

Dr.-Ing. Ying Zhao

School of Aerospace Engineering and Applied Mechanics, Tongji University,
Shanghai 200092, China

Phone: +86 18621650897
Email: 19531@tongji.edu.cn
Homepage: www.yingzhaotj.cn

Education

Dr.-Ing., Department of Materials Science, Technische Universität Darmstadt, Germany, Jan. 16, 2017.

M. Eng., Department of Aerospace Engineering and Applied Mechanics, Tongji University, Shanghai, China, March 2013.

B. Eng., Department of Aerospace Engineering and Applied Mechanics, Tongji University, Shanghai, China, G.P.A: 4.62/5.0, Outstanding Graduates of Tongji University, Jun. 2010.

Academic experiences

Dec., 2019–now, Distinguished Research Fellow (Profesor with tenure track), School of Aerospace Engineering, Tongji University, China.

Dec., 2017–Nov., 2019, post-doctoral research associate, Micromechanics Research Group, Department of Engineering, University of Cambridge, UK. (Prof. Norman A. Fleck)

Jan.–Sept., 2017, scientific staff (Wissenschaftliche Mitarbeiterin), Department of Materials Science, Technische Universität Darmstadt, Germany. (Prof. Bai-Xiang Xu)

Feb. 13–March 12, 2017, visiting scholar, Department of Material Science and Engineering, Tongji University, China. (Prof. Yunhui Huang)

Sep. 13–Dec. 13, 2015, visiting student, Department of Civil, Environmental, and Geo- Engineering, University of Minnesota, USA. (Prof. Dominik Schillingner)

Refereed English publications

- [1] Z. Chen and **Y. Zhao***, “Tortuosity estimation and microstructure optimization of non-uniform porous heterogeneous electrodes,” *Journal of Power Sources*, vol. 596, p. 234095, Mar. 2024. [10.1016/j.jpowsour.2024.234095](https://doi.org/10.1016/j.jpowsour.2024.234095)
- [2] J. Tian, J. Yang, and **Y. Zhao***, “Metamaterial with synergistically controllable Poisson’s ratio and thermal expansion coefficient,” *International Journal of Mechanical Sciences*, vol. 256, p. 108488, Oct. 2023. [10.1016/j.ijmecsci.2023.108488](https://doi.org/10.1016/j.ijmecsci.2023.108488)
- [3] Y. Xiong, B. Lu*, **Y. Zhao***, Y. Song, and J. Zhang*, “A coupled mechanical-electrochemical phase-field formulation for understanding the evolution of lithiated-silicon sponge,” *Journal of the Mechanics and Physics of Solids*, vol. 179, p. 105399, Oct. 2023. [10.1016/j.jmps.2023.105399](https://doi.org/10.1016/j.jmps.2023.105399)
- [4] J. A. Lewis, S. E. Sandoval, Y. Liu, D. L. Nelson, S. G. Yoon, R. Wang, **Y. Zhao**, M. Tian, P. Shevchenko, E. Martínez-Pañeda, and M. T. McDowell, “Accelerated Short Circuiting in Anode-Free Solid-State Batteries Driven by Local Lithium Depletion,” *Advanced Energy Materials*, p. 2204186, Feb. 2023. [10.1002/aenm.202204186](https://doi.org/10.1002/aenm.202204186)

- [5] **Y. Zhao***, R. Wang, and E. Martínez-Pañeda*, "A phase field electro-chemo-mechanical formulation for predicting void evolution at the Li–electrolyte interface in all-solid-state batteries," *Journal of the Mechanics and Physics of Solids*, vol. 167, p. 104999, Oct. 2022. [10.1016/j.jmps.2022.104999](https://doi.org/10.1016/j.jmps.2022.104999)
- [6] Z. Chen and **Y. Zhao***, "A quasi-physical method for random packing of spherical particles," *Powder Technology*, vol. 412, p. 118002, Nov. 2022. [10.1016/j.powtec.2022.118002](https://doi.org/10.1016/j.powtec.2022.118002)
- [7] W. Tang, Z. Chen, and **Y. Zhao***, "Assessment of Optimization Strategies for Battery Electrode-Active Particles Based on Chemomechanical Analysis," *Journal of Electrochemical Energy Conversion and Storage*, vol. 19, no. 4, p. 041001, May 2022. [doi:10.1115/1.4054460](https://doi.org/10.1115/1.4054460)
- [8] J. Tian, Z. Chen, and **Y. Zhao***, "Review on Modeling for Chemo-mechanical Behavior at Interfaces of All-Solid-State Lithium-Ion Batteries and Beyond," *ACS Omega*, Feb. 2022. [doi:10.1021/acsomega.1c06793](https://doi.org/10.1021/acsomega.1c06793)
- [9] **Y. Zhao**, V. S. Deshpande, and N. A. Fleck*, "A compliant and low-expansion 2-phase micro-architected material, with potential application to solid-state li-ion batteries," *Journal of the Mechanics and Physics of Solids*, vol. 158, p. 104683, 2022. [doi:10.1016/j.jmps.2021.104683](https://doi.org/10.1016/j.jmps.2021.104683)
- [10] B. H. Kim, K. Li, J.-T. Kim, Y. Park, H. Jang, X. Wang, Z. Xie, S. M. Won, H.-J. Yoon, G. Lee, W. J. Jang, K. H. Lee, T. S. Chung, Y. H. Jung, S. Y. Heo, Y. Lee, J. Kim, T. Cai, Y. Kim, P. Prasopsukh, Y. Yu, X. Yu, R. Avila, H. Luan, H. Song, F. Zhu, **Y. Zhao**, L. Chen, S. H. Han, J. Kim, S. J. Oh, H. Lee, C. H. Lee, Y. Huang, L. P. Chamorro, Y. Zhang, and J. A. Rogers, "Three-dimensional electronic microfilers inspired by wind-dispersed seeds," *Nature*, vol. 597, no. 7877, pp. 503–510, 2021. [doi:10.1038/s41586-021-03847-y](https://doi.org/10.1038/s41586-021-03847-y)
- [11] C. Shi, **Y. Zhao**, P. Zhu, J. Xiao, and G. Nie, "Highly Stretchable and Rehealable Wearable Strain Sensor Based on Dynamic Covalent Thermoset and Liquid Metal," *Smart Materials and Structures*, vol. 30, p. 105001, Aug. 2021. [doi:10.1088/1361-665X/ac1b3a](https://doi.org/10.1088/1361-665X/ac1b3a)
- [12] **Y. Zhao**, P. Stein, Y. Bai, M. Al-Siraj, Y. Yang, and B.-X. Xu, "A review on modeling of electro-chemo-mechanics in lithium-ion batteries," *Journal of Power Sources*, vol. 413, pp. 259–283, Feb. 2019. [doi:10.1016/j.jpowsour.2018.12.011](https://doi.org/10.1016/j.jpowsour.2018.12.011)
- [13] J. Xiang, Z. Cheng, **Y. Zhao**, B. Zhang, L. Yuan, Y. Shen, Z. Guo, Y. Zhang, J. Jiang, and Y. Huang, "A Lithium-Ion Pump Based on Piezoelectric Effect for Improved Rechargeability of Lithium Metal Anode," *Advanced Science*, p. 1901120, 2019. [10.1002/advs.201901120](https://doi.org/10.1002/advs.201901120)
- [14] I. Capone, J. Aspinall, E. Darnbrough, **Y. Zhao**, T.-U. Wi, H.-W. Lee, and M. Pasta, "Electrochemo-mechanical properties of red phosphorus anodes in lithium, sodium, and potassium ion batteries," vol. 3, no. 6, pp. 2012–2028. [10.1016/j.matt.2020.09.017](https://doi.org/10.1016/j.matt.2020.09.017)
- [15] H. J. Lee, Z. Brown, **Y. Zhao**, J. Fawdon, W. Song, J. H. Lee, J. Ihli, and M. Pasta, "Ordered $\text{LiNi}_{0.5}\text{Mn}_{1.5}\text{O}_4$ Cathode in Bis(fluorosulfonyl)imide-Based Ionic Liquid Electrolyte: Importance of the Cathode–Electrolyte Interphase," *Chemistry of Materials*, vol. 33, pp. 1238–1248, Feb. 2021. [10.1021/acs.chemmater.0c04014](https://doi.org/10.1021/acs.chemmater.0c04014)
- [16] **Y. Zhao**, D. Schillinger, and B.-X. Xu, "Variational boundary conditions based on the Nitsche method for fitted and unfitted isogeometric discretizations of the mechanically coupled Cahn–Hilliard equation," *Journal of Computational Physics*, vol. 340, pp. 177–199, July 2017. [doi:10.1016/j.jcp.2017.03.040](https://doi.org/10.1016/j.jcp.2017.03.040)
- [17] **Y. Zhao**, L. R. De Jesus, P. Stein, G. A. Horrocks, S. Banerjee, B.-X. Xu, "Modeling of phase separation across interconnected electrode particles in lithium-ion batteries," *RSC Advances*, vol. 7, pp. 41254–41264, Aug. 2017. [doi:10.1039/C7RA07352F](https://doi.org/10.1039/C7RA07352F)

- [18] **Y. Zhao**, B.-X. Xu, P. Stein, and D. Gross, "Phase-field study of electrochemical reactions at exterior and interior interfaces in Li-ion battery electrode particles," *Computer Methods in Applied Mechanics and Engineering*, vol. 312, pp. 428–446, Dec. 2016. doi:10.1016/j.cma.2016.04.033
- [19] **Y. Zhao**, P. Stein, and B.-X. Xu, "Isogeometric analysis of mechanically coupled Cahn–Hilliard phase segregation in hyperelastic electrodes of Li-ion batteries," *Computer Methods in Applied Mechanics and Engineering*, vol. 297, pp. 325–347, 2015. doi:10.1016/j.cma.2015.09.008
- [20] L. R. D. Jesus, **Y. Zhao**, G. A. Horrocks, J. L. Andrews, P. Stein, B.-X. Xu, and S. Banerjee, "Lithiation across interconnected V₂O₅ nanoparticle networks," *Journal of Materials Chemistry A*, vol. 5, pp. 20141–20152, Oct. 2017. doi:10.1039/C7TA04892K
- [21] J. Xiang, **Y. Zhao**, L. Yuan, C. Chen, Y. Shen, F. Hu, Z. Hao, J. Liu, B. Xu, and Y. Huang, "A strategy of selective and dendrite-free lithium deposition for lithium batteries," *Nano Energy*, 2017. doi:10.1016/j.nanoen.2017.10.065
- [22] Y. Bai, **Y. Zhao**, W. Liu, and B.-X. Xu, "Two-level modeling of lithium-ion batteries," *Journal of Power Sources*, vol. 422, pp. 92–103, May 2019. doi:10.1016/j.jpowsour.2019.03.026
- [23] P. Stein, **Y. Zhao**, and B.-X. Xu, "Effects of surface tension and electrochemical reactions in Li-ion battery electrode nanoparticles," *Journal of Power Sources*, vol. 332, pp. 154–169, Nov. 2016. doi:10.1016/j.jpowsour.2016.09.085
- [24] B.-X. Xu, **Y. Zhao**, and P. Stein, "Phase field modeling of electrochemically induced fracture in Li-ion battery with large deformation and phase segregation," *GAMM-Mitteilungen*, vol. 39, no. 1, pp. 92–109, 2016. doi:10.1002/gamm.201610006
- [25] Z. Gao, **Y. Zhao**, H. Wang, Y. Wang, L. Jiang, Y. Xu, B. Xu, L. Zheng, C. Jin, P. Liu, H. Yang, H. Zhao, X. Yang, and Y. Huang, "Rapid-Heating-Triggered in Situ Solid-State Transformation of Amorphous TiO₂ Nanotubes into Well-Defined Anatase Nanocrystals," *Crystal Growth & Design*, vol. 19, pp. 1086–1094, Feb. 2019. doi:10.1021/acs.cgd.8b01604,
- [26] Z. Gao, Z. Hao, M. Yi, Y. Huang, Y. Xu, **Y. Zhao**, Z. Li, S. Zhu, B. Xu, P. Liu, F. R. Wang, Y. Huang, H. Zhao, and X. Yang, "Correlation between Mechanical Strength of Amorphous TiO₂ Nanotubes and Their Solid State Crystallization Pathways," *ChemistrySelect*, vol. 3, no. 38, pp. 10711–10716, 2018. doi:10.1002/slct.201802588
- [27] D. Eder-Goy, **Y. Zhao**, and B.-X. Xu, "Dynamic pull-in instability of a prestretched viscous dielectric elastomer under electric loading," *Acta Mechanica*, pp. 1–15, Aug. 2017. doi:10.1007/s00707-017-1930-4
- [28] D. Schillinger, I. Harari, M.-C. Hsu, D. Kamensky, S. K. F. Stoter, Y. Yu, and **Y. Zhao**, "The non-symmetric Nitsche method for the parameter-free imposition of weak boundary and coupling conditions in immersed finite elements," *Computer Methods in Applied Mechanics and Engineering*, vol. 309, pp. 625–652, Sept. 2016. doi:10.1016/j.cma.2016.06.026
- [29] P. Stein, **Y. Zhao**, and B. Xu, "An analytical solution for the mechanically coupled diffusion problem in thin-film electrodes," *Proceedings in Applied Mathematics and Mechanics*, vol. 13, no. 1, pp. 237–238, 2013. doi:10.1002/pamm.201310114
- [30] **Y. Zhao**, P. Stein, and B.-X. Xu, "Phase field simulation of the intercalation-induced stresses in the hyperelastic solids via isogeometric analysis," *Proceedings in Applied Mathematics and Mechanics*, vol. 15, no. 1, pp. 443–444, 2015. doi:10.1002/pamm.201510212

Conference presentations

- [1] **Y. Zhao**, N. Fleck, “Compliant and low-expansion composite electrode for a solid-state battery” Oral presentation at *25th International Congress Theoretical and Applied Mechanics* (online), Miland, Italy, 2021.
- [2] **Y. Zhao**, B.-X. Xu, and P. Stein, “Phase-Field Modeling of Electro-Chemo-Mechanical Behavior of Li-Ion Battery Electrodes” Oral presentation at COUPLED PROBLEMS, Rhodes Island, Greece, 2017.
- [3] **Y. Zhao**, B.-X. Xu, and P. Stein, “Phase-Field Simulation of Fracture in Lithium-Ion Battery Electrodes” Oral presentation at 14th International Conference on Fracture, Rhodes Island, Greece, 2017.
- [4] **Y. Zhao**, D. Schillinger, B.-X. Xu, and L. H. Nguyen, “Chemo-mechanical modeling of Li-ion battery composite electrodes with the finite cell method.” Oral presentation at WCCM XII & APCOM VI, Seoul, South Korea, 2016.
- [5] **Y. Zhao**, D. Schillinger, and B.-X. Xu, “Modeling of lithium-ion battery composite electrodes using finite cell method.” Oral presentation at ECCOMAS, Crete Island, Greece, 2016.
- [6] **Y. Zhao**, P. Stein, and B.-X. Xu, “Phase-Field Modeling of Phase-Segregation Induced Crack Propagation in Li-Ion Battery Electrode Particles.” Oral presentation at Joint Annual Meeting of GAMM and DMV, Brunswick, Germany, 2016.
- [7] **Y. Zhao**, P. Stein, and B.-X. Xu, “3D Isogeometric Analysis of Phase Segregation and Mechanical Stresses in Li-Ion Battery Electrode Particles with Anisotropy.” Oral presentation at European Solid Mechanics Conference, Madrid, Spain, 2015.
- [8] **Y. Zhao**, P. Stein, and B.-X. Xu, “Isogeometric Analysis of Mechanically Coupled Phase Segregation in Li-Ion Battery Electrode Particles.” Oral presentation at 86th Annual Meeting of the International Association of Applied Mathematics and Mechanics, Lecce, Italy, 2015.
- [9] **Y. Zhao**, P. Stein, and B.-X. Xu, “Isogeometric analysis of Cahn–Hilliard phase field diffusion problem coupled with mechanical stresses in Li-ion battery electrode.” Oral presentation at Materials Science and Engineering Congress, Darmstadt, Germany, 2014.
- [10] **Y. Zhao**, P. Stein, and B.-X. Xu, “Isogeometric analysis of Cahn-Hilliard phase field diffusion problem coupled with mechanical stresses in Li-ion battery electrode.” Oral presentation at 14th European Mechanics of Materials Conference, Gothenburg, Sweden, 2014.
- [11] **Y. Zhao**, P. Stein, and B.-X. Xu, “Isogeometric analysis of the mechanically coupled Cahn-Hilliard phase-field model.” Oral presentation at 85th Annual Meeting of the International Association of Applied Mathematics and Mechanics, Erlangen, Germany, 2014.

Current research interests

Electro-chemo-mechanical modeling of lithium-ion batteries

Modeling of hyperelastic and viscoelastic materials

Phase-field approach for fracture and phase segregation

IsoGeometric Analysis (IGA), Finite Cell Method (FCM)