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**EMPLOYMENT**

Assistant Professor, Department of Chemistry, Binghamton University, NY Aug, 2018 – present

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**POSTDOCTORAL EXPERIENCE**

**Argonne National Laboratory, IL** June, 2015 – May, 2018

Advisors: Dr. Karena W. Chapman and Dr. Peter J. Chupas

Projects: Understanding the practical limit of Li-ion intercalation in Li-ion batteries; Development of synchrotron X-ray techniques for characterizing structural evolution of batteries

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**EDUCATION**

**University of Cambridge, UK, *Ph.D. in Chemistry*** 2011 – 2015

Advisor: Prof. Clare P. Grey

Thesis: “Understanding two-phase reaction processes in electrodes for Li-ion batteries”

**University of Cambridge, UK, *M.Phil. in Chemistry*** 2010 – 2011

Advisor: Prof. Clare P. Grey

Thesis: “In situ NMR and XRD studies of the delithiation process in LiFePO<sub>4</sub> as a cathode material in lithium ion batteries”

**City University of Hong Kong, Hong Kong, *B.Eng. in Materials Engineering*** 2006 – 2010  
First Class Honor

**University of Illinois at Urbana-Champaign, IL, *Study abroad program*** 2008

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**RESEARCH EXPERIENCE**

*Postdoctoral researcher, Advanced Photon Source, Argonne National Laboratory* 2015 – present

- Developed in-situ neutron imaging and synchrotron X-ray scattering techniques to investigate the function and failure of Li-ion batteries on multiple length scales
- Identified inter-granular cracking as the dominant cause for the long-term capacity fading of a commercial Li-ion battery electrode using in-situ synchrotron X-ray diffraction, ex-situ X-ray tomography, and electron spectroscopy
- Established a protocol/guide for structural studies of mixed-metal compounds using X-ray- and neutron-based diffraction techniques
- Designed sample environment for in-situ synchrotron X-ray scattering and spectroscopic studies of energy storage processes

*Graduate student, Department of Chemistry, University of Cambridge* 2010 – 2015

- Collaborated with Prof. Thornton’s group to measure the one-dimension diffusion of Li ions in LiFePO<sub>4</sub> via solid-state nuclear magnetic resonance (NMR) spectroscopy.
- Designed time-resolved, in situ synchrotron X-ray diffraction experiment to resolve a long-standing controversy about the reaction mechanism of a high-rate Li-ion battery electrode, LiFePO<sub>4</sub>.
- Developed an in-situ solid-state NMR method to investigate the Li ion deintercalation process of Li-ion battery electrode

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**TEACHING AND MENTORING EXPERIENCE**

**Lecturer**, Department of Chemistry, Binghamton University

- Techniques for Studying Solids (CHEM 411/511, MSE 511)
- Chemistry of Solids (CHEM 444/544)
- Materials for Energy (CHEM 481s/581s, MSE 581)

**Mentor**, Department of Chemistry, University of Cambridge 2011 – 2013

- Co-mentored a final year chemistry undergraduate on the mechanistic study of the doping effect of Mn. Supervised daily research activities, including sample synthesis and characterization
- Co-mentored a summer research student on tuning the morphology of LiFePO<sub>4</sub> particles via hydrothermal and solvothermal syntheses
- Co-mentored a visiting masters student on understanding the energy storage mechanism of mesoporous TiO<sub>2</sub> using solid-state NMR

**Tutor**, Department of Chemistry, University of Cambridge 2014

- Tutored 2 groups of 2 students every 2 weeks for 2 months on molecular energy levels, thermodynamics, and quantum mechanics (2nd-year physical chemistry course)

**Tutor**, Department of Chemistry, University of Cambridge 2015

- Tutored 2 groups of 2 students every 2 weeks for 2 months on molecular energy levels and thermodynamics (2nd-year physical chemistry course)

**Demonstrator**, Department of Chemistry, University of Cambridge 2011 – 2012

- Demonstrated experimental techniques, supervised laboratory activities and marked laboratory reports for groups of 10-12 1st-year chemistry undergraduate students every 2 weeks for the entire academic year

### SCHOLARSHIP AND AWARD

- *Outstanding Poster Presentation*, Annual Postdoctoral Research and Career Symposium, Argonne National Laboratory 2017
- *Cambridge Overseas Trust's Scholarship*, University of Cambridge 2011-2014

### SERVICE

*Representative* for the Northeast Center for Chemical Energy Storage 2016 – 2018

- Coordinate with representatives from other DOE-funded Energy Frontier Research Centers (EFRC) to plan and organize events for graduate students and postdocs
- Organized a meet-up event for students and postdocs affiliated with EFRCs at the 231st Electrochemical Society Meeting

*Journal reviewer* for international peer-review journals

- Nature Communications, Journal of Applied Crystallography, Electrochimica Acta, Energy Storage Materials

### PEER-REVIEWED PUBLICATIONS (>500 citations)

1. Revisiting the charge compensation mechanisms in LiNi<sub>0.8</sub>Co<sub>0.2-y</sub>Al<sub>y</sub>O<sub>2</sub> systems  
Lebens-Higgins, Z.W.; Faenza, N.V.; Radin, M.D.; **Liu, H.**; Sallis, S.; Rana, J.; Vinckeviciute, J.; Reeves, P.J.; Zuba, M.J.; Badway, F.; Pereira, N.; Chapman, K.W.; Lee, T.-L.; Wu, T.; Grey, C.P.; Melot, B.C.; Van Der Ven, A.; Amatucci, G.G.; Yang, W.; Piper, L.F.J., *Mater. Horiz.*, 2019
2. Quantifying Reaction and Rate Heterogeneity in Battery Electrodes in 3D through Operando X-ray Diffraction Computed Tomography  
Liu, H.; Kazemiabnavi, S; Grenier, A.; Vaughan, G.; Di Michiel, M.; Polzin, B.J.; Thornton, K.; Chapman, K.W.; Chupas, P.J., *ACS Appl. Mater. Interfaces*, 2019, 11, 20, 18386-18394
3. Reactivity-Guided Interface Design in Na Metal Solid-State Batteries  
Tian, Y.; Sun, Y.; Hannah, D.C.; Xiao, Y.; **Liu, H.**; Chapman, K.W.; Bo, S.-H.; Ceder, G., *Joule* 2019
4. Identifying the Chemical and Structural Irreversibility in LiNi<sub>0.8</sub>Co<sub>0.15</sub>Al<sub>0.05</sub>O<sub>2</sub> – A Model Compound for Classical Layered Intercalation

- Liu, H.D.; **Liu, H.**; Seymour, I.D.; Chernova, N.; Wiaderek, K.M.; Trease, N.M.; Hy, S.; Chen, Y.; An, K.; Zhang, M.; Borkiewicz, O.J.; Lapidus, S.H.; Qiu, B.; Xia, Y.; Liu, Z.; Chupas, P.J.; Chapman, K.W.; Whittingham, M.S.; Grey, C.P.; Meng, Y.S, *J. Mater. Chem. A*. 2018; 6, 4189-4198
5. Localized concentration reversal of lithium during intercalation into nanoparticles  
Zhang, W.; Yu, H.-C.; Wu, L.; **Liu, H.**; Abdellahi, A.; Qiu, B.; Bai, J.; Orvananos, B.; Strobridge, F.C.; Zhou, X.; Liu, Z.; Ceder, G.; Zhu, Y.; Thornton, K.; Grey, C.P.; Wang, F. ., *Sci. Adv.* 2018;4: eaao2608
  6. Reaction Heterogeneity in  $\text{LiNi}_{0.8}\text{Co}_{0.15}\text{Al}_{0.05}\text{O}_2$  Induced by Surface Layer  
Grenier, A.; **Liu, H.**; Wiaderek, K.M.; Lebens-Higgins, Z.W.; Borkiewicz, O.J.; Piper, L.F.J.; Chupas, P.J.; Chapman, K.W. *Chem. Mater.* 2017, 29 (17), 7345
  7. Intergranular Cracking as a Major Cause of Long-Term Capacity Fading of Layered Cathodes  
**Liu, H.**; Wolf, M.; Karki, K.; Yu, Y.-S.; Stach, E.; Cabana, J.; Chapman, K.W.; Chupas P.J. *Nano Lett.* 2017, 17 (6), 3452
  8. Sensitivity and Limitations of Structures from X-ray and Neutron-Based Diffraction Analyses of Transition Metal Oxide Lithium-Battery Electrodes  
**Liu, H.**; Liu, H.; Lapidus, S. H.; Meng, Y. S.; Chupas, P. J.; Chapman, K. W. *J. Electrochem. Soc.* 2017, 164, A1802.
  9. Effects of Antisite Defects on Li Diffusion in  $\text{LiFePO}_4$  Revealed by Li Isotope Exchange  
**Liu, H.**<sup>§</sup>; Choe, M.-J. <sup>§</sup>; Enrique, R. A.; Orvañanos, B.; Zhou, L.; Liu, T.; Thornton, K.; Grey, C. P. *J. Phys. Chem. C* 2017, 121 (22), 12025.
  10. Identifying the distribution of  $\text{Al}^{3+}$  in  $\text{LiNi}_{0.8}\text{Co}_{0.15}\text{Al}_{0.05}\text{O}_2$   
Trease, N. M.; Seymour, I. D.; Radin, M. D.; Liu, H.; **Liu, H.**; Hy, S.; Chernova, N.; Parikh, P.; Devaraj, A.; Wiaderek, K. M.; Chupas, P. J.; Chapman, K. W.; Whittingham, M. S.; Meng, Y. S.; Van Der Van, A.; Grey, C. P. *Chem. Mater.* 2016, 28 (22), 8170.
  11. Thermodynamics, Kinetics and Structural Evolution of  $\epsilon\text{-LiVOPO}_4$  over Multiple Lithium Intercalation  
Lin, Y.-C.; Wen, B.; Wiaderek, K. M.; Sallis, S.; **Liu, H.**; Lapidus, S. H.; Borkiewicz, O. J.; Quackenbush, N. F.; Chernova, N. A.; Karki, K.; Omenya, F.; Chupas, P. J.; Piper, L. F. J.; Whittingham, M. S.; Chapman, K. W.; Ong, S. P. *Chem. Mater.* 2016, 28 (6), 1794.
  12. A radially accessible tubular in situ X-ray cell for spatially resolved operando scattering and spectroscopic studies of electrochemical energy storage devices  
**Liu, H.**; Allan, P. K.; Borkiewicz, O. J.; Kurtz, C.; Grey, C. P.; Chapman, K. W.; Chupas, P. J. *J. Appl. Crystallogr.* 2016, 49 (5), 1665.
  13. Automatic Tuning Matching Cyclers (ATMC) in situ NMR spectroscopy as a novel approach for real-time investigations of Li- and Na-ion batteries  
Pecher, O.; Bayley, P. M.; **Liu, H.**; Liu, Z.; Trease, N. M.; Grey, C. P. *J. Magn. Reson.* 2016, 265, 200.
  14. Unraveling the Complex Delithiation Mechanisms of Olivine-Type Cathode Materials,  $\text{LiFe}_x\text{Co}_{1-x}\text{PO}_4$   
Strobridge, F. C.; **Liu, H.**; Leskes, M.; Borkiewicz, O. J.; Wiaderek, K. M.; Chupas, P. J.; Chapman, K. W.; Grey, C. P. *Chem. Mater.* 2016, 28 (11), 3676.
  15. Influence of particle size, cycling rate and temperature on the lithiation process of anatase  $\text{TiO}_2$   
**Liu, H.**; Grey, C. P. *J. Mater. Chem. A* 2016, 4 (17), 6433.
  16. Mapping the Inhomogeneous Electrochemical Reaction Through Porous  $\text{LiFePO}_4$ -Electrodes in a Standard Coin Cell Battery  
Strobridge, F. C.; Orvananos, B.; Croft, M.; Yu, H.-C.; Robert, R.; **Liu, H.**; Zhong, Z.; Connolly, T.; Drakopoulos, M.; Thornton, K.; Grey, C. P. *Chem. Mater.* 2015, 27 (7), 2374
  17. Capturing metastable structures during high-rate cycling of  $\text{LiFePO}_4$  nanoparticle electrodes

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**Liu, H.;** Strobridge, F. C.; Borkiewicz, O. J.; Wiaderek, K. M.; Chapman, K. W.; Chupas, P. J.; Grey, C. P. *Science* 2014, *344*, 1252817.

(§ Equal contribution)

### CONFERENCE TALKS

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1. “Understanding capacity fading of  $\text{LiNi}_{0.8}\text{Co}_{0.15}\text{Al}_{0.05}\text{O}_2$  via long-term operando X-ray diffraction studies” *231<sup>st</sup> ECS Meeting*, New Orleans, USA, 28 May – 2 June 2017
2. “Tracking Structural Changes of Layered Lithium Transition Metal Oxide Electrode over Multiple Charge-Discharge Cycles” *MRS Fall Meeting*, Boston, USA, 27 November – 2 December 2016
3. “Phase transition of nanoparticulate  $\text{LiFePO}_4$  during high rate cycling” *23rd Congress and General Assembly of the International Union of Crystallography*, Montreal, Canada 5 – 12 August 2014

### CONFERENCE POSTER PRESENTATIONS

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1. “Exploring multi-electron redox for Na-ion batteries” *North American Solid State Chemistry Conference*, Boulder, CO, 29 Jul – 2 Aug, 2019
2. “Mapping reaction heterogeneity in composite electrodes with synchrotron X-ray techniques” *Gordon Research Conference: Batteries*, Ventura, CA, 25 Feb – 2 Mar, 2018
3. “Intergranular cracking as a major cause of long-term capacity fading of layered cathodes” *Annual Postdoctoral Research and Career Symposium*, Argonne National Laboratory, 2 Nov, 2017
4. “Application of time-resolved in situ synchrotron X-ray powder diffraction in the study of non-equilibrium phase transformation of  $\text{LiFePO}_4$  during high rate electrochemical cycling” *14th European Powder Diffraction Conference*, Arhus, Denmark, 15-18 June 2014
5. “Ex situ  $^6\text{Li}$  and  $^7\text{Li}$  NMR study of the delithiation mechanism in lithium iron phosphate ( $\text{LiFePO}_4$ ) nano-particles” *International Battery Association Meeting*, Barcelona, Spain, 11-15 March 2013