

Stanford



Thomas Jaramillo

Associate Professor of Chemical Engineering and of Photon Science

 Curriculum Vitae available Online

CONTACT INFORMATION

• Alternate Contact

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Bio

BIO

Recent years have seen unprecedented motivation for the emergence of new energy technologies. Global dependence on fossil fuels, however, will persist until alternate technologies can compete economically. We must develop means to produce energy (or energy carriers) from renewable sources and then convert them to work as efficiently and cleanly as possible. Catalysis is energy conversion, and the Jaramillo laboratory focuses on fundamental catalytic processes occurring on solid-state surfaces in both the production and consumption of energy. Chemical-to-electrical and electrical-to-chemical energy conversion are at the core of the research. Nanoparticles, metals, alloys, sulfides, nitrides, carbides, phosphides, oxides, and biomimetic organo-metallic complexes comprise the toolkit of materials that can help change the energy landscape. Tailoring catalyst surfaces to fit the chemistry is our primary challenge.

ACADEMIC APPOINTMENTS

- Associate Professor, Chemical Engineering
- Associate Professor, Photon Science Directorate
- Affiliate, Precourt Institute for Energy

ADMINISTRATIVE APPOINTMENTS

- Deputy Director, SUNCAT Center for Interface Science and Catalysis, (2014- present)

PROFESSIONAL EDUCATION

- PhD, University of California, Santa Barbara (2004)
- MS, University of California, Santa Barbara , Chemical Engineering (2000)
- BS, Stanford , Chemical Engineering (1998)

LINKS

- <http://jaramillogroup.stanford.edu>: <http://jaramillogroup.stanford.edu>

Teaching

COURSES

2016-17

- Chemical Process Modeling, Dynamics, and Control: CHEMENG 100 (Aut)
- Electrochemical Energy Conversion: CHEMENG 432 (Spr)
- Energy: Chemical Transformations for Production, Storage, and Use: CHEMENG 25E, ENGR 25E (Win)
- Special Topics in Energy and Catalysis: CHEMENG 516 (Aut, Win, Spr, Sum)

2015-16

- Energy: Chemical Transformations for Production, Storage, and Use: CHEMENG 25E, ENGR 25E (Win)
- Fundamentals and Applications of Spectroscopy: CHEMENG 345, PHOTON 345 (Aut)
- Special Topics in Energy and Catalysis: CHEMENG 516 (Aut, Win, Spr, Sum)

2014-15

- Electrochemical Energy Conversion: CHEMENG 432 (Win)
- Energy: Chemical Transformations for Production, Storage, and Use: CHEMENG 25E, ENGR 25E (Win)
- Separation Processes: CHEMENG 130 (Spr)
- Special Topics in Energy and Catalysis: CHEMENG 516 (Aut, Win, Spr, Sum)

2013-14

- Energy: Chemical Transformations for Production, Storage, and Use: CHEMENG 25E, ENGR 25E (Win)
- Separation Processes: CHEMENG 130 (Spr)
- Special Topics in Energy and Catalysis: CHEMENG 516 (Aut, Win, Spr, Sum)

STANFORD ADVISEES

Doctoral (Program)

Brandon Loong

Postdoctoral Faculty Sponsor

Antaeres Dawn Antoniuk-Pablant, Drew Higgins, Amber Janda, Lauren King, Joshua McEnaney, Carlos Gilberto Morales Guio, Adam Nielander, Marat Orazov, Lei Wang, Andrew Wong

Doctoral Dissertation Reader (AC)

Joseph Singh, Charlie Tsai

Doctoral Dissertation Advisor (AC)

Zhihua Chen, Alan Landers, Brandon Loong

Publications

PUBLICATIONS

- **Solar water splitting by photovoltaic-electrolysis with a solar-to-hydrogen efficiency over 30.** *Nature communications*
Jia, J., Seitz, L. C., Benck, J. D., Huo, Y., Chen, Y., Ng, J. W., Bilir, T., Harris, J. S., Jaramillo, T. F.
2016; 7: 13237-?
- **A highly active and stable IrOx/SrIrO3 catalyst for the oxygen evolution reaction** *SCIENCE*
Seitz, L. C., Dickens, C. F., Nishio, K., Hikita, Y., Montoya, J., Doyle, A., Kirk, C., Vojvodic, A., Hwang, H. Y., Norskov, J. K., Jaramillo, T. F.

2016; 353 (6303): 1011-1014

- **Elucidating the electronic structure of supported gold nanoparticles and its relevance to catalysis by means of hard X-ray photoelectron spectroscopy** *SURFACE SCIENCE*
Reinecke, B. N., Kuhl, K. P., Ogasawara, H., Li, L., Voss, J., Abild-Pedersen, F., Nilsson, A., Jaramillo, T. F.
2016; 650: 24-33
- **Molybdenum Disulfide as a Protection Layer and Catalyst for Gallium Indium Phosphide Solar Water Splitting Photocathodes** *JOURNAL OF PHYSICAL CHEMISTRY LETTERS*
Britto, R. J., Benck, J. D., Young, J. L., Hahn, C., Deutsch, T. G., Jaramillo, T. F.
2016; 7 (11): 2044-2049
- **Improving the Photoelectrochemical Performance of Hematite by Employing a High Surface Area Scaffold and Engineering Solid-Solid Interfaces** *ADVANCED MATERIALS INTERFACES*
Chakthranont, P., Pinaud, B. A., Seitz, L. C., Forman, A. J., Jaramillo, T. F.
2016; 3 (7)
- **Band Edge Engineering of Oxide Photoanodes for Photoelectrochemical Water Splitting: Integration of Subsurface Dipoles with Atomic-Scale Control** *ADVANCED ENERGY MATERIALS*
Hikita, Y., Nishio, K., Seitz, L. C., Chakthranont, P., Tachikawa, T., Jaramillo, T. F., Hwang, H. Y.
2016; 6 (7)
- **Tuning Composition and Activity of Cobalt Titanium Oxide Catalysts for the Oxygen Evolution Reaction** *ELECTROCHIMICA ACTA*
Seitz, L. C., Nordlund, D., Gallo, A., Jaramillo, T. F.
2016; 193: 240-245
- **Engineering Cobalt Phosphide (CoP) Thin Film Catalysts for Enhanced Hydrogen Evolution Activity on Silicon Photocathodes** *ADVANCED ENERGY MATERIALS*
Hellstern, T. R., Benck, J. D., Kibsgaard, J., Hahn, C., Jaramillo, T. F.
2016; 6 (4)
- **Chemical and Phase Evolution of Amorphous Molybdenum Sulfide Catalysts for Electrochemical Hydrogen Production.** *ACS nano*
Lee, S. C., Benck, J. D., Tsai, C., Park, J., Koh, A. L., Abild-Pedersen, F., Jaramillo, T. F., Sinclair, R.
2016; 10 (1): 624-632
- **Benchmarking nanoparticulate metal oxide electrocatalysts for the alkaline water oxidation reaction** *JOURNAL OF MATERIALS CHEMISTRY A*
Jung, S., McCrory, C. C., Ferrer, I. M., Peters, J. C., Jaramillo, T. F.
2016; 4 (8): 3068-3076
- **Electrooxidation of Alcohols with Electrode-Supported Transfer Hydrogenation Catalysts** *ACS CATALYSIS*
Buonaiuto, M., De Crisci, A. G., Jaramillo, T. F., Waymouth, R. M.
2015; 5 (12): 7343-7349
- **Enhancement Effect of Noble Metals on Manganese Oxide for the Oxygen Evolution Reaction** *JOURNAL OF PHYSICAL CHEMISTRY LETTERS*
Seitz, L. C., Hersbach, T. J., Nordlund, D., Jaramillo, T. F.
2015; 6 (20): 4178-4183
- **Mapping Photoelectrochemical Current Distribution at Nanoscale Dimensions on Morphologically Controlled BiVO₄** *JOURNAL OF PHYSICAL CHEMISTRY LETTERS*
Chakthranont, P., Seitz, L. C., Jaramillo, T. F.
2015; 6 (18): 3702-3707
- **Platinum and hybrid polyaniline-platinum surfaces for the electrocatalytic reduction of CO₂** *MRS COMMUNICATIONS*
Abram, D. N., Kuhl, K. P., Cave, E. R., Jaramillo, T. F.
2015; 5 (2): 319-325
- **Benchmarking Hydrogen Evolving Reaction and Oxygen Evolving Reaction Electrocatalysts for Solar Water Splitting Devices** *JOURNAL OF THE AMERICAN CHEMICAL SOCIETY*
McCrory, C. C., Jung, S., Ferrer, I. M., Chatman, S. M., Peters, J. C., Jaramillo, T. F.
2015; 137 (13): 4347-4357

- **Simultaneous detection of electronic structure changes from two elements of a bifunctional catalyst using wavelength-dispersive X-ray emission spectroscopy and in situ electrochemistry** *PHYSICAL CHEMISTRY CHEMICAL PHYSICS*
Gul, S., Ng, J. W., Alonso-Mori, R., Kern, J., Sokaras, D., Anzenberg, E., Lassalle-Kaiser, B., Gorlin, Y., Weng, T., Zwart, P. H., Zhang, J. Z., Bergmann, U., Yachandra, et al
2015; 17 (14): 8901-8912
- **Designing an improved transition metal phosphide catalyst for hydrogen evolution using experimental and theoretical trends** *ENERGY & ENVIRONMENTAL SCIENCE*
Kibsgaard, J., Tsai, C., Chan, K., Benck, J. D., Norskov, J. K., Abild-Pedersen, F., Jaramillo, T. F.
2015; 8 (10): 3022-3029
- **CoTiOx Catalysts for the Oxygen Evolution Reaction** *JOURNAL OF THE ELECTROCHEMICAL SOCIETY*
Seitz, L. C., Pinaud, B. A., Nordlund, D., GORLIN, Y., Gallo, A., Jaramillo, T. F.
2015; 162 (12): H841-H846
- **Synthesis of thin film AuPd alloys and their investigation for electrocatalytic CO₂ reduction** *JOURNAL OF MATERIALS CHEMISTRY A*
Hahn, C., Abram, D. N., Hansen, H. A., Hatsukade, T., Jackson, A., Johnson, N. C., Hellstern, T. R., Kuhl, K. P., Cave, E. R., Feaster, J. T., Jaramillo, T. F.
2015; 3 (40): 20185-20194
- **Applications of ALD MnO to electrochemical water splitting** *PHYSICAL CHEMISTRY CHEMICAL PHYSICS*
Pickrahn, K. L., Gorlin, Y., Seitz, L. C., Garg, A., Nordlund, D., Jaramillo, T. F., Bent, S. F.
2015; 17 (21): 14003-14011
- **Designing Active and Stable Silicon Photocathodes for Solar Hydrogen Production Using Molybdenum Sulfide Nanomaterials** *ADVANCED ENERGY MATERIALS*
Benck, J. D., Lee, S. C., Fong, K. D., Kibsgaard, J., Sinclair, R., Jaramillo, T. F.
2014; 4 (18)
- **Molybdenum Phosphosulfide: An Active, Acid-Stable, Earth-Abundant Catalyst for the Hydrogen Evolution Reaction** *ANGEWANDTE CHEMIE-INTERNATIONAL EDITION*
Kibsgaard, J., Jaramillo, T. F.
2014; 53 (52): 14433-14437
- **Operando Characterization of an Amorphous Molybdenum Sulfide Nanoparticle Catalyst during the Hydrogen Evolution Reaction** *JOURNAL OF PHYSICAL CHEMISTRY C*
Casalongue, H. G., Benck, J. D., Tsai, C., Karlsson, R. K., Kaya, S., Ng, M. L., Pettersson, L. G., Abild-Pedersen, F., Norskov, J. K., Ogasawara, H., Jaramillo, T. F., Nilsson, A.
2014; 118 (50): 29252-29259
- **Catalyzing the Hydrogen Evolution Reaction (HER) with Molybdenum Sulfide Nanomaterials** *ACS CATALYSIS*
Benck, J. D., Hellstern, T. R., Kibsgaard, J., Chakhranont, P., Jaramillo, T. F.
2014; 4 (11): 3957-3971
- **Substrate Selection for Fundamental Studies of Electrocatalysts and Photoelectrodes: Inert Potential Windows in Acidic, Neutral, and Basic Electrolyte** *PLOS ONE*
Benck, J. D., Pinaud, B. A., Gorlin, Y., Jaramillo, T. F.
2014; 9 (10)
- **Optoelectronic properties of Ta₃N₅: A joint theoretical and experimental study** *PHYSICAL REVIEW B*
Morbec, J. M., Narkeviciute, I., Jaramillo, T. F., Galli, G.
2014; 90 (15)
- **Electrocatalytic Conversion of Carbon Dioxide to Methane and Methanol on Transition Metal Surfaces** *JOURNAL OF THE AMERICAN CHEMICAL SOCIETY*
Kuhl, K. P., Hatsukade, T., Cave, E. R., Abram, D. N., Kibsgaard, J., Jaramillo, T. F.
2014; 136 (40): 14107-14113
- **Electrocatalytic conversion of carbon dioxide to methane and methanol on transition metal surfaces.** *Journal of the American Chemical Society*
Kuhl, K. P., Hatsukade, T., Cave, E. R., Abram, D. N., Kibsgaard, J., Jaramillo, T. F.
2014; 136 (40): 14107-14113

- **Nickel-silver alloy electrocatalysts for hydrogen evolution and oxidation in an alkaline electrolyte.** *Physical chemistry chemical physics*
Tang, M. H., Hahn, C., Klobuchar, A. J., Ng, J. W., Wellendorff, J., Bligaard, T., Jaramillo, T. F.
2014; 16 (36): 19250-19257
- **Insights into the electrocatalytic reduction of CO₂ on metallic silver surfaces.** *Physical chemistry chemical physics*
Hatsukade, T., Kuhl, K. P., Cave, E. R., Abram, D. N., Jaramillo, T. F.
2014; 16 (27): 13814-13819
- **A carbon-free, precious-metal-free, high-performance O₂ electrode for regenerative fuel cells and metal-air batteries** *ENERGY & ENVIRONMENTAL SCIENCE*
Ng, J. W., Tang, M., Jaramillo, T. F.
2014; 7 (6): 2017-2024
- **Modeling practical performance limits of photoelectrochemical water splitting based on the current state of materials research.** *ChemSusChem*
Seitz, L. C., Chen, Z., Forman, A. J., Pinaud, B. A., Benck, J. D., Jaramillo, T. F.
2014; 7 (5): 1372-1385
- **Understanding Interactions between Manganese Oxide and Gold That Lead to Enhanced Activity for Electrocatalytic Water Oxidation.** *Journal of the American Chemical Society*
Gorlin, Y., Chung, C., Benck, J. D., Nordlund, D., Seitz, L., Weng, T., Sokaras, D., Clemens, B. M., Jaramillo, T. F.
2014; 136 (13): 4920-4926
- **Building an appropriate active-site motif into a hydrogen-evolution catalyst with thiomolybdate [Mo₃S₁₃](2-) clusters.** *Nature chemistry*
Kibsgaard, J., Jaramillo, T. F., Besenbacher, F.
2014; 6 (3): 248-253
- **Nearly Total Solar Absorption in Ultrathin Nanostructured Iron Oxide for Efficient Photoelectrochemical Water Splitting** *ACS PHOTONICS*
Wang, K. X., Wu, Z., Liu, V., Brongersma, M. L., Jaramillo, T. F., Fan, S.
2014; 1 (3): 235-240
- **Controlling the Structural and Optical Properties of Ta₃N₅ Films through Nitridation Temperature and the Nature of the Ta Metal** *CHEMISTRY OF MATERIALS*
Pinaud, B. A., Vailionis, A., Jaramillo, T. F.
2014; 26 (4): 1576-1582
- **High Surface Area Transparent Conducting Oxide Electrodes with a Customizable Device Architecture** *CHEMISTRY OF MATERIALS*
Forman, A. J., Chen, Z., Chakhranont, P., Jaramillo, T. F.
2014; 26 (2): 958-964
- **Climbing the Activity Volcano: Core-Shell Ru@Pt Electrocatalysts for Oxygen Reduction** *CHEMELECTROCHEM*
Jackson, A., Viswanathan, V., Forman, A. J., Larsen, A. H., Norskov, J. K., Jaramillo, T. F.
2014; 1 (1): 67-71
- **Insights into the electrocatalytic reduction of CO₂ on metallic silver surfaces** *PHYSICAL CHEMISTRY CHEMICAL PHYSICS*
Hatsukade, T., Kuhl, K. P., Cave, E. R., Abram, D. N., Jaramillo, T. F.
2014; 16 (27): 13814-13819
- **Nanostructured Manganese Oxide Supported onto Particulate Glassy Carbon as an Active and Stable Oxygen Reduction Catalyst in Alkaline-Based Fuel Cells** *JOURNAL OF THE ELECTROCHEMICAL SOCIETY*
Ng, J. W., Gorlin, Y., Nordlund, D., Jaramillo, T. F.
2014; 161 (7): D3105-D3112
- **An X-ray Photoelectron Spectroscopy Study of Surface Changes on Brominated and Sulfur-Treated Activated Carbon Sorbents during Mercury Capture: Performance of Pellet versus Fiber Sorbents** *ENVIRONMENTAL SCIENCE & TECHNOLOGY*
Saha, A., Abram, D. N., Kuhl, K. P., Paradis, J., Crawford, J. L., Sasmaz, E., Chang, R., Jaramillo, T. F., Wilcox, J.
2013; 47 (23): 13695-13701
- **A Precious-Metal-Free Regenerative Fuel Cell for Storing Renewable Electricity** *ADVANCED ENERGY MATERIALS*
Ng, J. W., Gorlin, Y., Hatsukade, T., Jaramillo, T. F.
2013; 3 (12): 1545-1550

- **Benchmarking Heterogeneous Electrocatalysts for the Oxygen Evolution Reaction** *JOURNAL OF THE AMERICAN CHEMICAL SOCIETY*
McCrory, C. C., Jung, S., Peters, J. C., Jaramillo, T. F.
2013; 135 (45): 16977-16987
- **Impedance-based study of capacitive porous carbon electrodes with hierarchical and bimodal porosity** *JOURNAL OF POWER SOURCES*
Suss, M. E., Baumann, T. F., Worsley, M. A., Rose, K. A., Jaramillo, T. F., Stadermann, M., Santiago, J. G.
2013; 241: 266-273
- **Technical and economic feasibility of centralized facilities for solar hydrogen production via photocatalysis and photoelectrochemistry** *ENERGY & ENVIRONMENTAL SCIENCE*
Pinaud, B. A., Benck, J. D., Seitz, L. C., Forman, A. J., Chen, Z., Deutsch, T. G., James, B. D., Baum, K. N., Baum, G. N., Ardo, S., Wang, H., Miller, E., Jaramillo, et al
2013; 6 (7): 1983-2002
- **In Situ X-ray Absorption Spectroscopy Investigation of a Bifunctional Manganese Oxide Catalyst with High Activity for Electrochemical Water Oxidation and Oxygen Reduction.** *Journal of the American Chemical Society*
Gorlin, Y., Lassalle-Kaiser, B., Benck, J. D., Gul, S., Webb, S. M., Yachandra, V. K., Yano, J., Jaramillo, T. F.
2013; 135 (23): 8525-8534
- **Bridging the Gap Between Bulk and Nanostructured Photoelectrodes: The Impact of Surface States on the Electrocatalytic and Photoelectrochemical Properties of MoS₂** *JOURNAL OF PHYSICAL CHEMISTRY C*
Chen, Z., Forman, A. J., Jaramillo, T. F.
2013; 117 (19): 9713-9722
- **Growth of Pt Nanowires by Atomic Layer Deposition on Highly Ordered Pyrolytic Graphite** *NANO LETTERS*
Lee, H., Baeck, S. H., Jaramillo, T. F., Bent, S. F.
2013; 13 (2): 457-463
- **Catalyzing chemical transformations in renewable energy: Tailoring Electrocatalyst Materials for Activity, Selectivity, and Stability**
Jaramillo, T., F.
2013
- **Effect of Temperature Treatment on CoTiO_x Catalyst for the Oxygen Evolution Reaction** *2nd International Symposium on Electrochemical Synthesis of Fuels (ESF)*
Seitz, L. C., Pinaud, B. A., Nordlund, D., Jaramillo, T. F.
ELECTROCHEMICAL SOC INC.2013: 285-91
- **Solar hydrogen production by photoelectrochemical (PEC) water-splitting: Advancing technology through the synergistic activities of the PEC working group (PEC WG)**
Jaramillo, T., F.
2013
- **Exploring Nano-architectures of MoS₂: How Surface Structure and Electronic Structure Impact H₂ Production by Electrocatalysis and Solar Photoelectrochemistry**
Jaramillo, T., F.
2013
- **Catalyzing Electrochemical Transformations in Renewable Energy**
Jaramillo, T., F.
2013
- **The Impact of Surface Structure on the Electrocatalytic and Photoelectrochemical (PEC) Properties of MoS₂**
Jaramillo, T., F.
2013
- **Electrocatalytic Conversion of Carbon Dioxide to Fuels and Chemicals on Transition Metal Electrodes**
Jaramillo, T., F., Kuhl, K., P., Cave, E., R., Abram, D., N., Hatsukade, T.
2013
- **Catalyzing key chemical transformations for renewable, sustainable energy**
Jaramillo, T., F.

2013

- **Mn₃O₄ Supported on Glassy Carbon: An Active Non-Precious Metal Catalyst for the Oxygen Reduction Reaction** *ACS CATALYSIS*
Gorlin, Y., Chung, C., Nordlund, D., Clemens, B. M., Jaramillo, T. F.
2012; 2 (12): 2687-2694
- **Engineering the surface structure of MoS₂ to preferentially expose active edge sites for electrocatalysis** *NATURE MATERIALS*
Kibsgaard, J., Chen, Z., Reinecke, B. N., Jaramillo, T. F.
2012; 11 (11): 963-969
- **New cubic perovskites for one- and two-photon water splitting using the computational materials repository** *ENERGY & ENVIRONMENTAL SCIENCE*
Castelli, I. E., Landis, D. D., Thygesen, K. S., Dahl, S., Chorkendorff, I., Jaramillo, T. F., Jacobsen, K. W.
2012; 5 (10): 9034-9043
- **Active MnO_x Electrocatalysts Prepared by Atomic Layer Deposition for Oxygen Evolution and Oxygen Reduction Reactions** *ADVANCED ENERGY MATERIALS*
Pickrahn, K. L., Park, S. W., Gorlin, Y., Lee, H., Jaramillo, T. F., Bent, S. F.
2012; 2 (10): 1269-1277
- **Mercury chemistry on brominated activated carbon** *FUEL*
Sasmaz, E., Kirchofer, A., Jew, A. D., Saha, A., Abram, D., Jaramillo, T. F., Wilcox, J.
2012; 99: 188-196
- **Amorphous Molybdenum Sulfide Catalysts for Electrochemical Hydrogen Production: Insights into the Origin of their Catalytic Activity** *ACS CATALYSIS*
Benck, J. D., Chen, Z., Kuritzky, L. Y., Forman, A. J., Jaramillo, T. F.
2012; 2 (9): 1916-1923
- **Effect of Film Morphology and Thickness on Charge Transport in Ta₃N₅/Ta Photoanodes for Solar Water Splitting** *JOURNAL OF PHYSICAL CHEMISTRY C*
Pinaud, B. A., Vesborg, P. C., Jaramillo, T. F.
2012; 116 (30): 15918-15924
- **Meso-Structured Platinum Thin Films: Active and Stable Electrocatalysts for the Oxygen Reduction Reaction** *JOURNAL OF THE AMERICAN CHEMICAL SOCIETY*
Kibsgaard, J., Gorlin, Y., Chen, Z., Jaramillo, T. F.
2012; 134 (18): 7758-7765
- **New insights into the electrochemical reduction of carbon dioxide on metallic copper surfaces** *ENERGY & ENVIRONMENTAL SCIENCE*
Kuhl, K. P., Cave, E. R., Abram, D. N., Jaramillo, T. F.
2012; 5 (5): 7050-7059
- **Simulating Linear Sweep Voltammetry from First-Principles: Application to Electrochemical Oxidation of Water on Pt(111) and Pt₃Ni(111)** *JOURNAL OF PHYSICAL CHEMISTRY C*
Viswanathan, V., Hansen, H. A., Rossmeisl, J., Jaramillo, T. F., Pitsch, H., Norskov, J. K.
2012; 116 (7): 4698-4704
- **Investigation of Surface Oxidation Processes on Manganese Oxide Electrocatalysts Using Electrochemical Methods and Ex Situ X-ray Photoelectron Spectroscopy** *JOURNAL OF THE ELECTROCHEMICAL SOCIETY*
Gorlin, Y., Jaramillo, T. F.
2012; 159 (10): H782-H786
- **Tailoring electrocatalyst materials to enhance activity, stability, and selectivity for key energy conversion reactions**
Jaramillo, T., F.
2012
- **Electrocatalysis 101**
Jaramillo, T., F.
2012
- **Developing Electrocatalysts for the Synthesis of Renewable Fuels**
Jaramillo, T., F.

2012

- **Catalyzing chemical transformations in renewable energy: Tailoring electrocatalyst materials for activity, selectivity, and stability**
Jaramillo, T., F.
2012
- **The electrocatalytic conversion of CO₂ to fuels and chemicals**
Jaramillo, T., F., Kuhl, Kendra, P., Cave, Etosha, R., Abram, David, N.
2012
- **Tailoring electrocatalyst materials to enhance activity, stability, and selectivity for key energy conversion reactions**
Jaramillo, T., F.
2012
- **Tailoring electrocatalyst materials to enhance activity, stability, and selectivity for key energy conversion reactions**
Jaramillo, T., F.
2012
- **Engineering the Surface Structure of MoS₂ Through Morphological Control At the Nano-Scale for Enhanced Electrocatalytic Hydrogen Production**
Jaramillo, T., F., Chen, Z., Kibsgaard, J., Reinecke, B., N.
2012
- **Bridging the gap between optical absorption and charge transport in metal oxide materials for the synthesis of solar fuels**
Jaramillo, T., F., Forman, A., J., Chen, Z., Thomann, I., Pinaud, B., A., Cho, I., S.
2012
- **Tailoring Electrocatalyst Materials at the Nano-Scale: Controlling Activity, Selectivity, and Stability for Energy Conversion Reactions**
Jaramillo, T., F.
2012
- **Tailoring Electrocatalyst Materials at the Nano-Scale: Controlling Activity, Selectivity, and Stability for Energy Conversion Reactions**
Jaramillo, T., F.
2012
- **Solar Fuels by Photocatalysis and Photoelectrochemistry**
Jaramillo, T., F.
2012
- **Insights into the electrochemical conversion of CO₂ to fuels and chemicals on transition metal surfaces**
Jaramillo, T., F., Kuhl, K., P., Cave, E., R., Abram, D., N., Hatsukade, T.
2012
- **Directed Nano-scale and Macro-scale Architectures for Semiconductor Absorbers and Transparent Conducting Substrates for Photoelectrochemical Water Splitting**
Jaramillo, T., F., Forman, A., Chen, Z., Pinaud, B., A., Seitz, L., Jackson, A.
2012
- **Addressing charge transport limitations in thin film Ta₃N₅ & TaON photoanodes for solar fuel synthesis**
Jaramillo, T., F., Pinaud, B., A.
2012
- **Energy Storage by Means of Renewable Fuels**
Jaramillo, T., F.
2012
- **Electrocatalyst development for renewable energy: Engineering surface structure at the atomic-scale by controlling morphology at the nano-scale**
Jaramillo, T., F.
2012
- **Tailoring Electrocatalyst Materials at the Nano-Scale: Controlling Activity, Selectivity, and Stability for Energy Conversion Reactions**
Jaramillo, T., F.

2012

● **Electrocatalyst development for the synthesis of renewable fuels from water and CO₂**

Jaramillo, T., F.

2012

● **A tutorial on electrocatalysis: Concepts, fundamentals, methods, and applications**

Jaramillo, T., F.

2012

● **Identifying active surface phases for metal oxide electrocatalysts: a study of manganese oxide bi-functional catalysts for oxygen reduction and water oxidation catalysis** *PHYSICAL CHEMISTRY CHEMICAL PHYSICS*

Su, H., Gorlin, Y., Man, I. C., Calle-Vallejo, F., Norskov, J. K., Jaramillo, T. F., Rossmeisl, J.

2012; 14 (40): 14010-14022

● **Addressing the terawatt challenge: scalability in the supply of chemical elements for renewable energy** *RSC ADVANCES*

Vesborg, P. C., Jaramillo, T. F.

2012; 2 (21): 7933-7947

● **Branched TiO₂ Nanorods for Photoelectrochemical Hydrogen Production** *NANO LETTERS*

Cho, I. S., Chen, Z., Forman, A. J., Kim, D. R., Rao, P. M., Jaramillo, T. F., Zheng, X.

2011; 11 (11): 4978-4984

● **Core-shell MoO₃-MoS₂ Nanowires for Hydrogen Evolution: A Functional Design for Electrocatalytic Materials** *NANO LETTERS*

Chen, Z., Cummins, D., Reinecke, B. N., Clark, E., Sunkara, M. K., Jaramillo, T. F.

2011; 11 (10): 4168-4175

● **Plasmon Enhanced Solar-to-Fuel Energy Conversion** *NANO LETTERS*

Thomann, I., Pinaud, B. A., Chen, Z., Clemens, B. M., Jaramillo, T. F., Brongersma, M. L.

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