu, Y. Wen, X. Fan, T. Gao, F. Han, **Chao Luo**, S. Liou, C. Wang, Red Phosphorus-Single-Walled Carbon Nanotube Composite as a Superior Anode for Sodium Ion Batteries, *ACS nano* **2015**, *9*, 3254-3264.
42. T. Gao, F. Han, Y. Zhu, L. Suo, **Chao Luo**, K. Xu and C. Wang, Hybrid Mg₂₊/Li⁺ Battery with Long Cycle Life and High Rate Capability, *Advanced Energy Materials* **2015**, *5*, 1401507.
43. J. Wang, **Chao Luo**, T. Gao, A. Langrock, A. C. Mignerey, C. Wang, An Advanced MoS₂/Carbon Anode for High Performance Sodium-Ion Batteries, *Small* **2015**, *11*, 473-481.
44. Y. Xu, Y. Zhu, F. Han, **Chao Luo**, C. Wang, 3D Si/C Fiber Paper Electrodes Fabricated by a Combined Electrospray/Electrospinning Technology for Li-Ion Batteries, *Adv. Energy Mater.* **2015**, *5*, 1400753.
45. S. Zheng, F. Yi, Z. Li, Y. Zhu, Y. Xu, **Chao Luo**, J. Yang, C. Wang, Copper-Stabilized Sulfur-Microporous Carbon Cathodes for Li-S Batteries, *Adv. Funct. Mater.* **2014**, *24*, 4156-4163.
46. Y. Zhu, Y. Xu, Y. Liu, **Chao Luo** and C. Wang, Comparison of Electrochemical Performances of Olivine NaFePO₄ in Sodium-Ion Batteries and Olivine LiFePO₄ in Lithium-Ion Batteries, *Nanoscale* **2013**, *5*, 780-787.
47. L. He, **Chao Luo**, Y. Hou, C. Li, Q. Zhou, Y. Sun, W. Wang, B. Zhang, X. Wang, The Effects of Micellar Media on the Photocatalytic H₂ Production from Water, *Int. J. Hydrogen Energy* **2011**, *36*, 10593-10599.

Academic Activity

1. Member, American Institute of Chemical Engineers (AIChE).
2. **Chao Luo**, J. Wang, C. Wang, "In Situ Formed Sulfur/Carbon Composites for Advanced Li-Sulfur and Na-Sulfur Batteries" Oral presentation, 2014 AIChE Annual Meeting, Atlanta, GA.
3. **Chao Luo**, C. Wang, "Low Cost and Sustainable Li-ion and Na-ion batteries" Oral Presentation, 2015 Dean's Doctoral Research Award Competition, University of Maryland.

4. **Chao Luo**, J. Wang, X. Fan, Y. Zhu, F. Han, L. Suo, C. Wang, “In Situ Precipitated Organic Nanorod Electrodes for Sodium Ion Batteries” Oral Presentation, 227th ECS Meeting, Chicago, IL.
5. **Chao Luo**, “Advanced Materials for Li/Na-Ion Batteries” Oral Presentation, 2016 Chemical Engineering Forum, University of Maryland.
6. **Chao Luo**, “Green and Sustainable Energy Storage Materials and Techniques” Oral Presentation, 2018 The International Interdisciplinary Forum, Wuhan University, China
7. 2014 Annual Merit Review and Peer Evaluation Meeting, U. S. Department of Energy, Washington D. C.
8. Volunteer for 44th International Chemistry Olympiad at University of Maryland, College Park.
9. Peer-Reviewed more than 100 papers for *Energy & Environmental Science*, *Chemistry of Materials*, *Nano Energy*, *Materials Horizons*, *Chemical Science*, *Nanoscale*, *Journal of Materials Chemistry A*, *Chemical Communications*, *ACS Applied Materials & Interfaces*, *ACS Applied Energy Materials*, *Physical Chemistry Chemical Physics*, *RSC Advances*, *CrystEngComm*, *New Journal of Chemistry*, *Journal of Nanomaterials*.