**CONTACT INFORMATION**

Jacob Smith, Postdoctoral Researcher

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**OBJECTIVE**

My primary goal is to develop the field of *in situ* transmission electron microscopy (TEM) experimentation to expand our ability to investigate novel and transient material behaviors. Presently, the field faces many challenges ranging from temporal and algorithmic limitations in data acquisition and *in situ* hardware limitations. I aim to resolve these limitations and expand what can be learned using *in situ* TEM through the application of autonomous data acquisition and *in situ* TEM hardware development.

**RESEARCH APPOINTMENTS**

Postdoctoral Researcher Oak Ridge National Laboratory 2023 - present

 Autonomous Data Acquisition for Complex Higher Dimensional Data

 4D-STEM Dynamic Sampling and Compressive Sensing Development

 In Situ TEM Dry Reforming of Methane Catalyst Research

 In Situ TEM Ammonia Synthesis Catalyst Research

Visiting Student Oak Ridge National Laboratory 2022 – 2023

 4D-STEM Non-Rigid Registration and Distortion Correction

 In Situ TEM Emission Control Catalyst Research

Graduate Research Assistant North Carolina State University 2018 – 2023

 In Situ TEM Catalyst Synthesis Research

 TEM Simulation for 4D-STEM Technique Development

Undergraduate Research Assistant North Carolina State University 2017 – 2018

**EDUCATION**

North Carolina State University Raleigh, NC Materials Sci. and Eng. PhD 2023

North Carolina State University Raleigh, NC Mechanical Engineering BS 2018

**AWARDS & HONORS**

2023 M&M Poster Award – 1st Place 08/2023

Oak Ridge National Laboratory Graduate Opportunities Fellowship via the 01/2022 Office of Advanced Scientific Computing Research

North Carolina State University Provost’s Doctoral Fellowship 08/2018

North Carolina State University Graduate Merit Award 08/2018

**NOTABLE TECHNICAL EXPERTISE**

Transmission Electron Microscopy

* Experience using Thermofisher, JEOL, and NION microscopes
* Autonomous scripted microscope control
* 4D-STEM, EELS, and EDS expertise
* Aberration corrector alignment

In Situ Transmission Electron Microscopy

* Atmospheric heating
	+ Pressurized gas and vapor system setup for gas manifold operation
* Cryogenic cooling
* Vacuum heating and biasing
* Liquid cell

Transmission Electron Microscopy Data Simulation

* STEM image simulation
* 4D-STEM diffraction simulation

AI/ML for Microscopy Data Acquisition and Analysis

* Video series analysis and feature quantification
* Machine learning for data reconstruction, classification, and segmentation
* 4D-STEM and EELS data processing
* Distortion correction and data denoising
* Python and MATLAB Scripting

**TEACHING EXPERIENCE**

Duke University (through Prof. Miaofang Chi): since Fall 2023

* Graduate student mentor for two graduate students
	+ Trained students on fundamentals of *in situ* TEM experimentation and data analysis
* Course guest lecturer for ME562: Materials Synthesis & Processing (2 years)
	+ Developed and presented classroom lecture material on TEM machine learning and data analysis

Conference Short Course Tutorial

* M&M 2022, *Data Correction for 4D-STEM Data Acquired at Cryogenic Conditions*

**SOCIETY MEMBERSHIP**

Microscopy Society of America (MSA)

* Early Career Committee Member
	+ Active member of Publishing and Educational Outreach subcommittees
		- Leading organization role in producing the Early Career Scientists issue of Microscopy Today celebrating early career microscopists
	+ Pre-meeting Student and Postdoc Congress Leadership for M&M 2025

Microanalysis Society (MAS)

Materials Research Society (MRS)

**PUBLICATIONS**1–19

1. **Smith, J.** *et al.* Advanced Compressive Sensing and Dynamic Sampling for 4D-STEM Imaging of Interfaces. *Small Methods* **9**, 2400742 (2025).

2. **Smith, J.** *et al.* Sintering Mechanism of Pt/Al2O3 in Complex Emission Gases Elucidated via In Situ Environmental STEM. *ACS Materials Lett.* **6**, 3301–3311 (2024).

3. **Smith, J. G.** *et al.* Disproportionation chemistry in K2PtCl4 visualized at atomic resolution using scanning transmission electron microscopy. *Science Advances* **10**, eadi0175 (2024).

4. **Smith, J.**, Huang, Z., Gao, W., Zhang, G. & Chi, M. Atomic Resolution Cryogenic 4D-STEM Imaging via Robust Distortion Correction. *ACS Nano* **17**, 11327–11334 (2023).

5. **Smith, J.**, Wang, S., Eldred, T. B., DellaRova, C. & Gao, W. Characterization of nanomaterials dynamics with transmission electron microscope. in *Encyclopedia of Nanomaterials (First Edition)* (eds. Yin, Y., Lu, Y. & Xia, Y.) 123–145 (Elsevier, Oxford, 2023). doi:10.1016/B978-0-12-822425-0.00049-X.

6. Fang, Z. *et al.* Ionic conduction and interfacial stability in Na1 **+** xZr2SixP3 **−** xO12 solid electrolytes: Past, present, and future perspectives. *Applied Physics Reviews* **12**, 011329 (2025).

7. Huang, Z. *et al.* Phase Changes of Multielemental Alloy Nanoparticles at Elevated Temperatures. *ACS Nano* **19**, 13457–13465 (2025).

8. Huang, Z. *et al.* Atomic Scale Responses of High Entropy Oxides to Redox Environments. *Nano Lett.* **24**, 11537–11543 (2024).

9. Liccardo, G. *et al.* Unveiling the Stability of Encapsulated Pt Catalysts Using Nanocrystals and Atomic Layer Deposition. *J. Am. Chem. Soc.* **146**, 23909–23922 (2024).

10. Huang, Z. *et al.* Tailoring Local Chemical Ordering via Elemental Tuning in High-Entropy Alloys. *J. Am. Chem. Soc.* **146**, 2167–2173 (2024).

11. Ni, H. *et al.* Quantifying Atomically Dispersed Catalysts Using Deep Learning Assisted Microscopy. *Nano Lett.* **23**, 7442–7448 (2023).

12. Sodpiban, O. *et al.* Catalysts Prepared from Atomically Dispersed Ce(III) on MgO Rival Bulk Ceria for CO Oxidation. *ACS Appl. Mater. Interfaces* **15**, 55885–55894 (2023).

13. Zhao, K. *et al.* Lithium carbonate-promoted mixed rare earth oxides as a generalized strategy for oxidative coupling of methane with exceptional yields. *Nat Commun* **14**, 7749 (2023).

14. Stone, M. L. *et al.* Ceria Incorporation in Sinter-Resistant Platinum-Based Catalysts. *ACS Catal.* **13**, 14853–14863 (2023).

15. Wang, S., Eldred, T. B., Smith, J. G. & Gao, W. AutoDisk: Automated diffraction processing and strain mapping in 4D-STEM. *Ultramicroscopy* **236**, 113513 (2022).

16. Witharamage, C. S., Christudasjustus, J., Smith, J., Gao, W. & Gupta, R. K. Corrosion behavior of an in situ consolidated nanocrystalline Al-V alloy. *npj Mater Degrad* **6**, 1–9 (2022).

17. Su, L. *et al.* Visualizing the Formation of High-Entropy Fluorite Oxides from an Amorphous Precursor at Atomic Resolution. *ACS Nano* **16**, 21397–21406 (2022).

18. Eldred, T. B., Smith, J. G. & Gao, W. Polarization fluctuation of BaTiO3 at unit cell level mapped by four-dimensional scanning transmission electron microscopy. *Journal of Vacuum Science & Technology A* **40**, 013205 (2022).

19. Narayan, J. *et al.* Q-carbon as a new radiation-resistant material. *Carbon* **186**, 253–261 (2022).

**PRESENTATIONS**

**University of Houston – (Invited)**

Temporal Transience - Investigating Atomic Scale Phenomena through *In Situ* Transmission Electron Microscopy

MRS Fall 2024

Smith, J. Chi, M, *Investigating the Thermal and Environmental Causes of Particle Migration in Pt/Al2O3 Catalysts*

Smith, J. Zhang, G. Chi, M., *Enhancing Cryogenic Scanning Transmission Electron Microscopy Efficiency with Machine Learning*

**Duke University – (Invited Recurring Classroom Guest Lecture Presentation)**

 **Machine Learning and Data Processing for In Situ TEM**

Oak Ridge National Laboratory Presentation

 *In Situ STEM for Energy Materials*

MRS Spring 2023

Smith, J. et al., *Compressive Sensing for 4D-STEM Imaging*

**National University of Singapore – (Invited Presentation)**

 **In Situ Catalyst Synthesis at the Atomic Level**

McMaster In Situ Workshop 2022

Smith, J. Gao, W., *Atomistic Dynamics of Disorder to Order Transitions Visualized by Computer Stabilized In Situ Electron Microscopy*

M&M 2022

Smith, J. Gao, W, *Atomistic Reaction Kinetics and Chemistry Revealed using In Situ STEM*

Smith, J. et al., *Correcting Scan Distortions in Cryogenic 4DSTEM Acquisitions using Affine Transformations*

Smith, J. et al., *Data Correction for 4D-STEM Data Acquired at Cryogenic Conditions*

M&M 2021

Smith, J. Gao, W. *Phase Transition and Atomic Scale Dynamics in Chemical Reaction Revealed in the Solid State by Electron Microscopy*

ACS Fall 2021

Smith, J. Gao, W., *Atomic resolution electron microscopy of solid-state phase transformations and chemical reduction*

**REFERENCES**

Dr. Miaofang Chi

Corporate Fellow

Oak Ridge National Laboratory – Center for Nanophase Materials Sciences

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Relationship: Oak Ridge National Laboratory Co-host

Dr. Guannan Zhang

Senior Staff Scientist

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Relationship: Oak Ridge National Laboratory Co-host

Dr. Matteo Cargnello

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Relationship: Collaborator

Dr. Wenpei Gao

Associate Professor

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Relationship: Doctoral Advisor