Chaoyi **Zhu**, PhD

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Self-motivated researcher with experience in multi-scale materials testing and characterization. Expert knowledge in deformation studies using electron backscatter diffraction and digital image correlation. Advanced software developer in bridging computer vision approaches with experimental mechanics. Interested in exploring processing-defect-property relationship of different alloy systems. Enjoy learning about research in sustainability for materials design and selection.

EDUCATION

University of California, San Diego | M.S. and Ph.D. June 2019
Materials Science and Engineering, GPA:3.8
Thesis: Multiscale Characterization Techniques to Elucidate Mechanical Behavior of Materials

Imperial College London | B.Eng. June 2015
Materials Science and Engineering, First Class with Honors

WORK EXPERIENCE

Research Associate | Carnegie Mellon University, USA August 2019-present
Department of Materials Science and Engineering, Supervisor: Professor Marc De Graef

- Developed a virtual characterization technique to query multiscale hierarchy between discrete dislocation field and continuum dislocation theory: a critical study for geometrically necessary dislocations.
- Developed the interaction volume EBSD pattern simulation method to understand the effect of Yoffe dislocations.
- Implemented optimization (Fortran) code for pattern center refinement and determination of residual strain.
- Developed the Fortran-to-Python interface (pyEMsoft) for crystallographic computations.
- Implemented Willis-Steeds-Lothe expression to calculate strain/stress field of dislocations segments in an anisotropic linear elastic medium.

Research Assistant | University of California, San Diego, USA Oct. 2015-June 2019
Materials Science and Engineering Program, Supervisor: Professor Kenneth Vecchio

- Devised quantitative methods to understand the microstructure and crystallographic anisotropy on the shear localization behavior of metallic alloys.
- Developed an indirect method to measure statistically stored dislocation density and validate Ashby's strengthening model based on the evolution of dislocations.
- Developed demons registration based approach to extract 1) type I surface macrostrains, 2) type II intragranular microstrains/residual stresses from composite materials and additively manufactured materials.
- Assisted in developing a convolutional neural network to classify crystal structures.
- Developed the feature generation code from an element property database to assist machine learning based alloy design.

Research Intern | Max-Planck-Institute for Iron Research, Germany July 2014-Sept. 2014
Microstructure Physics and Alloy Design Department, Supervisors: Professor Cem Tasan (now at MIT)

- Optimized the microstructure of ultra-fine grain (UFG) steel samples through improved thermomechanical processing.
- Assisted the design and setup of an in-situ tensile stage inside SEM.
- Worked on comparing in-situ DIC and crystal plasticity finite element analysis for the tensile deformation of a pure iron sample.

AWARDS

Dissertation Year Fellowship | University of California, San Diego 2018

GSA Travel Grant | University of California, San Diego 2018

EBSD Tropical Conference Grant | The Microanalysis Society 2018

Acta Materialia Student Award Finalist | Elsevier 2018

Charles Salter Prize | Imperial College London 2015

Engineering Dean's List | Imperial College London 2013, 2014

SELECTED PUBLICATIONS

26 published journal articles, 2 articles currently under review, and 1 article in preparation. Articles highlighted by Science Magazine, Microscopy Today, Advanced Science News. *: corresponding author; For a complete list of publications: Google Scholar.

1. Zhu,C., Harrington, T., Gray III, G.T. and Vecchio, K.S.*, 2018. Dislocation-type evolution in quasi-statically compressed polycrystalline nickel. Acta Materialia.
2. Zhu,C., Harrington, T., Livescu, V., Gray, G.T. and Vecchio, K.S.*, 2016. Determination of geometrically necessary dislocations in large shear strain localization in aluminum. Acta Materialia.
3. Zhu,C., Livescu, V., Harrington, T., Dippo, O., Gray, G.T. and Vecchio, K.S.*, 2017. Investigation of the shear response and geometrically necessary dislocation densities in shear localization in high-purity titanium. International Journal of Plasticity.
4. Zhu,C.*, Kurniawan, C., Ochsendorf, M., An, D., Zaefferer, S, De Graef, M., 2021. Orientation, Pattern Center Refinement and Deformation State Extraction through Global Optimization Algorithms. Ultramicroscopy (under review).
5. Ding, Z., Zhu, C.*, De Graef, M., 2021. Determining Crystallographic Orientation via Hybrid Convolutional Neural Network. Materials Characterization (under review).
6. Kurniawan, C., Zhu,C. and De Graef, M.*, 2021. Deformation state extraction from electron backscatter diffraction patterns via simulation-based pattern-matching. Scripta Materialia.
7. Zhu,C. and De Graef, M.*, 2020. EBSD Pattern Simulations for an Interaction Volume Containing Lattice Defects. Ultramicroscopy.
8. Zhu,C., Kaufmann, K. and Vecchio, K.*, 2020. Novel Remapping Approach for HR-EBSD based on Demons Registration. Ultramicroscopy.
9. Zhu,C., Wang, H., Kaufmann, K. and Vecchio, K.*, 2020. Computer Vision Approach to Study Deformation of Materials. Measurement Science and Technology.
10. Kaufmann, K., Zhu,C., Rosengarten, A.S., Maryanovsky, D., Harrington, T.J., Marin, E. and Vecchio, K.S.*, 2020. Crystal structure determination in electron diffraction using machine learning. Science.
11. Zhang, C., Zhu, C., Cao, P., Wang, X., Ye, F., Kaufmann, K., Casalena, L., MacDonald, B.E., Pan, X., Vecchio, K.* and Lavernia, E.J.*, 2020. Aged Metastable High-entropy Alloys with Heterogeneous Lamella Structure for Superior Strength-Ductility Synergy. Acta Materialia.
12. Zhang, C., Zhu, C., Harrington, T. and Vecchio, K.*, 2018. Design of non-equiatomic high entropy alloys with heterogeneous lamella structure towards strength-ductility synergy. Scripta Materialia.

SKILLS

- Expert: scanning electron microscopy, digital image correlation, in-situ mechanical testing, crystal plasticity, image processing, micromechanics, metallography, fracture mechanics, dislocation theory, nanoindentation
- Skilled in characterization techniques: EBSD, ECCI, EDS, SEM, OLM, XRD, IR, DSC

- Programming languages: Python, Matlab, Fortran; Operating Systems: windows, macOS, Linux
- Software: MS Office, Abaqus, DAMASK, EMsoft, LAMMPS, ParaDis, Illustrator, Lightroom, Solidworks, VS code
- Others: high performance computing, Jupyter Notebook, scikit-learn, TensorFlow, pandas, Git/Github, openMP, CMake, LaTex, HDF5, matplotlib, global optimization

PROFESSIONAL ACTIVITIES

Reviewer | MICROSC. MICROANAL., METALL. MATER. TRANS. A, etc 2019-present

MS&T Conference | Pittsburgh 2020

TMS Conferences | Member of The Minerals, Metals & Materials Society 2017,2019,2020,2021

EBSD Conference | University of Michigan 2018

HOBBIES

Tennis Running Reading Fingerstyle guitar Photography