Chaoyi **Zhu**, PhD

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Self-motivated researcher with 6 years of experience in processing and multiscale characterization of metallurgical materials. Advanced software developer in applying computational methods to facilitate experimental data analysis. Expert knowledge in electron microscopy and process-structure-property relationship of many alloy systems. Interested in machine-learning assisted alloy design.

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

- Established the virtual EBSD 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.
- Assisted in the design of hybrid convolutional neural network to determine crystallographic orientation.
- Developed the Python-based library (pyEMsoft) containing wrapped Fortran subroutines from EMsoft to do orientation calculation/conversion and basic crystallographic computations.

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.
- Assisted the design of heterogeneous lamella structure in high entropy alloys and beta-titanium alloys.
- Developed the feature generation code from an element property database to assist machine learning based alloy design.

Undergraduate Researcher | Imperial College London, United Kingdom Oct. 2014-July 2015
Department of Materials, Supervisors: Professor T.B. Britton (now at UBC); Professor Fionn Dunne

- Implemented an integral method for accessing Nye's dislocation tensor on Hough based lattice rotation tensor.
- Worked on Ruggles and Fullwood's method for smeared out dislocations in a box.

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 in-situ DIC and CPFEM analysis for the tensile deformation of pure iron sample.

AWARDS

Dissertation Year Fellowship | 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 2012-2015

SELECTED PUBLICATIONS

26 published journal articles, 2 articles currently under review, and 1 article is 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.*, 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).
2. Kurniawan, C., Zhu,C. and De Graef, M.*, 2021. Deformation state extraction from electron backscatter diffraction patterns via simulation-based pattern-matching. Scripta Materialia.
3. Zhu,C. and De Graef, M.*, 2020. EBSD Pattern Simulations for an Interaction Volume Containing Lattice Defects. Ultramicroscopy.
4. Zhu,C., Kaufmann, K. and Vecchio, K.*, 2020. Novel Remapping Approach for HR-EBSD based on Demons Registration. Ultramicroscopy.
5. Zhu,C., Wang, H., Kaufmann, K. and Vecchio, K.*, 2020. Computer Vision Approach to Study Deformation of Materials. Measurement Science and Technology.
6. 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.
7. Zhu,C., Harrington, T., Gray III, G.T. and Vecchio, K.S.*, 2018. Dislocation-type evolution in quasi-statically compressed polycrystalline nickel. Acta Materialia.
8. 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.
9. 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.
10. Kaufmann, K., Maryanovsky, D., Mellor, W.M., Zhu, C., Rosengarten, A.S., Harrington, T.J., Oses, C., Toher, C., Curtarolo, S. and Vecchio, K.S., 2020. Discovery of high-entropy ceramics via machine learning. Npj Computational Materials.
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. Zhao, S., Li, Z., Zhu, C., Yang, W., Zhang, Z., Grant, P., Ritchie, R.*, Meyers, M.*, 2021. Amorphization in Extreme Deformation of the CrMnFeCoNi High-Entropy Alloy. Science Advances.
13. 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, mechanical testing, high-throughput characterization, crystal plasticity, image processing, micromechanics, global optimization
- Proficient: additive manufacturing, metallography, fracture mechanics, nanoindentation, heat treatment, fractography
- Skilled in characterization techniques: EBSD, ECCI, EDS, SEM, OLM, XRD, IR, DSC
- Language skills: Native in Chinese, bilingual proficiency in English
- Programming languages: Python, Matlab, Fortran; Operating Systems: windows, macOS, Linux
- Software: MS Office, Abaqus, DAMASK, EMsoft, LAMMPS, Illustrator, Lightroom, Solidworks, Solid Edge, VS code
- Others: high performance computing, scikit-learn, Jupyter Notebook, Tensorflow, Anaconda, Git, Github, openMP, CMake, LaTex, HDF5, matplotlib

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