Shize Yang

Eyring Materials Center, Arizona State University, Phone: (865)742-9545
Tempe, Arizona, 85287 Email: shize.yang@asu.edu

Current Position: Associate Research Scientist, Eyring Materials Center, Arizona State University

Research Interests:

- Develop low-voltage and four-dimensional scanning transmission electron microscopy techniques for understanding the structure-property relationship in energy materials
- Apply advanced chromatic corrected spectroscopy for understanding collective excitations in 2D materials
- Study the dynamic structural evolution of materials by advanced in-situ electron microscopy techniques

Education:

Institution	Degree	Year(s)	Major
Peking University	Ph.D.	09/2009-07/2014	Condensed Matter Physics
Shandong University	B.E.	09/2005-07/2009	Physics

Research and Professional Experience:

Associate Research Scientist & PI, 03/2020 – now
Eyring Materials Center, Arizona State University

- Development of monochromated EELS
- Electron microscopy and spectroscopy study on energy materials

Postdoc Research Associate, 02/2018 – 03/2020
Scientific Strategy and Integration Department

- "The Center for Mesoscale Transport Properties" an energy frontier science center supported by Department of Energy of United States
- Develop and combine advanced cryogenic, STEM-EELS, tomography and in-situ TEM techniques to address the critical fundamental question in lithium batteries.
- Cryogenic tomography imaging and 3D reconstruction of the DNA self-assembly structures.

Postdoc Research Associate, 03/2015 – 02/2018
Materials Science and Technology Division/Center for Nanophase Materials Sciences, Oak Ridge National Laboratory

- Low-voltage electron microscopy of two-dimensional materials
- Advanced STEM and spectroscopy imaging of energy materials

Research Assistant, 07/2014 – 03/2015
Institute of Physics, Chinese Academy of Science, Beijing, China

- In-situ TEM study of semiconductor nanowires

Selected Publications (Total publications: 69; Citations: 1119; h-index 19; i10-index: 31; including Nature Nanotechnology (1), Nature Communications (4), Advanced Materials (6), JACS (3)，PRL(1)

and other peer reviewed journals, # for co-first author and * for corresponding authors)

1. **Yang Shize**, et al. The Piezotronic Effect of Zinc Oxide Nanowires Studied by In Situ TEM. ***Advanced Materials*** 24, 4676 (2012).
2. **Shize Yang**, et al. In-situ optical transmission electron microscope study of exciton phonon replicas in ZnO nanowires by cathodoluminescence. ***Applied Physics Letters*** 105, 071901 (2014).
3. **Shi-Ze Yang#**, Weiwei Sun#, Yu-Yang Zhang, Yongji Gong, Mark P. Oxley, Andrew R. Lupini, Pulickel M. Ajayan, Matthew F. Chisholm, Sokrates T. Pantelides, and Wu Zhou. Direct Cation Exchange in Monolayer MoS_2 via Recombination-Enhanced Migration. ***Physical Review Letters*** 122, 106101 (2019).
4. **Shi-Ze Yang#**, Yongji Gong#*, Priyanka Manchanda#, et al., Pulickel M. Ajayan*, Matthew F. Chisholm, and Wu Zhou*. Rhenium-Doped and Stabilized MoS_2 Atomic Layers with Basal-Plane Catalytic Activity. ***Advanced Materials*** 30, 1803477 (2018).
5. Akinola D. Oyedele#, **Shize Yang**#, et al. $PdSe_2$: Pentagonal Two-Dimensional Layers with High Air Stability for Electronics. ***Journal of the American Chemical Society*** 139, 14090 (2017).
6. Akinola D. Oyedele#, **Shi-Ze Yang**#, Tianli Feng#, et al. Defect-mediated phase transformation in anisotropic 2D PdSe2 crystals for seamless electrical contacts. ***Journal of the American Chemical Society,*** 141, 8928 (2019).
7. X. Tian#, D. S. Kim#, **Shize Yang**#, C. J. Ciccarino, Y. Gong, Y. Yang, Y. Yang, B. Duschatko, Y. Yuan, and P. M. Ajayan, et al. and John Miao, Correlating 3D atomic defects and electronic properties of 2D materials with picometer precision. ***Nature Materials***, under review.
8. Tian Xuezeng, **Yang Shize**, Zeng Min, Wang Lifen, Wei Jiake, Xu Zhi, Wang Wenlong, and Bai Xuedong Bipolar Electrochemical Mechanism for Mass Transfer in Nanoionic Resistive Memories. ***Advanced Materials*** 26, 3649 (2014).
9. Peifeng Li, Qingliang Liao, **Shize Yang**, et al. In Situ Transmission Electron Microscopy Investigation on Fatigue Behavior of Single ZnO Wires under High-Cycle Strain. ***Nano Letters*** 14, 480 (2014).
10. Lifen Wang, Donghua Liu, **Shize Yang**, et al. Exotic Reaction Front Migration and Stage Structure in Lithiated Silicon Nanowires. ***ACS Nano*** 8, 8249 (2014).
11. Polo-Garzon Felipe, **Yang Shi-Ze**, et al. Controlling Reaction Selectivity through the Surface Termination of Perovskite Catalysts. ***Angewandte Chemie International Edition*** 56, 9820 (2017).
12. Yongji Gong, Hongtao Yuan, Chun-Lan Wu, Peizhe Tang, **Shi-Ze Yang**, et al. Spatially controlled doping of two-dimensional SnS_2 through intercalation for electronics. ***Nature Nanotechnology*** 13, 294 (2018).
13. Qi Shao#, Yu Wang#, **Shize Yang**#, et al. Stabilizing and Activating Metastable Nickel Nanocrystals for Highly Efficient Hydrogen Evolution Electrocatalysis. ***ACS Nano*** 12, 11625 (2018).
14. Sizhe Wang#, Feng Gong#, **Shize Yang**#, et al. Graphene Oxide-Template Controlled Cuboid-Shaped High-Capacity VS_4 Nanoparticles as Anode for Sodium-Ion Batteries. ***Advanced Functional Materials*** 28, 1801806 (2018).
15. Cheng Yi#, Zhao Shiyong#, et al., Cheng Hui-Ming, **Yang Shi-Ze***, and Jiang San Ping* Atomically Dispersed Transition Metals on Carbon Nanotubes with Ultrahigh Loading for Selective Electrochemical Carbon Dioxide Reduction. ***Advanced Materials*** 30, 1706287 (2018).
16. Chenhao Zhang#, **Shize Yang**#, Jingjie Wu#, et al., Pulickel M. Ajayan, and James M. Tour

Electrochemical CO_2 Reduction with Atomic Iron-Dispersed on Nitrogen-Doped Graphene. ***Advanced Energy Materials*** 8, 1703487 (2018).

17. Jun Di, Jiexiang Xia*, et al., **Shi-Ze Yang***, Huaming Li, Zheng Liu*, and Sheng Dai. Defect-Tailoring Mediated Electron–Hole Separation in Single-Unit-Cell Bi_3O_4Br Nanosheets for Boosting Photocatalytic Hydrogen Evolution and Nitrogen Fixation. ***Advanced Materials*** 0, 1807576 (2019).
18. Y. Zhao, X. Wang, **S. Yang**, E. Kuttner, et al. and G. D. Stucky, Protecting the Nanoscale Properties of Ag Nanowires with a Solution-Grown SnO2 Monolayer as Corrosion Inhibitor. ***Journal of the American Chemical Society*** 141, 13977 (2019).

Selected Conference Presentations:

- Quantitative Scanning Transmission Electron Microscopy Study of Monolayer $Re_xMo_{1-x}S_2$, poster, Microscopy & Microanalysis 2016 Annual Meeting, Columbus, Ohio.
- Exchange of Re and Mo Atoms in MoS_2 driven by Scanning Transmission Electron Microscopy, oral, Microscopy & Microanalysis 2017 Annual Meeting, St Louis, Missouri
- Direct Exchange of Re and Mo Atoms in Monolayer MoS_2, MRS fall meeting, 2017, Boston, Massachusetts
- Direct Exchange of Re and Mo atoms in monolayer MoS_2, APS March Meeting 2018, Los Angeles, California
- Atomic level structural characterization of catalyst materials by electron microscopy, Tufts University, 2018, Boston, Massachusetts

Honors and awards:

Best Poster Award, Annual Meeting of Chinese National Microscopy Congress, 2012
Guanghua Scholarship of Peking University, 2012-2013

Journal Reviewer for:

Nano Letters (1), Journal of the American Chemical Society (1), Applied Physics Letters (4), ACS Catalysis (4), ACS Applied Nano Materials (1), Nanotechnology (1), Materials Letters (8), Chemical Engineering Journal (3), Journal of Physics D: Applied Physics (1), Chinese Physics Letters (1).

Professional Memberships

Materials Research Society (MRS)

Technical Skills:

- Programming languages: MATLAB, Python, C, LabView
- Computer aided design/engineering: Solidworks
- Design and assembly of in-situ TEM holder
- Other: linux, VASP, computer clusters, deep learning

References:

Yimei Zhu, Senior Scientist, Group Leader, Brookhaven National Laboratory
Email: zhu@bnl.gov Tel: (631) 344-3057

Sergei V. Kalinin, Distinguished Research Staff Member, Oak Ridge National Laboratory
Email: sergei2@ornl.gov Tel: 865-241-0236

Dr. Yang's full publication

[1] L. Wang, X. Tian, S. Yang, Z. Xu, W. Wang, and X. Bai, Dynamic nanomechanics of zinc oxide nanowires. Applied Physics Letters **100**, 163110 (2012).

[2] Y. Shize, W. Lifen, T. Xuezeng, X. Zhi, W. Wenlong, B. Xuedong, and W. Enge, The Piezotronic Effect of Zinc Oxide Nanowires Studied by In Situ TEM. Advanced Materials **24**, 4676 (2012).

[3] X. Min, Y. Shize, G. Hongyan, H. Wei, Y. Qingzhi, and G. Changchun, Observation of intermediate template directed SiC nanowire growth in Si–C–N systems. Nanotechnology **23**, 415704 (2012).

[4] Q. Huang, F. Li, Y. Gong, J. Luo, S. Yang, Y. Luo, D. Li, X. Bai, and Q. Meng, Recombination in SnO2-Based Quantum Dots Sensitized Solar Cells: The Role of Surface States. The Journal of Physical Chemistry C **117**, 10965 (2013).

[5] X. Tian, L. Wang, X. Li, J. Wei, S. Yang, Z. Xu, W. Wang, and X. Bai, Recent development of studies on the mechanism of resistive memories in several metal oxides. Science China Physics, Mechanics and Astronomy **56**, 2361 (2013).

[6] L. Wang, Z. Xu, S. Yang, X. Tian, J. Wei, W. Wang, and X. Bai, Real-time in situ TEM studying the fading mechanism of tin dioxide nanowire electrodes in lithium ion batteries. Science China Technological Sciences **56**, 2630 (2013).

[7] P. Li, Q. Liao, S. Yang, X. Bai, Y. Huang, X. Yan, Z. Zhang, S. Liu, P. Lin, Z. Kang, and Y. Zhang, In Situ Transmission Electron Microscopy Investigation on Fatigue Behavior of Single ZnO Wires under High-Cycle Strain. Nano Letters **14**, 480 (2014).

[8] X. Tian, S. Yang, M. Zeng, L. Wang, J. Wei, Z. Xu, W. Wang, and X. Bai, Bipolar Electrochemical Mechanism for Mass Transfer in Nanoionic Resistive Memories. Advanced Materials **26**, 3649 (2014).

[9] X. Tian, L. Wang, J. Wei, S. Yang, W. Wang, Z. Xu, and X. Bai, Filament growth dynamics in solid electrolyte-based resistive memories revealed by in situ TEM. Nano Research **7**, 1065 (2014).

[10] L. Wang, D. Liu, S. Yang, X. Tian, G. Zhang, W. Wang, E. Wang, Z. Xu, and X. Bai, Exotic Reaction Front Migration and Stage Structure in Lithiated Silicon Nanowires. ACS Nano **8**, 8249 (2014).

[11] S. Yang, X. Tian, L. Wang, J. Wei, K. Qi, X. Li, Z. Xu, W. Wang, J. Zhao, X. Bai, and E. Wang, In-situ optical transmission electron microscope study of exciton phonon replicas in ZnO nanowires by cathodoluminescence. Applied Physics Letters **105**, 071901 (2014).

[12] W. Jiake, X. Zhi, W. Hao, T. Xuezeng, Y. Shize, W. Lifen, W. Wenlong, and B. Xuedong, In - situ TEM imaging of the anisotropic etching of graphene by metal nanoparticles. Nanotechnology **25**, 465709 (2014).

[13] L. Li, S.-H. Chai, A. Binder, S. Brown, S.-Z. Yang, and S. Dai, Synthesis of MCF-supported AuCo nanoparticle catalysts and the catalytic performance for the CO oxidation reaction. RSC Advances **5**, 100212 (2015).

[14] P. Zhang, H. Lu, Y. Zhou, L. Zhang, Z. Wu, S. Yang, H. Shi, Q. Zhu, Y. Chen, and S. Dai, Mesoporous MnCeOx solid solutions for low temperature and selective oxidation of hydrocarbons. Nature Communications **6**, 8446 (2015).

[15] Z. Pengfei, L. Hanfeng, Y. Shize, Z. Wangcheng, Z. Wenshuai, J. Xueguang, H. Caili, and D. Sheng, Realizing Selective and Aerobic Oxidation by Porous Transition-Metal-Salt@Ceria Catalyst. ChemistrySelect **1**, 1179 (2016).

[16] J. Di, C. Chen, S.-Z. Yang, M. Ji, C. Yan, K. Gu, J. Xia, H. Li, S. Li, and Z. Liu, Defect engineering in atomically-thin bismuth oxychloride towards photocatalytic oxygen evolution. Journal of Materials Chemistry A **5**, 14144 (2017).

[17] W. Shan, P. Zhang, S. Yang, H. Zhu, P. Wu, H. Xing, and S. Dai, Sustainable synthesis of alkaline metal oxide-mesoporous carbons via mechanochemical coordination self-assembly. Journal of Materials Chemistry A **5**, 23446 (2017).

[18] S. Linfeng, L. W. Sun, Y. Shize, C. M. F., L. Shi-Jun, A. L. Kee, T. Yongjian, M. Yunwei, K. Jing, and Y. H. Ying, Concurrent Synthesis of High-Performance Monolayer Transition Metal Disulfides. Advanced Functional Materials **27**, 1605896 (2017).

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[23] Z. Pengfei, Y. Shize, C. M. F., J. Xueguang, H. Caili, and D. Sheng, Coordination-Supported Imidazolate Networks: Water- and Heat-Stable Mesoporous Polymers for Catalysis. Chemistry – A European Journal **23**, 10038 (2017).
[24] P.-G. Felipe, Y. Shi-Ze, F. Victor, F. G. Shiou, B. E. E., C. M. F., J. De-en, and W. Zili, Controlling Reaction Selectivity through the Surface Termination of Perovskite Catalysts. Angewandte Chemie International Edition **56**, 9820 (2017).
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[36] W. Xiao, S. Yang, P. Zhang, P. Li, P. Wu, M. Li, N. Chen, K. Jie, C. Huang, N. Zhang, and S. Dai, Facile Synthesis of Highly Porous Metal Oxides by Mechanochemical Nanocasting. Chemistry of Materials **30**, 2924 (2018).
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Ajayan, High efficiency electrochemical reduction of CO2 beyond the two-electron transfer pathway on grain boundary rich ultra-small SnO2 nanoparticles. Journal of Materials Chemistry A **6**, 10313 (2018).
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[46] Q. Shao, Y. Wang, S. Yang, K. Lu, Y. Zhang, C. Tang, J. Song, Y. Feng, L. Xiong, Y. Peng, Y. Li, H. L. Xin, and X. Huang, Stabilizing and Activating Metastable Nickel Nanocrystals for Highly Efficient Hydrogen Evolution Electrocatalysis. ACS Nano **12**, 11625 (2018).
[47] S.-Z. Yang, Y. Gong, P. Manchanda, Y.-Y. Zhang, G. Ye, S. Chen, L. Song, S. T. Pantelides, P. M. Ajayan, M. F. Chisholm, and W. Zhou, Rhenium-Doped and Stabilized MoS2 Atomic Layers with Basal-Plane Catalytic Activity. Advanced Materials **30**, 1803477 (2018).
[48] Y. Cheng, S. Yang, S. P. Jiang, and S. Wang, Supported Single Atoms as New Class of Catalysts for Electrochemical Reduction of Carbon Dioxide. Small Methods **0**, 1800440.
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[51] S. Tan, F. Sayed, S. Yang, Z. Li, J. Wu, and P. M. Ajayan, Strong Effect of B-Site Substitution on the Reactivity of Layered Perovskite Oxides Probed via Isopropanol Conversion. ACS Materials Letters **1**, 230 (2019).
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Nanoparticle Catalysts via a Ultrasonication-Assisted Wet Chemistry Method under Ambient Conditions. Advanced Materials Interfaces **6**, 1900015 (2019).
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