Jonathan Schwartz

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Education

University of Michigan, Ann Arbor **September 2017 – April 2023**
Ph.D. Material Science and Engineering *Ann Arbor, MI*

- Thesis: Recovering Material Chemistry and 3D Structure at near Atomic Resolution
- *Awards:* DOE SCGSR Fellow, Rackham Merit Fellowship, Microscopy and Microanalysis 2019 Scholar, Eagle Scout, Discretionary Director's (DD) Allocation for Summit, ThetaGPU and Polaris Supercomputers, Molecular Foundry User

Arizona State University **September 2013 – May 2017**
Bachelor of Science, Chemical Engineering *Tempe, AZ*

Publications

1. **J. Schwartz**, Z.W. Di Y. Jiang, A. Fielitz, D.H. Ha, S. Perera, I. Baggari, *et. al.* "Imaging Atomic-Scale Chemistry from Fused Multi-Modal Electron Microscopy" *npj Computational Materials* **8**, 16 (2022).
2. **J. Schwartz**, C. Harris, J. Pietryga, H. Zheng, P. Kumar, A. Visheratina, N. Kotov, *et. al.* "Real-Time 3D Analysis During Electron Tomography using tomviz" *Nature Communications* **13**, 4458 (2022).
3. M. Cao, **J. Schwartz**, H. Zheng, Y. Jiang, R. Hovden, Y. Han "Atomic Defect Identication with Sparse Sampling and Deep Learning" *Communications in Computer and Information Science* **1512** (2022).
4. **J. Schwartz**, H. Zheng, M. Hanwell, Y. Jiang, R. Hovden, "Dynamic Compressed Sensing for Real-Time Tomographic Reconstruction" *Ultramicroscopy* **219** (2020) 113122.
5. **J. Schwartz**, Y, Jiang, Y. Wang, A. Aiello, P. Bhattacharya, H. Yuan, *et. al,* "Removing Stripes, Scratches, and Curtaining with Non-Recoverable Compressed Sensing," *Microsc. and Microanal.* **25** (2019) 705-710.

Research Experience

University of Michigan **August 2017 – Present**
Graduate Research Assistant, Electron Microscopist *Ann Arbor, MI*

- Designed an image processing algorithm (written in Python and C++) that improves signal-to-noise over 500% by correlating simultaneously acquired multi-modal chemical signals collected inside the electron microscope.
- Deployed quantum mechanical electron scattering simulations (producing > 7 TB of data) on GPU-accelerated Supercomputers at Oak Ridge National Lab to validate dose-requirements for atomic-resolution tomography algorithms.
- Developed efficient multi-threaded tomography algorithms with OpenMP/MPI, CUDA, and C++ wrapped in a Python interface to achieve over a 10x performance speed-up, enabling the real-time 3D analysis of volumetric data.
- Automated tomography experiments on electron microscopes with an easy-to-use GUI for user intervention.

Arizona State University **January 2016 – May 2017**
Undergraduate Research Assistant *Tempe, AZ*

- Built field-effect transistors with MoS_2 2D flakes to measure electrical property enhancements due to chemical doping.
- Fabricated 2D materials (e.g. graphene) with chemical vapor deposition and characterized with Raman Spectroscopy.

Harvard University **Summer 2016**
Center for Nanoscale Systems Researcher *Cambridge, MA*

- Designed and constructed micro-heating devices with AutoCAD and nano-fabrication techniques (e.g. lithography).

Projects

Semantic Segmentation of Materials at Atomic Resolution with 3D Deep Learning | *PyTorch* **Summer 2022**

- Trained 3D U-Net convolutional neural network architectures for the segmentation and identification of atom coordinates from experimental and synthetic atomic-resolution 3D tomographic models achieving 85% accuracy on the test dataset.

Classifying Crystal Symmetry with Distributed Deep Learning | *Keras, Horovod* **Summer 2020**

- Trained popular convolutional network architectures (e.g. ResNet51) with $> 10^6$ simulated diffraction images on a HPC-system using mutli-GPU and multi-node data parallelism. Obtained 55% classification accuracy on the test dataset.

Tools/Skills

Software: Python, MATLAB, C/C++, CUDA, OpenMP/MPI, LaTeX, GitHub, Bash, Julia

Experimental: *Microscopes*: SEM, TEM, S/TEM, EDX, EELS, Raman, *Clean-room*: PVD, CVD, Lithography

Relevant Coursework

- Deep Learning for Computer Vision
- Optimization Methods for ML
- Machine Learning (ML)
- Computational Data Science
- Quantum Mechanics
- Condensed Matter Physics

Publications (Continued)

1. N. Kotov, P. Kumar, T. Vo, M. Cha, A. Visheratina, J.K. Kim, W. Xu, **J. Schwartz**, *et. al.* "Photonically Active Bowtie Nanoassemblies with Chirality Continuum" *Nature* (Accepted).
2. W. Liu, X. Guo, **J. Schwartz**, *et. al.*, "A three-stage magnetic phase transition revelead in ultrahigh-quality van der Waals magnet CrSBr" *ACS Nano* **16**, 15917 - 15926 (2022).
3. I. Navid, A. Pandey, Y.M. Goh, **J. Schwartz**, R. Hovden, Z. Mi, "GaN-based Deep-nano structures: Break the Efficiency Bottleneck of Conventional Nanoscale Optoelectronics" *Adv. Optical Mater.* **2102263** (2022).
4. P. Wang, D. Wang, Y. Bi, B. Wang, **J. Schwartz**, R. Hovden, Z. Mi, "Quaternary Alloy ScAlGaN: A Promising Strategy to Improve the Quality of ScAlN" *Appl. Phys. Lett.* **120**, 012104 (2022).
5. Y.M. Goh, **J. Schwartz**, T. Ma, B. Kerns, R. Hovden, "Contaminaition of TEM Holders Quantified and Mitigated with the Open-Hardware, High-Vacuum Bakeout System" *Microsc. and Microanal.* **26** (2020) 906-912.
6. Y. Wang, Y. Wu, **J. Schwartz**, *et. al.* "A Single Junction Cathodic Approach for Stable Unassisted Solar Water Splitting" *Joule* **3** (2019) 1-13.
7. Y. Wang **J. Schwartz**, *et. al.* "Stable Unassisted Solar Water Splitting on Semiconductor Photocathodes Protected by Multi-Functional GaN Nanostructures" *ACS Energy Lett.* **4** (2019) 1541-1548.

Contributed Presentations

1. **J. Schwartz**, *et. al.* "Recovering Atomic-Scale Chemistry from Fused Multi-Modal Electron Microscopy", Microscopy and Microanalysis Meeting (Online) and Materials Research Society Fall Meeting (Boston, MA 2021).
2. **J. Schwartz**, *et. al.* "Real-Time 3D Analysis During Electron Tomography using tomviz", Microscopy and Microanalysis Meeting (Invited - Portland, OR 2022) and Materials Research Society Fall Meeting (Boston, MA) (2021).
3. **J. Schwartz**, "Optimization Frameworks for Recovering Chemistry and 3D Atomic Structure with Electron Microscopy", X-Ray Science Division at Advanced Photon Source, Argonne National Laboratory (Invited Talk) (2021).
4. **J. Schwartz**, *et. al.* "Dynamic Compressed Sensing for Real-Time Tomographic Reconstruction", Microscopy and Microanalysis Meeting, Online (2020).
5. **J. Schwartz**, *et. al,* "Removing Stripes, Scratches, and Curtaining with Non-Recoverable Compressed Sensing", Microscopy and Microanalysis Meeting, Portland, OR (2019) and SEM-FIB 2018 Workshop.

Published Abstracts

1. M. Cao, **J. Schwartz**, H. Zheng and Y. Jiang, "Atomic Defect Identification with Sparse Sampling and Deep Learning", Smoky Mountain Computational Sciences Conference (2021).
2. J. Pietryga, **J. Schwartz**, *et. al.* "Rapid Holographic Display of 3D Nanomaterials", Microsc. and Microanal., **27** (S1) (2021).
3. **J. Schwartz**, *et. al.* "Recovering Atomic-Scale Chemistry from Fused Multi-Modal Electron Microscopy", Microsc. and Microanal., **27** (S1) (2021).
4. **J. Schwartz**, *et. al.* "Real-Time 3D Analysis During Electron Tomography using tomviz", Microsc. and Microanal., **27** (S1) (2021).
5. **J. Schwartz**, *et. al.* "Dynamic Compressed Sensing for Real-Time Tomographic Reconstruction", Microsc. and Microanal., **26** (S2) (2020).
6. C. Ophus, H. Brown, L. Dacosta, P. Pelz, **J. Schwartz**, *et. al.* "Improving the Speed and Accuracy of Large-Scale Scanning Transmission Electron Microscopy Scattering Simulations", Microsc. and Microanal., **26** (S2) (2020).
7. R. Yalisove, S. Sung, **J. Schwartz**, *et. al.* "Achieving High-Resolution of Large Specimens Using Aberration Corrected Tomography", Microsc. and Microanal., **26** (S2) (2020).
8. R. Hovden, R. Yalisove, **J. Schwartz**, *et. al.* "Filling in the Missing Wedge with Aberration-corrected Electron Tomography", Microsc. and Microanal., **26** (S2) (2020).
9. Y.M. Goh, **J. Schwartz**, *et. al.* "Contamination of TEM Holdens Quantified and Mitigated with Open-Hardware High-Vacuum Bakeout", Microsc. and Microanal., **26** (S2) (2020).
10. **J. Schwartz**, *et. al,* "Removing Stripes, Scratches, and Curtaining with Non-Recoverable Compressed Sensing", Microsc. and Microanal., **25** (S2) (2019).
11. M. Hanwell, C. Harris, A. Genova, **J. Schwartz**, *et. al,* "Tomviz: Open Source Platform Connecting Image Processing Pipelines to GPU Accelerated 3D Visualization", Microsc. and Microanal., **25** (S2) (2019).
12. R. Hovden, **J. Schwartz**, *et. al,* "Real-Time Tomography with Interactive 3D Visualization using *tomviz*", Microsc. and Microanal., **24** (S1) (2018).