

Charles Clark

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Education

Stony Brook University

M.Sc. Materials Science & Engineering, GPA: 3.97/4.00

Thesis: *Synchrotron X-ray Data Processing & Visualization Techniques for Analysis of Functional Materials*

Stony Brook, New York

August 2021 - May 2023

Stony Brook University

B.E. Engineering Science, GPA: 3.90/4.00

summa cum laude

Stony Brook, New York

August 2017 - May 2021

Research Experience

University of Stuttgart

Research Assistant, Computational Imaging Systems (CIS)

Advisor: Professor Sven Simon

Project: *Deep Learning for Inline Industrial Sparse-view Computer Tomography (CT)*

Stuttgart, Germany

August 2023 - present

- Implemented and trained neural network models to improve the reconstruction quality of CT images from sparse-view data, where the limited amount of projection data results in streaking artifacts in reconstructed volumes. Experimented with model hyperparameters in order to achieve optimal training times for inline industrial applications.
- Benchmarked various neural network architectures when applied to sparse view CT, including image processing architectures such as U-Nets and Partial Convolution (PConv).
- Implemented a CT scan simulation pipeline for generating training and test data for neural networks using Tcl scripting language and Artist CT simulation software.
- Assisted in running beamtimes at the Beamline for Hierarchical Phase Contrast Tomography (BM18) of the European Synchrotron Radiation Facility (ESRF) for multispectral CT experiments using silicon prism arrays.
- Developed an image analysis algorithm for tracking pores in CT images of welded copper by observing structures in the 3D image gradient, using scientific Python packages such as SciPy, scikit-image, and OpenCV for implementation.

Brookhaven National Lab

Software Development & Data Analysis Intern

National Synchrotron Light Source II (NSLS-II), ISS Beamline

Brookhaven, New York

August 2022 - May 2023

- Collaborated with beamline scientists and software engineers to develop and deploy synchrotron data analysis software.
- Created prototype web application for visualization and analysis of X-ray absorption spectroscopy (XAS) data stored in a facility-wide Mongo database.
- Developed and deployed a pipeline for automatic reduction and calibration of X-ray emission spectroscopy (XES) images recorded using von Hamos spectrometer.
- Implemented ingestion pipeline for beamline data into an AI multimodal analysis database.

Stony Brook University
Graduate Research Assistant, Chen-Wiegart Group
Advisor: Professor Karen Chen-Wiegart
Thesis: *Synchrotron X-ray Data Processing & Visualization Techniques for Analysis of Functional Materials*

Stony Brook, New York
August 2021 - August 2022

- Conducted synchrotron X-ray experiments from sample preparation to data analysis and writing results, in collaboration with PhD students and beamline scientists. Performed an in-depth study of state-of-the-art methods for analysis and visualization of data from synchrotron experiments. Made significant contributions in several projects for co-authorship in published results.
- Contributed to physical validation of predictions from a random forest machine learning (ML) model for predicting thin-film dealloying systems.
 - Prepared samples using thin-film sputter deposition and heat treatment under vacuum and in inert gaseous environments.
 - Verified dealloying via scanning electron microscopy (SEM), synchrotron X-ray diffraction (XRD), and synchrotron X-ray absorption spectroscopy (XAS) data analysis.
- Contributed to a study of corrosion and morphological evolution of Ni-20Cr alloys in molten salt environments.
 - Utilized Avizo, Fiji, and scientific Python packages such as SciPy and scikit-image to analyze and visualize 3D tomography datasets.
 - Performed semi-quantitative analysis of porosity growth during in-situ experiments by measuring the volume fraction of pores inside material regions over time.
- Utilized multivariate curve resolution alternating least squares (MCR-ALS) algorithm to perform spectral decomposition analysis on XAS data from an in-situ investigation of phase evolution in aqueous MnO₂/Zn battery electrode systems.
- Conducted beamtime experiments at NSLS-II in collaboration with PhD students and beamline scientists, including XAS at the Beamline for Materials Measurement (BMM, 6-BM), XRD at the X-ray Powder Diffraction beamline (XPD, 28-ID-2), and nano-tomography at the Full-field X-ray Imaging beamline (FXI, 18-ID).

Stony Brook University
Research Project Assistant
Advisor: Professor Clive Clayton
Project: *Investigation of Hydrogen Induced Corrosion of Stainless Steels*

Stony Brook, New York
December 2020 - August 2021

- Conducted electrochemical experiments to investigate hydrogen-induced corrosion of stainless steel electrodes in order to model corrosive environments found in hydrogen gas pipelines.
- Prepared stainless steel samples by diamond-paste polishing and epoxy mounting onto electrodes.
- Experimented with different steel alloys, reaction environments, and reaction times.
- Analyzed experimental results using optical microscopy, SEM, and electrochemistry analysis software.

Teaching Experience

University of Stuttgart

Teaching Assistant, Computational Imaging Systems (CIS)

Stuttgart, Germany

August 2023 - present

- Supervised Bachelor and Master students in projects applying neural networks to CT imaging, and developing a data management application for accessing an internal CT database.
- Ran theoretical and practical exercises for courses in computational 3D imaging, and introductory computer engineering.

Stony Brook University

Undergraduate Teaching Assistant, *Engineering Lab*

Stony Brook, New York

August 2020 - December 2021

- Assisted lab director with instructing third year engineering students.
- Collaborated with other teaching assistants for timely grading of weekly lab reports.
- Served as initial point of contact for students with questions about lab reports, making figures, and engineering concepts.

Materials Science & Engineering Skills

Characterization Techniques: Scanning Electron Microscopy (SEM), Optical Microscopy, X-ray Diffraction (XRD), X-ray Absorption Spectroscopy (XAS), Computed Tomography (Lab CT and Synchrotron-based)

Sample Preparation: Thin-film Sputter Deposition, Heat Treatment, Vacuum Systems, Electrolyte & Electrode Preparation

Materials Analysis: Dealloying, Corrosion, Spectral Decomposition Analysis

Programming & Software Development Skills

Programming Languages: Python, C++, MATLAB

Data Analysis: Pandas, NumPy, SciPy, Matplotlib, Plotly, Dash

Machine Learning: PyTorch, scikit-learn

Image Processing: OpenCV, Fiji, scikit-image

Software Development: Git, Linux

Publications

Xingyu Liu, Charles Clark, Steffen Kieß, Ammar Alsaffar, Hieu Tran, Guhathakurta Jainabalkya, and Sven Simon. Artifact-robust object segmentation using thresholding based on binarized image object analysis (TB2IOA) in X-ray computed tomography. 13th Conference on Industrial Computed Tomography (iCT) 2023, 6 - 9 February 2024 in School of Engineering, Wels Campus, Austria. *e-Journal of Nondestructive Testing*, 2024.

Contribution: Developed segmentation algorithm with lead author and wrote significant portions of manuscript.

Chonghang Zhao, Lin-Chieh Yu, Kim Kisslinger, Charles Clark, Cheng-Chu Chung, Ruipeng Li, Masafumi Fukuto, Ming Lu, Jianming Bai, Xiaoyang Liu, Hui Zhong, Mingzhao Liu, Sanjit Ghose, and Yu-chen Karen Chen-Wiegar. Kinetics and evolution of solid-state metal dealloying in thin films with multimodal analysis. *Acta Materialia*, 242:118433, 2023.

Contribution: Analyzed grazing incidence wide-angle scattering (GIWAXS) data to identify intermediate phases formed during dealloying reactions, with particular focus on reviewer comments about Ti-Cu intermetallics.

Varun R. Kankanallu, Xiaoyin Zheng, Denis Leshchev, Nicole Zmich, Charles Clark, Cheng-Hung Lin, Hui Zhong, Sanjit Ghose, Andrew M. Kiss, Dmytro Nykypanchuk, Eli Stavitski, Esther S. Takeuchi, Amy C. Marschilok, Kenneth J. Takeuchi, Jianming Bai, Mingyuan Ge, and Yu-chen Karen Chen-Wiegar. Elucidating a dissolution–deposition reaction mechanism by multimodal synchrotron X-ray characterization in aqueous Zn/MnO₂ batteries. *Energy Environ. Sci.*, 16:2464–2482, 2023.

Contribution: Applied multivariate curve resolution (MCR) through the NIST pyMCR Python package to XAS data, in attempt to perform decomposition of spectral data into pure components for better understanding of the reaction mechanism.

Cheng-Chu Chung, Charles Clark, Chonghang Zhao, Kim Kisslinger, Fernando Camino, Dmytro Nykypanchuk, Hui Zhong, Sanjit Ghose, Ruipeng Li, Chang-Yong Nam, and Yu-chen Karen Chen-Wiegar. Oxidation driven thin-film solid-state metal dealloying forming bicontinuous nanostructures. *Advanced Materials Interfaces*, 10(35):2300454, 2023.

Contribution: Prepared thin-film NbAl-Sc alloy samples via sputter deposition and heat treatment. Conducted XAS, and XRD experiments at NSLS-II in collaboration with lead author and beamline scientists.

Lin-Chieh Yu, Charles Clark, Xiaoyang Liu, Arthur Ronne, Bobby Layne, Phillip Halstenberg, Fernando Camino, Dmytro Nykypanchuk, Hui Zhong, Mingyuan Ge, Wah-Keat Lee, Sanjit Ghose, Sheng Dai, Xianghui Xiao, James F. Wishart, and Yu-chen Karen Chen-Wiegar. Evolution of micro-pores in Ni–Cr alloys via molten salt dealloying. *Scientific Reports*, 12(1):20785, Dec 2022.

Contribution: Created 3D data visualization figures to show pore evolution at different depths from the material interface, using data from synchrotron nano-tomography experiments. Reviewed final text of manuscript and communicated with journal editors to address comments and fix errors.