Stanford

Matthew Kanan

Professor of Chemistry and Senior Fellow at the Precourt Institute for Energy

Curriculum Vitae available Online

CONTACT INFORMATION

- **Administrative Contact**

  Tina Lin - Administrative Associate

  Email tinatl@stanford.edu

  Tel (650) 736-8120

Bio

BIO

Matt Kanan is a Professor of Chemistry and Senior Fellow at the Precourt Institute for Energy at Stanford. Matt's research group works across multiple fields of chemistry and engineering with applications for sustainable plastics, critical mineral recovery, and carbon management. Their work has led to several inventions in these areas, including new performance-advantaged bioplastics, electrochemical systems to recycle acid and base, metal-free catalysts for C1 transformations, and thermal mineral conversion processes. Matt is the co-founder of ReSource Chemical Corp., an Oakland-based start-up commercializing manufacturing technology developed in his lab, and Mafix, Inc., a spin-out developing mineral fertilizers that remove CO2 from the atmosphere. Prior to joining the Stanford faculty in 2009, Matt did his Ph.D. studies in organic chemistry at Harvard and postdoctoral research at MIT in inorganic chemistry. He earned his B.A. in chemistry from Rice University in 2000.

ACADEMIC APPOINTMENTS

- Professor, Chemistry
- Senior Fellow, Precourt Institute for Energy
- Member, Bio-X
- Member, Maternal & Child Health Research Institute (MCHRI)

HONORS AND AWARDS

- Selected one of first annual Talented 12, Chemistry & Engineering News (2015)
- Camille Dreyfus Teacher-Scholar Award, Camille & Henry Dreyfus Foundation (2014)
- Hellman Faculty Scholar Award, Hellman Fellows Program (2013)
- Camille and Henry Dreyfus Environmental Mentor, Camille & Henry Dreyfus Foundation (2012)
- Thieme Journal Award, Thieme Medical Publishers (2010)
- Eli Lilly New Faculty Award, Eli Lilly and Company (2009)

PROFESSIONAL EDUCATION

- Postdoc, Massachusetts Institute of Technology , Water-Oxidation Catalysis (2005)

- PhD, Harvard University , Organic Chemistry (2005)
- BA Summa Cum Laude, Rice University , Chemistry (2000)

LINKS

- The Kanan Lab: http://kananlab.stanford.edu/

Teaching

COURSES

2025-26

- Chemical Foundations and 21st Century Problems: CHEM 31E (Aut)
- Understanding the Natural and Unnatural World through Chemistry: CHEM 121 (Spr)

2024-25

- Chemical Foundations and 21st Century Problems: CHEM 31E (Aut)
- Understanding the Natural and Unnatural World through Chemistry: CHEM 121 (Spr)

2023-24

- Organic Polyfunctional Compounds: CHEM 123 (Aut)
- Understanding the Natural and Unnatural World through Chemistry: CHEM 121 (Spr)

2022-23

- Organic Polyfunctional Compounds: CHEM 123 (Aut)
- Understanding the Natural and Unnatural World through Chemistry: CHEM 121 (Spr)

STANFORD ADVISEES

Doctoral Dissertation Reader (AC)

Huayue Ai, Mircea-Raul Bodrogean, Caravaggio Caniglia, Molly Corr, Julia Dressel, Ricky Hage, Karime Hernandez Perez, Daniel Howell, Uran Iwata, Francesca Starvaggi, Alex Su

Doctoral Dissertation Advisor (AC)

Nawal Alghoraibi, Ben Charnay, Robert Kennedy, Anne Kiely, Helene Koumans, Nate Luis, Jade Marcus, Jason Misleh, Lucas Sanchez, Kesha Tamakuwala, Henry Thomas, Daniel Wehbeh, Gage Wright, Hongyi Zhang

Doctoral Dissertation Co-Advisor (AC)

David Dumas

Publications

PUBLICATIONS

- **Transforming Waste Cooking Oil into Linear and Branched Polyethylene Mimics.** *Journal of the American Chemical Society*
  Mahadas, N. A., Sanchez, L. A., Suhail, A., Price, J., Anik, A. M., Kanan, M. W., Kuksenok, O., Tang, C.
  2025
- **Membrane-free electrochemical production of acid and base solutions capable of processing ultramafic rocks.** *Nature communications*
  Charnay, B. P., Chen, Y., Misleh, J. W., Wright, J. G., Agarwal, R. G., Sauvé, E. R., Toh, W. L., Surendranath, Y., Kanan, M. W.
  2025; 16 (1): 9759
- **Quantifying the Partitioning of Vehicular and Structural Lithium Transport in Binary Carbonate Electrolytes** *ACS ENERGY LETTERS*
  Charnay, A. P., Charnay, B. P., Pan, J., Zhang, Y., Kanan, M. W., Zheng, W., Fayer, M. D.

2025

- **Enhancing Biopolyester Backbone Rigidity with an Asymmetric Furanic Monomer.** *ACS sustainable chemistry & engineering*
  Woroch, C. P., Addison, B., Stovall, A., Rognerud, E., Lincoln, C., Miscall, J., Rosetto, G., Kanan, M. W., Rorrer, N. A., Beckham, G. T.
  2025; 13 (41): 17625-17634
- **Electrochemical Production of >1 M Acid and Base from Neutral Salt at High Current Density and Low Energy Demand** *ACS ENERGY LETTERS*
  Wright, J., Kanan, M. W.
  2025
- **Intermediate-Temperature Reverse Water-Gas Shift under Process-Relevant Conditions Catalyzed by Dispersed Alkali Carbonates.** *JACS Au*
  Tamakuwala, K. N., Kennedy, R. P., Li, C. S., Mutz, B., Boller, P., Bare, S. R., Kanan, M. W.
  2025; 5 (3): 1083-1089
- **Thermal Ca2+/Mg2+ exchange reactions to synthesize CO2 removal materials.** *Nature*
  Chen, Y., Kanan, M. W.
  2025
- **Toughening Poly(lactic acid) without Compromise - Statistical Copolymerization with a Bioderived Bicyclic Lactone.** *Journal of the American Chemical Society*
  Sanchez, L. A., Woroch, C. P., Dumas, D. M., Waymouth, R. M., Kanan, M. W.
  2025
- **Accurate and Efficient Structure Elucidation from Routine One-Dimensional NMR Spectra Using Multitask Machine Learning.** *ACS central science*
  Hu, F., Chen, M. S., Rotskoff, G. M., Kanan, M. W., Markland, T. E.
  2024; 10 (11): 2162-2170
- **Electrified thermochemical reaction systems with high-frequency metamaterial reactors** *JOULE*
  Lin, C. H., Wan, C., Ru, Z., Cremers, C., Mohapatra, P., Mantle, D. L., Tamakuwala, K., Hofelmann, A. B., Kanan, M. W., Rivas-Davila, J., Fan, J. A.
  2024; 8 (10)
- **Continuum Model for Optimizing CO Reduction Gas Diffusion Electrodes** *ACS SUSTAINABLE CHEMISTRY & ENGINEERING*
  Disselkoen, K. R., Rabinowitz, J. A., Mani, A., Kanan, M. W.
  2024
- **Improving Carbonate-Promoted C-H Carboxylation Using Mesoporous Carbon Supports** *ACS SUSTAINABLE CHEMISTRY & ENGINEERING*
  Chant, E. D., Li, C. S., Kanan, M. W.
  2023; 11 (15): 5876-5882
- **A Semicrystalline Furanic Polyamide Made from Renewable Feedstocks.** *Journal of the American Chemical Society*
  Woroch, C. P., Cox, I. W., Kanan, M. W.
  2022
- **Operando Nanoscale Imaging of Electrochemically Induced Strain in a Locally Polarized Pt Grain.** *Nano letters*
  Sheyfer, D., Mariano, R. G., Kawaguchi, T., Cha, W., Harder, R. J., Kanan, M. W., Hruszkewycz, S. O., You, H., Highland, M. J.
  2022
- **Improving the Energy Efficiency of CO Electrolysis by Controlling Cu Domain Size in Gas Diffusion Electrodes** *ACS ENERGY LETTERS*
  Rabinowitz, J. A., Ripatti, D. S., Mariano, R. G., Kanan, M. W.
  2022: 4098-4105
- **Carbonate-catalyzed reverse water-gas shift to produce gas fermentation feedstocks for renewable liquid fuel synthesis** *CELL REPORTS PHYSICAL SCIENCE*
  Li, C. S., Frankhouser, A. D., Kanan, M. W.
  2022; 3 (9)
- **Hypophosphite addition to alkenes under solvent-free and non-acidic aqueous conditions.** *Chemical communications (Cambridge, England)*
  Huang, Z., Chen, Y., Kanan, M. W.

1800

- **A framework for automated structure elucidation from routine NMR spectra.** *Chemical science*
  Huang, Z., Chen, M. S., Woroch, C. P., Markland, T. E., Kanan, M. W.
  2021; 12 (46): 15329-15338
- **A High-T-g Polyamide Derived from Lignocellulose and CO2** *MACROMOLECULES*
  Woroch, C. P., Lankenau, A. W., Kanan, M. W.
  2021; 54 (21): 9978-9983
- **Microstructural origin of locally enhanced CO2 electroreduction activity on gold.** *Nature materials*
  Mariano, R. G., Kang, M., Wahab, O. J., McPherson, I. J., Rabinowitz, J. A., Unwin, P. R., Kanan, M. W.
  2021
- **Carbonate-promoted C-H carboxylation of electron-rich heteroarenes** *CHEMICAL SCIENCE*
  Porter, T. M., Kanan, M. W.
  2020; 11 (43): 11936–44
- **Carbonate-promoted C-H carboxylation of electron-rich heteroarenes.** *Chemical science*
  Porter, T. M., Kanan, M. W.
  2020; 11 (43): 11936-11944
- **Phase Behavior That Enables Solvent-Free Carbonate-Promoted Furoate Carboxylation.** *The journal of physical chemistry letters*
  Frankhouser, A. D., Kanan, M. W.
  2020: 7544–51
- **Point-of-Care Analysis of Blood Ammonia with a Gas-Phase Sensor.** *ACS sensors*
  Veltman, T. R., Tsai, C. J., Gomez-Ospina, N., Kanan, M. W., Chu, G.
  2020
- **Comparing Scanning Electron Microscope and Transmission Electron Microscope Grain Mapping Techniques Applied to Well-Defined and Highly Irregular Nanoparticles.** *ACS omega*
  Mariano, R. G., Yau, A., McKeown, J. T., Kumar, M., Kanan, M. W.
  2020; 5 (6): 2791–99
- **Polyamide monomers via carbonate-promoted C-H carboxylation of furfurylamine** *CHEMICAL SCIENCE*
  Lankenau, A. W., Kanan, M. W.
  2020; 11 (1): 248–52
- **The future of low-temperature carbon dioxide electrolysis depends on solving one basic problem.** *Nature communications*
  Rabinowitz, J. A., Kanan, M. W.
  2020; 11 (1): 5231
- **Polyamide monomers via carbonate-promoted C-H carboxylation of furfurylamine.** *Chemical science*
  Lankenau, A. W., Kanan, M. W.
  2019; 11 (1): 248-252
- **A closed cycle for esterifying aromatic hydrocarbons with CO2 and alcohol.** *Nature chemistry*
  Xiao, D. J., Chant, E. D., Frankhouser, A. D., Chen, Y., Yau, A., Washton, N. M., Kanan, M. W.
  2019
- **Gaseous carbon waste streams uilization: Status and research needs**
  Tway, C., Allen, D., Barteau, M., Burkart, M., Dunn, J., Gaffney, A., Gupta, R., Hazari, N., Kanan, M., Kenis, P., Klee, H., Sant, G.
  AMER CHEMICAL SOC.2019
- **Carbon Monoxide Gas Diffusion Electrolysis that Produces Concentrated C-2 Products with High Single-Pass Conversion** *JOULE*
  Ripatti, D. S., Veltman, T. R., Kanan, M. W.
  2019; 3 (1): 240–56
- **Carbonate-Promoted Hydrogenation of Carbon Dioxide to Multicarbon Carboxylates.** *ACS central science*
  Banerjee, A., Kanan, M. W.

2018; 4 (5): 606–13

- **Editorial overview: Seeds for a bioenergy future** *CURRENT OPINION IN CHEMICAL BIOLOGY*
  Kanan, M. W.
  2017; 41: A1–A2
- **Editorial overview: Seeds for a bioenergy future.** *Current opinion in chemical biology*
  Kanan, M. W.
  2017; 41: A1-A2
- **Selective increase in CO2 electroreduction activity at grain-boundary surface terminations** *SCIENCE*
  Mariano, R. G., McKelvey, K., White, H. S., Kanan, M. W.
  2017; 358 (6367): 1187–91
- **Imaging the Hydrogen Absorption Dynamics of Individual Grains in Polycrystalline Palladium Thin Films in 3D.** *ACS nano*
  Yau, A., Harder, R. J., Kanan, M. W., Ulvestad, A.
  2017
- **Bragg coherent diffractive imaging of single-grain defect dynamics in polycrystalline films** *SCIENCE*
  Yau, A., Cha, W., Kanan, M. W., Stephenson, G. B., Ulvestad, A.
  2017; 356 (6339): 739-?
- **.** *Chemical science*
  Beh, E. S., Basun, S. A., Feng, X., Idehenre, I. U., Evans, D. R., Kanan, M. W.
  2017; 8 (4): 2790-2794
- **Electrostatic Control of Regioselectivity in Au(I)-Catalyzed Hydroarylation** *JOURNAL OF THE AMERICAN CHEMICAL SOCIETY*
  Lau, V. M., Pfalzgraff, W. C., Markland, T. E., Kanan, M. W.
  2017; 139 (11): 4035-4041
- **Molecular catalysis at polarized interfaces created by ferroelectric BaTiO3** *CHEMICAL SCIENCE*
  Beh, E. S., Basun, S. A., Feng, X., Idehenre, I. U., Evans, D. R., Kanan, M. W.
  2017; 8 (4): 2790-2794
- **A Direct Grain-Boundary-Activity Correlation for CO Electroreduction on Cu Nanoparticles.** *ACS central science*
  Feng, X., Jiang, K., Fan, S., Kanan, M. W.
  2016; 2 (3): 169-174
- **Carbon dioxide utilization via carbonate-promoted C-H carboxylation.** *Nature*
  Banerjee, A., Dick, G. R., Yoshino, T., Kanan, M. W.
  2016; 531 (7593): 215-219
- **Probing the Active Surface Sites for CO Reduction on Oxide-Derived Copper Electrocatalysts** *JOURNAL OF THE AMERICAN CHEMICAL SOCIETY*
  Verdaguer-Casadevall, A., Li, C. W., Johansson, T. P., Scott, S. B., McKeown, J. T., Kumar, M., Stephens, I. E., Kanan, M. W., Chorkendorff, I.
  2015; 137 (31): 9808-9811
- **Correction: Electrostatic control of regioselectivity via ion pairing in a Au(i)-catalyzed rearrangement.** *Chemical science*
  Lau, V. M., Gorin, C. F., Kanan, M. W.
  2015; 6 (5): 3268
- **Pd-catalyzed electrohydrogenation of carbon dioxide to formate: high mass activity at low overpotential and identification of the deactivation pathway.** *Journal of the American Chemical Society*
  Min, X., Kanan, M. W.
  2015; 137 (14): 4701-4708
- **Grain-Boundary-Dependent CO2 Electroreduction Activity.** *Journal of the American Chemical Society*
  Feng, X., Jiang, K., Fan, S., Kanan, M. W.
  2015; 137 (14): 4606-4609
- **Controlling H+ vs CO2 Reduction Selectivity on Pb Electrodes** *ACS CATALYSIS*

Lee, C. H., Kanan, M. W.
2015; 5 (1): 465-469

- **Alkaline O2 reduction on oxide-derived Au: high activity and 4e$^-$ selectivity without (100) facets.** *Physical chemistry chemical physics*
  Min, X., Chen, Y., Kanan, M. W.
  2014; 16 (27): 13601-13604
- **Electroreduction of carbon monoxide to liquid fuel on oxide-derived nanocrystalline copper** *NATURE*
  Li, C. W., Ciston, J., Kanan, M. W.
  2014; 508 (7497): 504-?
- **Alkaline O-2 reduction on oxide-derived Au: high activity and 4e(-) selectivity without (100) facets** *PHYSICAL CHEMISTRY CHEMICAL PHYSICS*
  Min, X., Chen, Y., Kanan, M. W.
  2014; 16 (27): 13601-13604
- **Electrostatic control of regioselectivity via ion pairing in a Au(I)-catalyzed rearrangement** *CHEMICAL SCIENCE*
  Lau, V. M., Gorin, C. F., Kanan, M. W.
  2014; 5 (12): 4975-4979
- **Interfacial electric field effects on a carbene reaction catalyzed by rh porphyrins.** *Journal of the American Chemical Society*
  Gorin, C. F., Beh, E. S., Bui, Q. M., Dick, G. R., Kanan, M. W.
  2013; 135 (30): 11257-11265
- **Aqueous CO2 Reduction at Very Low Overpotential on Oxide-Derived Au Nanoparticles** *JOURNAL OF THE AMERICAN CHEMICAL SOCIETY*
  Chen, Y., Li, C. W., Kanan, M. W.
  2012; 134 (49): 19969-19972
- **CO2 Reduction at Low Overpotential on Cu Electrodes Resulting from the Reduction of Thick Cu2O Films** *JOURNAL OF THE AMERICAN CHEMICAL SOCIETY*
  Li, C. W., Kanan, M. W.
  2012; 134 (17): 7231-7234
- **Tin Oxide Dependence of the CO2 Reduction Efficiency on Tin Electrodes and Enhanced Activity for Tin/Tin Oxide Thin-Film Catalysts** *JOURNAL OF THE AMERICAN CHEMICAL SOCIETY*
  Chen, Y., Kanan, M. W.
  2012; 134 (4): 1986-1989
- **An Electric Field-Induced Change in the Selectivity of a Metal Oxide-Catalyzed Epoxide Rearrangement** *JOURNAL OF THE AMERICAN CHEMICAL SOCIETY*
  Gorin, C. F., Beh, E. S., Kanan, M. W.
  2012; 134 (1): 186-189

PRESENTATIONS

- News article: Stanford scientists make renewable plastic from carbon dioxide and plants - Bio-based News (March 15, 2016)
- News article: Scientists discover a novel way to make ethanol without corn or other plants - Phys.org (April 9, 2014)
- News article: Scientists discover low-cost way to trap carbon using common rocks