

Metin Karayilan, PhD

Assistant Professor, Department of Chemistry, Case Western Reserve University

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Research Interests: Polymer chemistry, organic chemistry, materials science, biomaterials, polymer recycling, (bio)degradable and sustainable polymers, controlled polymerization, photochemistry, 3D printing, machine learning, automation, flow chemistry, surface-initiated polymerization, microfluidics, green chemistry, coatings, ocular research, chemical education.

EDUCATION

Ph.D. in Chemistry | The University of Arizona, Tucson, AZ 2019

Thesis: *Synthesis of electrocatalytic [2Fe-2S]-metallopolymers and organic/inorganic hybrid materials*

M.Sc. in Chemical Engineering | Koç University, Turkey 2014

Thesis: *Investigations of sol-gel parameters, thermal and optical properties of silica aerogels for large scale applications*

B.S. in Chemistry | Middle East Technical University (METU), Turkey 2011

Thesis: *Aminoconduritol synthesis from imidazolone derivatives*

RESEARCH & PROFESSIONAL EXPERIENCE

Assistant Professor of Chemistry | Case Western Reserve University (CWRU) 2022–present

Postdoctoral Associate | Duke University | Department of Chemistry 2020-2022

Synthesis of polymer melts and soft elastomers with tunable viscosity and refractive index for intraocular lens applications

Graduate Research Assistant | The University of Arizona | Dept. of Chem. & Biochem. 2014-2019

1. *Synthesis of enzyme mimetic metallopolymers and electrocatalytic hydrogen evolution in water*

2. *Synthesis of functional sulfur polymers for thermosetting plastic applications*

3. *Air-free synthesis of II-VI semiconductor nanocrystals for investigations of surface energetics*

Graduate Research Assistant | Koç University | Dept. of Chemical & Biological Eng. 2011-2014

Synthesis of aerogels with high transparency and low thermal conductivity via sol-gel chemistry and supercritical CO₂ drying

Undergraduate Researcher | METU | Department of Chemistry 2010-2011

Multi-step organic synthesis

TEACHING EXPERIENCE

@ Case Western Reserve University 2022-present

Instructor | Synthetic Methods for Organic Chemistry (Chem 435) | Fall 2022-present

Instructor | Physical Methods for Determining Organic Structure (Chem 325/425) | Spring 2023-present

Guest Lecturer | Modern Topics in Physical Chemistry (Chem 447) | Fall 2022

Topic: Physical Properties of Polymers, Instructor: Prof. Daniel Scherson

Course Evaluations: Overall rating of the instructor/course: 4.50/4.08 (Fall 2022, Chem 435), 4.90/4.80 (Spring 2023, Chem 325/425), 4.93/4.94 (Fall 2023, Chem 435), 4.82/4.82 (Spring 2024, Chem 325/425)

@ Duke University 2020-2021

Guest lecturer | Theoretical and Applied Polymer Science (BME 529) | Fall 2021

Topic: NMR Spectroscopy for Polymers, Instructor: Prof. Stefan Zauscher

Guest Lecturer | Materials Synthesis and Processing (ME 555) | Fall 2021

4 lectures on Polymer Synthesis and Processing, Instructor: Prof. David Mitzi

Postdoctoral Teaching Fellow | General Chemistry (Chem 110), Virtual/In-person lab experiments design and development | Fall 2020

@ The University of Arizona 2014-2019

Guest Lecturer | Polymer Chemistry (Chem 542) | 3 lectures, Instructor: Prof. Jeff Pyun | Fall 2019

Graduate Teaching Assistant | Organic Chemistry Labs (Chem 243 and 247), General Chemistry (Chem 151 and 152) | 2014-2016

@ Koç University 2011-2014
Graduate Teaching Assistant | Chemical Engineering Lab (CHBI402), Physical Chemistry Labs and Recitation (Chem 301&302), General Chemistry Lab (Chem 103)

HONORS & AWARDS

Veale Faculty Fellow | CWRU Veale Institute for Entrepreneurship 2024
Online Learning Advisory Committee/ Online Learning Community (OLAC/OLC) Fellow | CWRU [U]Tech Teaching and Learning Technologies 2023
Mentor Fellow | CWRU Office of Faculty Development 2023
Glennan Fellowship | CWRU UCITE | *Incorporating chemistry laboratory experiments into the classroom through virtual online learning* 2023
Departmental Diversity Seminar Series funding support | CWRU Office of the Provost 2022
ACS PMSE Future Faculty Fellow 2021
Georgia Tech Postdoc Talk Competition Finalist 2021
ACS Lasting Encounters between Aspiring and Distinguished Scientists (LEADS) Fellow 2021
Preparing Future Faculty (PFF) Fellow | Duke University Graduate School 2021
Cottrell Emerging Scholar (Mentor: Prof. Frank Leibfarth, UNC Chapel Hill) 2021
ACS Green Chemistry Institute Kenneth G. Hancock Memorial Award 2020
Galileo Circle Scholarship | College of Science, The University of Arizona 2019
Salutes to Excellence Award | ACS Southern Arizona Local Section 2019
Outstanding Oral Presentation | National Graduate Research Polymer Conference, The University of Minnesota, MN 2018
ACS Excellence in Graduate Polymer Research | ACS National Meeting in New Orleans, LA 2018
Fast Pitch Award | 7th Annual Arizona Energy Conference on Renewable Energy Science, Technology, and Policy at the Energy-Water Nexus 2018
Distinguished Teaching Assistant (DTA) | The University of Arizona, Dept. of Chem. & Biochem. 2016

Karayilan Lab Student Awards (2022-present)

SOURCE PSURG/STEM Summer Undergraduate Research Fellowship (7) | Daniele Vinella (Chem), Anuj Pahuja (Chem), Jaimie Lwin (Biochem), Daniel Schleif (BME), Sophie Beilharz (Chem), Dhoopshikha Basgeet (Chem & Computer Science), Alexey Shorin (BME)
Charles F. Mabery Award Best Thesis in Chemistry | Daniele Vinella, Sophie Beilharz
Costin D. Nenitzescu and Margareta Avram Award Outstanding Research in Organic Chemistry | Daniele Vinella (undergrad) and Konpal Raheja (graduate student)
Olin Freeman Tower Prize Excellence in Physical Chemistry | Sophie Beilharz
Carl F. Prutton Prize Scholarship in Chemistry | Sophie Beilharz
Hippolyte Gruener Award Student Merit in Chemistry | Anuj Pahuja
Inorganic Chemistry Award Excellence in Inorganic Chemistry | Sophie Beilharz
Expanding Horizons Initiative (EHI) IGNITE Most Creative Research Project Pitch | Lucia Yuan
Dr. John Paul and Marilyn Jones Endowed Undergraduate Research Award | Daniele Vinella
CWRU Office of Postdoctoral Affairs Biophysics Day Flash Talks Award | Lucia Yuan
The Graduate Council of Arts and Sciences (GCAS) Graduate Student Scholarship and Creative Endeavors (GSSCE) Grants | Lucia Yuan (2023) and Konpal Raheja (2024)
ACS Cleveland Miniature Meeting Graduate Student Award for Best Presentation | Konpal Raheja
CWRU Intersection Undergraduate Poster Awards | Anuj Pahuja (2nd-place, 2023) and Daniele Vinella (2nd-place, 2024)
Dumitru and Gheorghe D. Mateescu Student Citizenship Award | Lucia Yuan, Jacqueline Knappenberger
Nenitzescu-Avram Award | Sophia Beilharz
Flora Stone Mather Center for Women Research and Professional Development Grant | Lucia Yuan

Carl F. Prutton Prize | Anuj Pahuja
Case Alumni Scholarship Foundation | Sophie Beilharz
W. R. Veazey Prize Excellence in Physical Chemistry | Griffin Pardo
Excellence in Inorganic Chemistry | Jacqueline Knappenberger
Margareta Avram Award Outstanding Research in Organic Chemistry | Lucia Yuan

SELECTED PRESENTATIONS

The Ohio Polymer and Soft Matter Symposium (OPoSM) Invited Talk | *Eye-Catching Polymers: Injectable Fluorescent Viscoelastics for Ocular Surgery* | August 2025
Polymers GRC, Mount Holyoke College, MA | *Injectable, stimuli-responsive, and fluorescent polymers: Tuning structural heterogeneity to control properties (poster)* | June 2025
ACS Cleveland Local Section Meeting in Miniature (MiM) Plenary Talk | *Keeping Eyes on Innovation: Injectable Polymeric Materials for Transformative Biomedical Applications* | March 2025
Kent State University, Department of Chemistry and Biochemistry, OH Seminar | *Injectable Fluorescent Bottlebrush Polymers for Interventional Procedures* | October 2024
Denison University, Department of Chemistry and Biochemistry, OH Seminar | *Injectable and Thermoresponsive Polymers for Biomedical Applications* | October 2024
ACS National Meeting (POLY: Stimuli-Responsive Polymers as Functional Biomaterials), Denver, CO | *Thermoresponsive and dual-responsive polymers: Tuning structural heterogeneity to control flow characteristics* | August 2024
ACS National Meeting (POLY: Incorporating Polymer Science in the Classroom), New Orleans, LA | *Summer research activities for ACS Project SEED program in a polymer chemistry laboratory* | March 2024
ACS National Meeting (PMSE: General: Novel Applications of Polymeric Materials), New Orleans, LA | *Polymeric materials for enhanced ocular treatments* | March 2024
CWRU, Department of Chemical and Biomolecular Engineering, OH Seminar | *Keeping Eyes on the Prize: Polymeric Materials for Ocular Research* | October 2023
NSF BioPACIFIC MIP, UC Santa Barbara, CA | *Karayilan Research Lab @ CWRU: Fluorescent polymeric viscoelastics for ocular research* | August 2023
Polymers GRC, Mount Holyoke College, MA | *Synthesis of Polymeric Viscoelastics and Elastomers for Biomedical Research (poster)* | June 2023
Thomas Jefferson University, Department of Biological and Chemical Sciences, PA | *Synthesis of Polymeric Materials for Ocular Implants* | February 2023 (virtual)
CWRU, Department of Physics, OH | *The 2022 Nobel Prizes in Sciences Colloquium: The Nobel Prize in Chemistry 2022* | February 2023
Penn State Behrend, Department of Chemistry, Erie, PA | *Karayilan Research Lab @ CWRU: Polymer Synthesis and Applications in Biomedical Research* | October 2022
CWRU, Department of Macromolecular Science and Engineering, OH Seminar | *Synthesis of Polymeric Fluids for Intraocular Lens Implants* | September 2022
ACS National Meeting (PMSE: Future Faculty Symposium), San Diego, CA | *Polymeric materials with defined viscosity and optical properties for intraocular lens applications* | March 2022
ACS National Meeting (POLY: Incorporating Polymer Science into the Classroom), San Diego, CA | *Zooming in on polymer chemistry and designing a polymer synthesis experiment for virtual undergraduate laboratory* | March 2022

PUBLICATIONS ([Google Scholar](#))

[18] Yuan, Y.; Beilharz, S.; Everson, H.; Nupnar, N.; Debnath, M. K.; Vinella, D.; Uruena, J. M.; Orge, F.; Hore, M. J. A.; Mathur, D.; **Karayilan, M.***, "Injectable Fluorescent Bottlebrush Polymers for Interventional Procedures and Biomedical Imaging", **2025**, *Biomacromolecules*, 26, 2, 1234-1250.
<https://doi.org/10.1021/acs.biomac.4c01550>
[17] Beilharz, S.; Debnath, M. K.; Vinella, D.; Shoffstall, A. J.; **Karayilan, M.***, "Advances in Injectable Polymeric Biomaterials and Their Contemporary Medical Practices", **2024**, *ACS Appl. Bio Mater.*, 7, 12, 8076-8101. <https://doi.org/10.1021/acsabm.4c01001>

- [16] Beilharz, S.; Vermut-Young, M.; Anderson, K.; Vinella, D.; Pahuja, A.; Yuan, Y.; Raheja, K.; Crespo-Hernández, C. E.; **Karayilan, M.***, "Summer Research Plan in Polymer Chemistry Laboratory for ACS Project SEED Program.", *J. Chem. Educ.* **2024**, 101, 3, 1120–1129. <https://doi.org/10.1021/acs.jchemed.3c01175>
- [15] Patiny, L.; Musallam, H.; Bolaños, A.; Zasso, M.; Wist, J.; **Karayilan, M.**; Ziegler, E.; Liermann, J. C.; Schlörer, N. E., "NMRium: Teaching nuclear magnetic resonance spectra interpretation in an online platform." *Beilstein J. Org. Chem.* **2024**, 20, 25–31. <https://doi.org/10.3762/bjoc.20.4>.
- [14] Dikki, R.; Cagli, E.; Penley, D.; **Karayilan, M.**; Gurkan, B. "Formation of choline salts and dipolar ions for CO₂ reactive eutectic solvents." *Chem. Commun.* **2023**. <https://doi.org/10.1039/D3CC03272H>.
- [13] Yuan, L.; Raheja, K.; Milbrandt, N.; Beilharz, S.; Tene, S.; S. Oshabaheebwa, Gurkan, U. A.; Samia, A. C; **Karayilan, M.*** "Thermoresponsive polymers with LCST transition: synthesis, characterization, and their impact on biomedical frontiers." *RSC Applied Polymers*, **2023**, 1, 158-189. <https://doi.org/10.1039/D3LP00114H>.

Before CWRU

- [12] **Karayilan, M.***; McDonald, S. M.; Bahnick, A. J.; Godwin, K.; Chan, Y. M.; Becker, M. L. "Reassessing undergraduate polymer laboratory experiments for virtual learning environments." *J. Chem. Educ.*, **2022**, 99, 5, 1877-1889.
- [11] **Karayilan, M.***; Vakil, J.; Fowler, D.; Becker, M. L.; Cox, C. "Zooming in on polymer chemistry and designing synthesis of high-sulfur content polymers for virtual undergraduate laboratory experiment" *J. Chem. Educ.*, **2021**, 98, 6, 2062-2073.
- [10] **Karayilan, M.**; Clamen, L.; Becker, M. L. "Polymeric materials for eye surface and intraocular applications." *Biomacromolecules*, **2021**, 22, 2, 223-261.
- [9] Clary, K. E.; **Karayilan, M.**; McCleary-Petersen, K. C.; Petersen, H.; Glass, R. S.; Pyun, J.; Lichtenberger, D. L. "Enhancing the hydrogen evolution reaction in neutral water with protic buffer electrolytes." *PNAS*, **2020**, 117, 52, 32947-32953.
- [8] Shallcross, R. C.; Graham, A. L.; **Karayilan, M.**; Pavlopoulos, N. G.; Meise, J. A.; Pyun, J. and Armstrong, N. R. "Influence of processing environment on the surface composition and electronic structure of size-quantized CdSe quantum dots." *J. Phys. Chem. C*, **2020**, 124, 39, 21305–21318.
- [7] **Karayilan, M.**; McCleary-Petersen, K. C.; Hamilton, M. O.; Fu, L.; Matyjaszewski, K.; Lichtenberger, D. L.; Glass, R. S.; Pyun, J. "Synthesis of new metallopolymer via ATRP from a [2Fe-2S] initiator: Effects of polymer size on hydrogen evolution catalysis." *Macromol. Rapid. Commun.*, **2020**, 41.
- [6] **Karayilan, M.**; Kleine, T. S.; Carothers, K.; Griebel, J. J.; Frederick, K. M.; Loy, D. A.; Glass, R. S.; Mackay, M. E.; Char, K.; Pyun, J. "Chalcogenide hybrid inorganic/organic polymer (CHIP) resins: Amine functional prepolymers from elemental sulfur." *J. Polym. Sci.*, **2020**, 58, 35-41.
- [5] **Karayilan, M.**; Brezinski, W. P.; Clary, K. E.; Lichtenberger, D. L.; Glass, R. S.; Pyun, J. "Catalytic metallopolymer from [2Fe-2S] clusters: Artificial metalloenzymes for hydrogen production." *Angew. Chem. Int. Ed.*, **2019**, 58, 7537-7550.
- [4] Zhang, Y.; Pavlopoulos, N. G.; Kleine, T. S.; **Karayilan, M.**; Glass, R. S.; Char, K. and Pyun, J., "Nucleophilic activation of elemental sulfur in inverse vulcanization and dynamic covalent polymerization." *J. Polym. Sci., Part A: Polym. Chem.* **2019**, 57, 7-12.
- [3] Glass, R. S.; Pyun, J.; Lichtenberger, D. L.; Brezinski, W. P.; **Karayilan, M.**; Clary, K. E.; Pavlopoulos, N. G. and Dennis L. Evans, "Water-soluble and air-stable [2Fe-2S]-metallopolymer: A new class of electrocatalysts for H₂ production via water splitting." *Phosphorus, Sulfur and Silicon and Relat. Elem.*, **2019**, 6, 701-706.
- [2] Brezinski, W. P.; **Karayilan, M.**; Clary, K. E.; McCleary-Petersen, K. C.; Fu, L.; Matyjaszewski, K.; Evans, D. H.; Lichtenberger, D. L.; Glass, R. S.; Pyun, J. "Macromolecular engineering of the outer coordination sphere of [2Fe-2S] metallopolymer to enhance catalytic activity for H₂ production." *ACS Macro Lett.* **2018**, 7, 1383-1387.
- [1] Brezinski, W. P.; **Karayilan, M.**; Clary, K. E.; Pavlopoulos, N. G.; Li, S.; Fu, L. Y.; Matyjaszewski, K.; Evans, D. H.; Glass, R. S.; Lichtenberger, D. L.; Pyun, J. "[FeFe]-hydrogenase mimetic metallopolymer with enhanced catalytic activity for hydrogen production in water." *Angew. Chem. Int. Ed.* **2018**, 57, 11898.

FUNDING & GRANTS

ACS Petroleum Research Fund (Role: PI, 68078-DNI7), Tuning structural heterogeneity to control flow characteristics of polymer solutions 2025-2027
CWRU Veale Institute for Entrepreneurship Seed Funding (Role: PI) 2024-2025
Expanding Horizons Initiative (EHI) Interdisciplinary Grant (Role: PI), Thermoresponsive polymers with unique architecture as ocular adhesives | CWRU College of Arts and Sciences 2023-2024
NSF Industry-University Cooperative Research Center for Materials Data Science for Reliability and Degradation (MDS-Rely) Grant (Role: PI), Predictive framework to indicate the age of plastics for proper recycling | CWRU & University of Pittsburgh 2023-2024
Expanding Horizons Initiative (EHI) Interdisciplinary Grant (Role: PI), Fluorescent ophthalmic viscosurgical devices for cataract surgery | CWRU College of Arts and Sciences 2022-2023

PATENTS, PATENT APPLICATIONS, & INVENTION DISCLOSURES

@ Case Western Reserve University

[6] **Karayilan, M.**; Mathur, D.; Orge, F.; Yuan, Y.; Beilharz, S.; Injectable fluorescent bottlebrush polymers for interventional procedures and biomedical imaging | US63/747,935 | 2025

@ Duke University

[5] Becker, M. L.; **Karayilan, M.**; Photopolymerized elastomers for all-in-one intraocular lens implants | US63/344,186 | 2022

[4] Becker, M. L.; **Karayilan, M.**; Biostable polymer brushes with defined viscosity and optical properties | US63/191,018, PCT/US2022/030255 | 2021

@ The University of Arizona

[3] Lichtenberger, D. L.; Pyun, J.; Glass, R. S.; Brezinski, W. P.; Clary, K. E.; **Karayilan, M.**; Enhanced Water Splitting with Protic Buffer/Electrolyte Cocatalysts | US16/771,597 | 2020

[2] Pyun, J.; Glass, R. S.; Lichtenberger D. L.; Brezinski, W. P.; Clary, K. E.; **Karayilan, M.**; Metallopolymers for Catalytic Generation of Hydrogen | US16/466,571 | 2019

[1] Pyun, J.; Glass, R. S.; Lichtenberger D. L.; Brezinski, W. P.; Clary, K. E.; **Karayilan, M.**; Electrocatalytic Systems for the Generation of Molecular Hydrogen from Aqueous Feedstocks | UA18-069 | 2019

RESEARCH MENTOR

Postdoc: Dr. Mithun Kumar Debnath

PhD students: Lucia Yuan (4th-year), Konpal Raheja (4th-year), Maryam Khoshgoee (3rd-year), Bablu Hasan (2nd-year), Audrey Hostetler (2nd-year)

Undergraduate Researchers: Alexey Shorin, Ajitesh Lalam, Jackie Knappenberger, Griffin Pardo, Dhoopshika Basgeet, Aaryan Patel, Kaan Aydin.

Alumni: UG: Daniele Vinella (current: PhD student at UCSB, CA), Anuj Pahuja (current: EMT at CWRU Emergency Medical Service), Daniel Schleif (current: Medical student at Uniformed Services University F. Edward Hebert School of Medicine, MD), Malena Vermut-Young (current: Undergrad, at Ohio University, OH), Ryan Anthony (current: PhD student at Ohio State University, OH), Jaimie Lwin (current: Biomedical Sciences Training Program, School of Medicine at CWRU), Sophie Beilharz (current: Geisinger Commonwealth School of Medicine), Eva Nieman, Dazerna Akamah, Lilly Stanley. **High school student:** Katherine Anderson (ACS SEED Project, current: Undergrad. at Ohio State, OH), Sawar Sahni (Hawken STEMM program, current: High school student at Hawken Upper School in Gates Mills, OH), Abdulbaasir Tadese (ACS SEED Project, current: High school student at Cleveland School of Science and Medicine), Yongyi Mei (ACS SEED Project, current: Magnificant High School), Max Viktoroff (Hawken STEMM program, current: High school student at Hawken Upper School in Gates Mills, OH), Rekha O'Neil.

(**Total:** 1 postdoc, 5 graduate students, 17 undergraduate students, 6 high school students since 2022)

MEMBERSHIP, SERVICE, AND OUTREACH

CWRU Chemistry Graduate Admission Committee member and Colloquium/Frontiers Seminar Committee co-chair | 2022-present

Case Chemistry Research Symposium (C²RS) co-organizer | Chemistry Department research presentations given by graduate students since 2022 (first time organized by Drs. Karayilan and Parker)

ACS Symposium Organizer | Stimuli-Responsive Polymers as Functional Biomaterials, POLY Division, ACS Fall 2024, Denver, CO (Raised \$5500 from private companies and ACS)

Reviewer | ACS (JACS, Biomacromolecules, J of Chem Educ, ACS Appl Mater Interfaces, ACS Nano), RSC (ChemComm), Elsevier (Polymer), Wiley (ChemistrySelect), and Springer (J of Polymer Research, J of Polymers and the Environment, J of Rubber Research)

Early Career Reviewer (ECR) | NIH Study Section, Brain Imaging, Vision, Bioengineering and Low Vision Technology Development (BIVT) ZRG1 | 2023

ACS POLY and PMSE Members | 2017-present