

Xingyu Liu

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RESEARCH SUMMARY

My research asks how materials survive radiation. Inside a nuclear reactor, or in space, energetic particles knock atoms out of place and change a material from within, until it fails. I use ion irradiation to recreate in days what a reactor would take years to do, and advanced microscopy techniques to observe radiation damage.

Research Interests: Materials Science Nuclear Materials Radiation Damage Microscopy Metals Ceramics

EMPLOYMENT

University of Wisconsin-Madison

Postdoctoral Research Associate in Materials Science and Engineering

- Supervised by Dr. Izabela Szlufarska

Aug 2026 — Present
Madison, WI, United States

Pennsylvania State University

Graduate Research Assistant in Nuclear Engineering

- Supervised by Dr. Xing Wang and Dr. Arthur T. Motta

Sep 2021 — Aug 2026
University Park, PA, United States

University of Science and Technology Beijing

Undergraduate Research Assistant in Materials Science and Engineering

- Supervised by Dr. Wentuo Han and Dr. Chi Xu

Sep 2018 — Dec 2020
Beijing, China

EDUCATION

Pennsylvania State University

Ph.D. in Materials Science and Engineering

- Advised by Dr. Xing Wang and Dr. Arthur T. Motta

Jan 2021 — Aug 2026
University Park, PA, United States

University of Science and Technology Beijing

B.E. in Materials Science and Engineering

- Advised by Dr. Wentuo Han and Dr. Chi Xu

Sep 2016 — Jul 2020
Beijing, China

RESEARCH EXPERIENCE

Deciphering the role of nitrogen on the performance of ferritic-martensitic steels

Feb 2025 — 2027

PI: Dr. Xing Wang (PSU), Dr. Benjamin Eftink (Los Alamos National Laboratory)

- Investigated the effect of nitrogen (N) on microstructural and microchemical evolution in irradiated ferritic-martensitic steel HT9.
 - Conducted ex-situ dual ion irradiations on N-15 isotope implanted ferritic-martensitic steel HT9 at Michigan Ion Beam Laboratory.
 - Characterized the distribution of implanted N-15 isotope after irradiation using correlative scanning transmission electron microscopy and atom probe tomography at the Critical Materials and Energy Systems Innovation Center, Idaho National Laboratory.

Qualification under ion irradiation of core components

Jul 2023 — Mar 2026

PI: Dr. Gary S. Was (University of Michigan), Dr. Arthur T. Motta (PSU), Dr. Xing Wang (PSU)

- Emulated neutron-induced microstructural and microchemical evolution in alloy 800H using dual ion irradiation at high doses.
 - Conducted ex-situ dual ion irradiations over a wide dose range on alloy 800H at Michigan Ion Beam Laboratory.
 - Characterized radiation-induced cavities, dislocation loops, precipitates, and segregation near grain boundaries and cavities.
- Investigated cavity evolution in irradiated alloy 800H using in-situ ion irradiations at different dose rates and temperatures.
 - Designed and conducted in situ single ion irradiations on irradiated alloy 800H across wide ranges of dose rate and temperature using Intermediate Voltage Electron Microscope at Argonne National Laboratory.
 - Characterized cavities using transmission electron microscopy and modeled their evolution through cascade overlapping.

Effect of minor alloying elements on helium bubble formation in ferritic-martensitic steels

Oct 2022 — Jul 2025

PI: Dr. Xing Wang (PSU)

- Characterized the segregation and clustering of minor alloying elements near helium bubbles in ferritic-martensitic steel T91 and reduced-activation ferritic-martensitic steel F82H using scanning transmission electron microscopy and atom probe tomography.
- Discovered the difference of radiation-induced segregation near grain boundaries and helium bubbles in ferritic-martensitic steels.

Swift heavy ion irradiation damage in semi-conductors gallium oxide and gallium nitride

Aug 2022 — Aug 2026

PI: Dr. Rongming Chu (PSU), Dr. Xing Wang (PSU), Dr. Miaomiao Jin (PSU)

- Investigated amorphization in gallium oxide Ga_2O_3 along different crystal orientations under swift heavy ion irradiation.
- Investigated cavity formation in gallium nitride GaN and aluminum nitride AlN under swift heavy ion irradiation.

Short range ordering in medium/high entropy alloys

Sep 2021 — Jun 2023

PI: Dr. Xing Wang (PSU)

- Investigated short range ordering evolution in NiCoFe, NiCoCr, and NiCoFeCrMn through diffraction during in-situ annealing in transmission electron microscope.

Microstructures in oxide dispersion strengthened steels

Sep 2018 — Jul 2020

PI: Dr. Wentuo Han (USTB)

- Characterized YAlO oxide dispersoids and dislocations using transmission electron microscopy.

TECHNICAL EXPERTISE

Materials Characterization: Transmission electron microscopy (TEM) Scanning transmission electron microscopy (STEM)

Scanning electron microscopy Energy-dispersive X-ray spectroscopy Electron energy loss spectroscopy S/TEM tomography

High-resolution S/TEM In-situ TEM annealing Focused ion beam Atom probe tomography (APT) Correlative STEM-APT

Ion Irradiation: Ex-situ dual ion irradiation In-situ single ion irradiation SRIM simulation

PUBLICATIONS

corresponding author

1. **X. Liu**, F. Reza, M. Jin[#], X. Wang[#]. Amorphization in gallium oxide under swift heavy ion irradiation. Manuscript in preparation.
2. **X. Liu**, A. Waegaert, W-Y. Chen, X. Wang[#], A.T. Motta[#]. Cavity evolution in irradiated alloy 800H studied with in-situ ion irradiation. *Acta Mater.* 318 (2026) 122616. doi: [10.1016/j.actamat.2026.122616](https://doi.org/10.1016/j.actamat.2026.122616).
3. C-M. Hsu, S. Xu, M.J. Lynch, Y. Wang, **X. Liu**, C. Williams, K.G. Field, X. Wang, L. Qian, X. Qian[#]. INR-TEM: Robust cavity detection in multifocus TEM images via implicit neural representations. *APL Mach Learn* 4 (2026) 016105. doi: [10.1063/5.0301417](https://doi.org/10.1063/5.0301417).
4. X. Xu, **X. Liu**, W.J. Weber, Y. Zhang, X. Wang[#]. Combining 2D simulations with atom probe tomography to investigate radiation-induced segregation near nanoscale cavities. *npj Mater Degrad* 10 (2026) 14. doi: [10.1038/s41529-025-00727-y](https://doi.org/10.1038/s41529-025-00727-y).
5. **X. Liu**, J. Poplawsky, Y. Wang, X. Xu, X.F. Chen, X. Wang[#]. Understanding the effect of minor alloying elements on helium bubble formation in ferritic-martensitic steels. *J Nucl Mater* 616 (2025) 156045. doi: [10.1016/j.jnucmat.2025.156045](https://doi.org/10.1016/j.jnucmat.2025.156045).
6. M. Sadek[#], Y. Xiong, Y. Du, J.T. Kemmerling, R. Guan, J. Song, **X. Liu**, X. Wang, A. Xie, R. Chu. Field-dependent carrier transport in implanted isolation region of GaN lateral power devices. *APL Mater* 13 (2025) 051113. doi: [10.1063/5.0245549](https://doi.org/10.1063/5.0245549).
7. M. Mahfuz, F. Reza, **X. Liu**, R. Chu, M. Lang, M. Snure, X. Wang[#], M. Jin[#]. Microstructural changes in GaN and AlN under 950 MeV Au swift heavy ion irradiation. *Appl Phys Lett* 124 (2024) 112104. doi: [10.1063/5.0189812](https://doi.org/10.1063/5.0189812).
8. A. Saefan, **X. Liu**, E. Lang, L. Higgins, Y. Wang, O.E. Atwani, J.P. Allain, X. Wang[#]. Effects of transition metal carbide dispersoids on helium bubble formation in dispersion-strengthened tungsten. *Sci Rep* 13 (2023) 13352. doi: [10.1038/s41598-023-40421-0](https://doi.org/10.1038/s41598-023-40421-0).
9. C. Xing, H. Zhang[#], K. Long, Y. Xiao, H. Zhang, Z. Qiu, D. He, **X. Liu**, Y. Zhang, Y. Long. The effect of different atomic substitution at Mn site on magnetocaloric effect in Ni₅₀Mn₃₅Co₂Sn₁₃ alloy. *Crystals* 8 (2018) 329. doi: [10.3390/cryst8080329](https://doi.org/10.3390/cryst8080329).

CONFERENCES

corresponding author

1. X. Wang[#], **X. Liu**, A. Waegaert, W-Y. Chen, A.T. Motta[#]. [Understanding the role of collision cascades in cavity formation using in situ ion irradiation](#). Materials Science & Technology (MS&T). Pittsburgh, PA, United States. Oct 2026.
2. **X. Liu**, A. Waegaert, W-Y. Chen, X. Wang[#], A.T. Motta[#]. [Investigating effect of dose rate on microstructure evolution in 800H alloy at high doses](#). Nuclear Science User Facilities (NSUF) annual program review. Online. May 2026.
3. **X. Liu**, X. Wang[#]. [Understanding the effect of nitrogen on cavity formation and precipitate stability using correlative STEM-APT technique](#). Minerals, Metals & Materials Society (TMS). San Diego, CA, United States. Mar 2026.
4. **X. Liu**, J. Poplawsky, Y. Wang, X. Xu, X.F. Chen, X. Wang[#]. [Effect of minor alloying elements on helium bubble formation in T91 and F82H ferritic-martensitic steels](#). Materials in Nuclear Energy Systems (MiNES). Cleveland, OH, United States. Dec 2025.
5. **X. Liu**, A. Waegaert, W-Y. Chen, X. Wang[#], A.T. Motta[#]. [Investigating the effect of dose rate on cavity evolution in 800H alloy using ex-situ and in-situ irradiation](#). Materials in Nuclear Energy Systems (MiNES). Cleveland, OH, United States. Dec 2025.

6. **X. Liu**, A. Waegaert, X. Wang[#], A.T. Motta[#]. [Emulation of microchemical evolution at high doses in neutron irradiated 800H using dual ion irradiation](#). *Minerals, Metals & Materials Society (TMS)*. Las Vegas, NV, United States. Mar 2025.
7. A. Waegaert, **X. Liu**, X. Wang[#], A.T. Motta[#]. [Cavity and dislocation loop evolution in neutron irradiated 800H alloy](#). *Minerals, Metals & Materials Society (TMS)*. Las Vegas, NV, United States. Mar 2025.
8. **X. Liu**, A. Waegaert, X. Wang[#], A.T. Motta[#]. [Emulation of neutron irradiation-induced cavities and precipitates at high dose in 800H alloy using dual ion irradiation](#). *Materials Science & Technology (MS&T)*. Pittsburgh, PA, United States. Oct 2024.
9. **X. Liu**, J. Poplawsky, M. Chancey, Y. Wang, X. Wang[#]. [Radiation-induced segregation around helium bubbles in reduced-activation ferritic/martensitic \(RAFM\) steels](#). *Minerals, Metals & Materials Society (TMS)*. Orlando, FL, United States. Mar 2024.

AWARDS

1. Recipient of [Nuclear Science User Facilities \(NSUF\) Rapid Turnaround Experiment \(RTE\) Award #24-5164](#) from the U.S. Department of Energy's Office of Nuclear Energy. **Xingyu Liu** serves as PI, with Dr. Arthur T. Motta and Dr. Xing Wang as co-PIs. Sep 2024.

SERVICE

1. Laboratory manager and treasurer of Dr. Xing Wang's RDMAP lab (2023-2026).
2. Teaching assistant of PSU graduate course NucE 509 Physics of Radiation Damage (2024 fall).
3. Peer review service: *Journal of Nuclear Materials*, *The Journal of The Minerals, Metals & Materials Society (TMS)*.