

Spedding Fellow

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Education and Training

2024-current	Spedding Fellow Ames National Laboratory
2023-2024	Postdoctoral Associate (Advisor: Benjamin Doughty) Chemical Separations Group, Oak Ridge National Laboratory
2022-2023	Postdoctoral Associate (Advisor: Mark L. Schlossman) Department of Physics, University of Illinois at Chicago
2019-2022	Postdoctoral Associate (Advisors: Binhua Lin and Mark L. Schlossman) NSF's ChemMatCARS, University of Chicago
2014-2019	Ph.D. in Chemical Engineering (Advisors: Kun Huang and Huizhou Liu) University of Chinese Academy of Sciences, Beijing, China
2010-2014	B.S. in Metallurgical Engineering (Advisor: Qinggang Li) Central South University, Changsha, China

Awards

5. National Scholarship Award by Chinese Academy of Sciences, Beijing, China. (2016, 2018)
4. Excellent Student Award by Chinese Academy of Sciences, Beijing, China. (2015-2019)
3. Excellent Graduate of Central South University, Changsha, China. (2014)
2. Excellent Student Award by Central South University, Changsha, China. (2010-2014)
1. National Scholarship Award by Central South University, Changsha, China. (2012)

Research Highlights

4. [UIC physicists find hidden flaw in century-old, common chemical extraction technique](#), University of Illinois at Chicago, 2024. (Proc. Natl. Acad. Sci. U.S.A. 2024, 121(13), e2315584121)
3. [Solving a Critical Solvent Extraction Riddle](#), University of Chicago, 2023. (ACS Central Science, 2021, 7(11), 1908–1918)
2. [Revealing Fundamental Details Surrounding Nanoparticle Self-Assembly](#), Advanced Photon Source, 2022. (Nano Letters, 2021, 21, 1613–1619)
1. [Polymer membranes could benefit from taking a dip](#), Argonne National Laboratory, 2020. (Advanced Functional Materials, 2020, 1910062)

Publications ([Google Scholar](#), [ORCID](#), h-index: 17, total citations: 799)

*Corresponding author, #Co-first author

At Oak Ridge National Laboratory

33. Pan Sun*, Uvinduni Premadasa, Benjamin Doughty*. Elucidating kinetic barriers of ionic transport from oil to water: A case study of rare earth recovery in the back-extraction process. (in preparation)
32. Pan Sun*, Robert L. Sacchi, Uvinduni I. Premadasa, Jan–Michael Y. Carrillo*, Santanu Roy*, Benjamin Doughty*. Metastable Clusters and Competitive Solvation Shape Hydrogen Bonding at Interfaces. (Submitted)
31. Pan Sun, Nabarupa Bhattacharjee, Jeffrey D. Einkauf*, and Benjamin Doughty*. Bulk anion recognition kinetically holds back interfacial adsorption. *J. Phys. Chem. Lett.* 2025, 16, 2128–2135.

At the University of Illinois at Chicago

30. Luis E Ortuno Macias, Felipe Jiménez-Ángeles, Jason G Marmorstein, Yiming Wang, Stephen A Crane, Surabh KT, Pan Sun, Bikash Sapkota, Eshe Hummingbird, Woojin Jung, Baofu Qiao, Daeyeon Lee, Ivan J Dmochowski, Robert J Messinger, Mark L Schlossman, Cesar de la Fuente-Nunez, Ravi Radhakrishnan, E James Petersson, Monica Olvera de la Cruz, Wei Bu, Mrinal Bera, Binhua Lin, Raymond S Tu, Kathleen J Stebe, Charles Maldarelli. Lanthanide binding peptide surfactants at air–aqueous interfaces for interfacial separation of rare earth elements. *Proc. Natl. Acad. Sci. U.S.A.* 2024, 121, 52, e2411763121.
29. Pan Sun*, Erik A Binter, Bikash Sapkota, M Alex Brown, Artem V Gelis, Mrinal K Bera, Binhua Lin, Wei Bu*, Mark L Schlossman*. X-ray-tunable rare earth ion adsorption to the air–water interface. *ACS Applied Materials & Interfaces* 2024, 16, 37, 49935–49943.
28. Pan Sun*, Xiao-Min Lin, Mrinal K. Bera, Binhua Lin, Dongchen Ying, Tieyan Chang, Wei Bu*, Mark L. Schlossman*. Metastable precipitation and ion-extractant transport in liquid–liquid separations of trivalent elements. *Proc. Natl. Acad. Sci. U.S.A.* 2024, 121(13), e2315584121.
27. Xiaobin Yang, Pan Sun, Yajie Wen, Anil U Mane, Jeffrey W Elam, Jun Ma, Shaomin Liu, Seth B Darling*, Lu Shao*. Protein-activated atomic layer deposition for robust crude-oil-repellent hierarchical nano-armored membranes. *Science Bulletin* 2023, 69(2), 218–226.
26. Pan Sun, Erik A. Binter, Trung Vo, Ilan Benjamin, Mrinal K. Bera, Binhua Lin, Wei Bu*, Mark L. Schlossman*. Relevance of surface adsorption and aqueous complexation for the separation of Co (II) and Ni (II). *J. Phys. Chem. B* 2023, 127(15), 3505–3515.
25. Daliang Fang, Shaozhuan Huang, Tingting Xu, Pan Sun, Xue Liang Li, Yew Von Lim, Dong Yan, Yang Shang, Bing-Jian Su, Jenh-Yih Juang, Qi Ge, Hui Ying Yang.* Low-Coordinated Zn–N₂ Sites as Bidirectional Atomic Catalysis for Room-Temperature Na–S Batteries. *ACS Appl. Mater. Interfaces* 2023, 15, 22, 26650–26659.
24. Srikant Kumar Singh, Wei Bu, Pan Sun, Matthew F Paige*. Mixing in Langmuir Monolayers: Perfluorotetradecanoic Acid and a Gemini Surfactant without a Linker. *Langmuir* 2023, 39, 46, 16503–16512.

At the University of Chicago

23. Shuo Zhang, Yongxin Li*, Chunlei Liu, Yanhui Zhang, Pan Sun*, Xiaopeng Lan*, Chunzhao Liu*. Supramolecular amino acid-based metallo-nanozyme through multicomponent coordination self-assembly for in-site tumor synergistic catalytic-chemotherapy. *Chemical*

Engineering Journal 2022, 437, 1352312.

22. Srikant Kumar Singh, Alfred Yeboah, Wei Bu, Pan Sun, and Matthew F. Paige*. Physicochemical Properties of Monolayers of a Gemini Surfactant with a Minimal-Length Spacer. *Langmuir* 2022, 38(51), 16004–16013.

21. Shuo Zhang, Yongxin Li*, Chunlei Liu, Yanhui Zhang, Pan Sun*, Xiaopeng Lan*, Chunzhao Liu*. Supramolecular amino acid-based metallo-nanozyme through multicomponent coordination self-assembly for in-site tumor synergistic catalytic-chemotherapy. *Chemical Engineering Journal* 2022, 437, 135312.

20. Daliang Fang, Pan Sun, Shaozhuan Huang, Yang Shang, Xueliang Li, Dong Yan, Yew Von Lim, Ching-Yuan Su, Bing-Jian Su, Jenh-Yih Juang, Huiying Yang*. An exfoliation–evaporation strategy to regulate N coordination number of Co single-atom catalysts for high-performance lithium–sulfur batteries. *ACS Materials Letter* 2022, 4(1), 1–10.

19. Pan Sun, Erik A. Binter, Zhu Liang, M. Alex Brown, Artem V. Gelis, Ilan Benjamin, Mrinal K. Bera, Binhua Lin, Wei Bu*, Mark L. Schlossman* Antagonistic Role of Aqueous Complexation in the Solvent Extraction and Separation of Rare Earth Ions. *ACS Central Science* 2021, 7(11), 1908–1918.

18. Pan Sun#, Linsey M. Nowack#, Wei Bu, Mrinal K. Bera, Sean Griesemer, Morgan Reik, Joshua Portner, Stuart A. Rice*, Mark L. Schlossman* and Binhua Lin*. Free thiols regulate the interactions and self-assembly of thiol-passivated metal nanoparticles. *Nano Letters* 2021, 21, 1613–1619.

17. Shigang Chen, Pan Sun, John Humphreys, Peimiao Zou, Mengfei Zhang, Georgina Jeerh, Boyao Sun, Shanwen Tao*. N,N-Dimethylacetamide-diluted nitrate electrolyte for aqueous Zn/LiMn₂O₄ hybrid ion batteries. *ACS Appl. Mater. Interfaces* 2021, 13(39), 46634–46643.

16. Shigang Chen, Pan Sun, Boyao Sun, John Humphreys, Peimiao Zou, Kui Xie, Shanwen Tao*. Nitrate-based ‘oversaturated gel electrolyte’ for high-voltage and high-stability aqueous lithium batteries. *Energy Storage Materials* 2021, 37, 598–608.

15. Shigang Chen, Pan Sun, Peimiao Zou, Mengfei Zhang, Georgina Jeerh, Shanwen Tao*. Acetate-based ‘oversaturated gel electrolyte’ enabling highly stable aqueous Zn-MnO₂ battery. *Energy Storage Materials* 2021, 42, 240–251.

At the University of Chinese Academy of Sciences

14. Yongxin Li, Pan Sun, Luyang Zhao, Xuehai Yan, Dennis Kee-Pui Ng, Pui-Chi Lo*. Fe³⁺-Driven Assembly of Catalase-Like Supramolecular Photosensitizing Nanozymes for Combating Hypoxic Tumor. *Angew. Chem. Int. Ed* 2020, 132 (51), 23428–23438.

13. Xiaobin Yang, Pan Sun, Huiru Zhang, Zijing Xia, Ruben Z. Waldman, Anil U. Mane, Jeffrey W. Elam, Lu Shao*, and Seth B. Darling*. Polyphenol-Sensitized Atomic Layer Deposition for Membrane Interface Hydrophilization. *Advanced Functional Materials* 2020, 1910062.

12. Pan Sun, Kun Huang*, Xinping Wang, Jiemiao Yu, Wenhui Tu, Olivier Diat, Huizhou Liu. Confined complexation reaction between a metal ion and a lipophilic surfactant at water/air interface: A new understanding based on surface experiments and molecular dynamic simulations. *Langmuir* 2019, 35, 4548–4556.

11. Pan Sun, Kun Huang*, Huizhou Liu. The nature of salt effect in enhancing the extraction of rare earths by non-functional ionic liquids: Synergism of salt anion complexation and

Hofmeister bias. *Journal of Colloid and Interface Science* 2019, 539, 214–222.

10. Pan Sun, Kun Huang*, Huizhou Liu. In situ study of the competitive adsorption of ions at an organic-aqueous two-phase interface: the essential role of the Hofmeister effect. *Soft Matter* 2019, 15, 4346–4350.
9. Pan Sun, Kun Huang*, Huizhou Liu. Separation of adjacent rare earth elements enhanced by “external push-pull” extraction system: An example for the separation of Pr and Nd. *Hydrometallurgy* 2019, 189, 105136.
8. Pan Sun, Kun Huang*, Huizhou Liu. Specific salt effect on the interaction between rare earth ions and TOPO molecules at organic-aqueous two phase interface: Experiments and molecular dynamics simulations. *Langmuir* 2018, 34, 11374–11383.
7. Pan Sun, Kun Huang*, Huizhou Liu. Competitive adsorption of ions at the oil–water Interface: A possible mechanism underlying the separation selectivity for liquid–liquid solvent extraction. *Langmuir* 2018, 34, 13155–13161.
6. Pan Sun, Kun Huang*, Jieyuan Lin, Huizhou Liu. The role of hydrophobic interaction in driving the partitioning of metal ions in PEG-based aqueous two-phase system. *Industrial & Engineering Chemistry Research* 2018, 57, 11390–11398.
5. Pan Sun, Kun Huang*, Weiyuan Song, Zhen Gao, Huizhou Liu. Separation of rare earths from the transition metals using a novel ionic liquid-based aqueous two phase system: Towards green and efficient recycling of rare earths from the NdFeB magnets. *Industrial & Engineering Chemistry Research* 2018, 57, 16934–16943.
4. Pan Sun, Kun Huang*, Xiaoqin Wang, Na Sui, Jieyuan Lin, Wenjuan Cao, Huizhou Liu. Three-liquid-phase extraction and separation of V(V) and Cr(VI) from acidic leach solutions of high-chromium vanadium-titanium magnetite. *Chinese Journal of Chemical Engineering* 2018, 26, 1451–1457.
3. Pan Sun, Kun Huang*, Xiaoqin Wang, Weiyuan Song, Han Zheng, Huizhou Liu. Separation of V from alkaline solution containing Cr using acidified primary amine N1923 with the addition of trisodium citrate. *Separation and Purification Technology* 2017, 179, 504–512.
2. Pan Sun, Kun Huang*, Huizhou Liu. Separation of V and Cr in alkaline aqueous solution using acidified primary amine N1923. *Hydrometallurgy* 2016, 165, 370–380.

At the Central South University

1. Guotao Zhou, Qinggang Li, Pan Sun, Wenjuan Guan, Guiqing Zhang, Zuoying Cao, Li Zeng. Removal of impurities from scandium chloride solution using 732-type resin. *Journal of Rare Earth* 2018, 36(3), 311–316.

Patents

4. Kathleen J. Stebe, Daeyeon Lee, Ravi Radhakrishnan, Cesar de la Fuente-Nunez, Ivan Julian Dmochowski, E. James Petersson, Jason G. Marmorstein, Stephen Crane, Eshe Jael Hummingbird, Yiming Wang, Elizabeth J. Biddinger, Charles Maldarelli, Robert J. Messinger, Raymond S. Tu, Luis Ortuno Macias, Saurabh Sachdeva, Mark Schlossman, Bikash Sapkota, Pan Sun, Monica Olvera de la Cruz, Felipe Jiménez-Ángeles, Baofu Qiao. (2023) Peptide sequences and compositions at air-aqueous interface for lanthanide recovery, U.S. Patent No.18448427
3. Kun Huang, Pan Sun. (2019) A method for the separation of Praseodymium and

- Neodymium by the liquid-liquid-liquid three phases “external push-pull” system, CN Patent No.109735718B
2. Kun Huang, Pan Sun, Huizhou Liu. (2016) A method for the extraction of vanadium(V), chromium(VI) and removal of aluminum(III), silicon(IV) from alkaline solutions, CN Patent No.105603220A
 1. Kun Huang, Pan Sun, Huizhou Liu. (2015) A method for the extraction and separation of vanadium(V) and chromium(VI) from alkaline solutions, CN Patent No. 104694749A

Skills and Expertise

- Interfacial science
 - Synchrotron X-ray surface scattering techniques, including X-ray reflectivity, X-ray fluorescence near total reflection, and grazing-incidence diffraction (*APS Sector 15; BNL Sector 12*)
 - Sum-frequency generation spectroscopy
 - Polarization modulation infrared reflection-absorption spectroscopy
 - Langmuir-Blodgett trough
 - Drop shape analyzer (DSA100, KRÜSS)
 - Spinning drop tensiometer (KRÜSS)
- Nanoscale self-assembly
 - Anomalous small angle X-ray scattering (*APS Sector 15*)
 - Small angle X-ray scattering (*APS Sector 12 and 15*)
- Chemical speciation and coordination structure of ion-ligand complexes
 - Extended X-ray absorption fine structure (EXAFS, *APS Sector 12 and 15*)
 - Inductively coupled plasma optical emission spectrometer (ICP-OES)
 - Ion chromatograph
- Molecular dynamics simulations (Gromacs, NAMD, Material Studio)

Participation in Academic Conferences

5. Competitive anion adsorption at air/water and oil/water interfaces: A tale of solvation in two phases, The 98th ACS Colloid and Surface Science Symposium, 2024, USA. (Oral Report)
4. Antagonistic role of aqueous complexation in the solvent extraction and separation of metal ions, AIChE Annual Meeting, 2022, USA. (Oral Report)
3. Free thiols regulate the interactions and self-Assembly of thiol-passivated metal nanoparticles, ACS Spring Conference, 2021, USA. (Oral Report)
2. Study of competitive adsorption kinetics of lanthanide ions at liquid/liquid interface by total reflection UV-vis spectroscopy, The 20th National Conference on Molecular Spectroscopy, 2018, Qingdao, China. (Oral Report)
1. Orientation of extractant TOPO at air-water interface studied by sum frequency generation spectroscopy, The 19th National Conference on Molecular Spectroscopy, 2016, Fuzhou, China. (Poster)

Synergistic Activities and Service

1. Writing proposals for beamtime in APS, BNL and facilities in CNM (Argonne)

2. Associate Editor on the Editorial Board of Frontiers in Chemistry
3. Reviewer for scientific journals such as Journal of Colloid and Interface Science, Environmental Science Technology, Langmuir, Soft Matter, The Journal of Physical Chemistry B

Recent Collaborations with Researchers at other Institutions

1. Xiao-min Lin, M Alex Brown, Argonne National Laboratory
2. Artem V Gelis, University of Nevada, Las Vegas
3. Ilan Benjamin, University of California, Santa Cruz
4. Kathleen J. Stebe, University of Pennsylvania
5. Monica Olvera de la Cruz, Northwestern University
6. Charles Maldarelli, Robert J. Messinger, Raymond S. Tu, The City College of New York
7. Shanwen Tao, University of Warwick
8. Pui-Chi Lo, City University of Hong Kong
9. Huiying Yang, Singapore University of Technology and Design