



## Matteo Cargnello

Assistant Professor of Chemical Engineering and, by courtesy, of Materials Science and Engineering

 Curriculum Vitae available Online

### CONTACT INFORMATION

- **Administrative Contact**

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### Bio

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#### BIO

Matteo Cargnello is Assistant Professor of Chemical Engineering and Terman Faculty Fellow. His group research interests are in the preparation and use of uniform and tailored materials for heterogeneous catalysis and photocatalysis and the technological exploitation of nanoparticles and nanocrystals. Reactions of interest are related to sustainable energy generation and use, control of emissions of greenhouse gases, and better utilization of abundant building blocks (methane, biomass). Dr. Cargnello received his Ph.D. in Nanotechnology in 2012 at the University of Trieste (Italy) and he was then a post-doctoral scholar in the Chemistry Department at the University of Pennsylvania (Philadelphia) before joining the Faculty at Stanford.

#### ACADEMIC APPOINTMENTS

- Assistant Professor, Chemical Engineering
- Assistant Professor (By courtesy), Materials Science and Engineering

#### HONORS AND AWARDS

- Early Career Award in Catalysis, ACS Catalysis Division (2022)
- Leonardo Award in Engineering/Math, Leonardo Da Vinci Society (2021)
- Catalysis Science Award for Creative Work, Mitsui Chemicals (2020)
- Mid-Career Nanotechnology Scientific Award, ANNIC (2019)
- Sloan Research Fellowship, Alfred P. Sloan Foundation (2018)
- Outstanding Poster Award, Catalysis Gordon Research Conference (2018)
- Hellman Fellow, Hellman Fellows Fund (2018)
- Junior award, European Rare Earth and Actinide Society (ERES) (2018)
- Young Scientist Prize, 16th International Congress on Catalysis, Beijing (China) (2016)
- Terman Faculty Fellow, Stanford University (2015)
- Best European PhD Thesis in Catalysis, European Federation of Catalysis Societies (EFCATS) (2013)
- ENI Award "Debut in Research", ENI (2013)
- Levi Award, Italian Chemical Society (SCI) (2012)

- Inorganic Chemistry Division Award, Italian Chemical Society (SCI) (2012)

## PROFESSIONAL EDUCATION

- PhD, University of Trieste , Nanotechnology (2012)

## LINKS

- Cargnello Group Website: <http://cargnellogroup.stanford.edu/>

## Teaching

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### COURSES

#### 2021-22

- Microkinetics - Molecular Principles of Chemical Kinetics: CHEMENG 130A (Spr)
- Principles and practice of heterogeneous catalysis: CHEMENG 443 (Win)
- Special Topics in Nanostructured Materials for Energy and the Environment: CHEMENG 521 (Aut, Win, Spr, Sum)

#### 2020-21

- Graduate Practical Training: CHEMENG 299 (Sum)
- Microkinetics - Molecular Principles of Chemical Kinetics: CHEMENG 130A (Spr)
- Principles and practice of heterogeneous catalysis: CHEMENG 443 (Win)
- Special Topics in Nanostructured Materials for Energy and the Environment: CHEMENG 521 (Aut, Win, Spr, Sum)

#### 2019-20

- Graduate Practical Training: CHEMENG 299 (Sum)
- Microkinetics - Molecular Principles of Chemical Kinetics: CHEMENG 130A (Spr)
- Special Topics in Nanostructured Materials for Energy and the Environment: CHEMENG 521 (Aut, Win, Spr, Sum)
- When Chemistry Meets Engineering: CHEMENG 31N (Aut)

#### 2018-19

- Fundamentals and Applications of Spectroscopy: CHEMENG 345, PHOTON 345 (Win)
- Separation Processes: CHEMENG 130 (Spr)
- Special Topics in Nanostructured Materials for Energy and the Environment: CHEMENG 521 (Aut, Win, Spr, Sum)
- When Chemistry Meets Engineering: CHEMENG 31N (Aut)

## STANFORD ADVISEES

### Doctoral Dissertation Reader (AC)

Sarah Blair, Sindhu Nathan, Lingze Wei

### Postdoctoral Faculty Sponsor

Steven Chavez, Evan Gardner, Marco Gigantino, Eric McShane, Mickey Stone, Zhenwei Wu

### Doctoral Dissertation Advisor (AC)

Pin-Hung Chung, Jinwon Oh, Makenna Pennel, Chengshuang Zhou

### Doctoral Dissertation Co-Advisor (AC)

Alan Dai, Genni Liccardo, Shradha Sapru, Julian Vigil

### Postdoctoral Research Mentor

Steven Chavez, Evan Gardner, Marco Gigantino, Eric McShane, Mickey Stone

## Publications

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### PUBLICATIONS

- **Steering CO<sub>2</sub> hydrogenation toward C-C coupling to hydrocarbons using porous organic polymer/metal interfaces.** *Proceedings of the National Academy of Sciences of the United States of America*  
Zhou, C., Asundi, A. S., Goodman, E. D., Hong, J., Werghi, B., Hoffman, A. S., Nathan, S. S., Bent, S. F., Bare, S. R., Cargnello, M.  
2022; 119 (7)
- **Colloidal Platinum-Copper Nanocrystal Alloy Catalysts Surpass Platinum in Low-Temperature Propene Combustion.** *Journal of the American Chemical Society*  
Tahsini, N., Yang, A. C., Streibel, V., Werghi, B., Goodman, E. D., Aitbekova, A., Bare, S. R., Li, Y., Abild-Pedersen, F., Cargnello, M.  
2022
- **Voltage cycling process for the electroconversion of biomass-derived polyols.** *Proceedings of the National Academy of Sciences of the United States of America*  
Kim, D., Zhou, C., Zhang, M., Cargnello, M.  
2021; 118 (41)
- **Monolayer Support Control and Precise Colloidal Nanocrystals Demonstrate Metal-Support Interactions in Heterogeneous Catalysts.** *Advanced materials (Deerfield Beach, Fla.)*  
Goodman, E. D., Asundi, A. S., Hoffman, A. S., Bustillo, K. C., Stebbins, J. F., Bare, S. R., Bent, S. F., Cargnello, M.  
2021: e2104533
- **Insights and comparison of structure-property relationships in propane and propene catalytic combustion on Pd- and Pt-based catalysts** *JOURNAL OF CATALYSIS*  
Yang, A., Streibel, V., Choksi, T. S., Aljama, H., Werghi, B., Bare, S. R., Sanchez-Carrera, R. S., Schaefer, A., Li, Y., Abild-Pedersen, F., Cargnello, M.  
2021; 401: 89-101
- **Support Acidity Improves Pt Activity in Propane Combustion in the Presence of Steam by Reducing Water Coverage on the Active Sites** *ACS CATALYSIS*  
Yang, A., Zhu, H., Li, Y., Cargnello, M.  
2021; 11 (11): 6672-6683
- **A General Approach for Monolayer Adsorption of High Weight Loadings of Uniform Nanocrystals on Oxide Supports.** *Angewandte Chemie (International ed. in English)*  
Kao, K., Yang, A., Huang, W., Zhou, C., Goodman, E. D., Holm, A., Frank, C. W., Cargnello, M.  
2021
- **Steam-created grain boundaries for methane C-H activation in palladium catalysts.** *Science (New York, N.Y.)*  
Huang, W., Johnston-Peck, A. C., Wolter, T., Yang, W. D., Xu, L., Oh, J., Reeves, B. A., Zhou, C., Holtz, M. E., Herzing, A. A., Lindenberg, A. M., Mavrikakis, M., Cargnello, et al  
2021; 373 (6562): 1518-1523
- **Atmospheric Methane Removal: A Research Agenda** *Philosophical Transactions of the Royal Society A*  
Jackson, R. B., et al  
2021; 379: 20200454
- **Size-controlled nanocrystals reveal spatial dependence and severity of nanoparticle coalescence and Ostwald ripening in sintering phenomena.** *Nanoscale*  
Goodman, E. D., Carlson, E. Z., Dietze, E. M., Tahsini, N., Johnson, A., Aitbekova, A., Nguyen Taylor, T., Plessow, P. N., Cargnello, M.  
2020
- **A phytophotonic approach to enhanced photosynthesis** *ENERGY & ENVIRONMENTAL SCIENCE*  
Kunz, L. Y., Redekop, P., Ort, D. R., Grossman, A. R., Cargnello, M., Majumdar, A.  
2020; 13 (12): 4794-4807
- **Nanoscale Spatial Distribution of Supported Nanoparticles Controls Activity and Stability in Powder Catalysts for CO Oxidation and Photocatalytic H<sub>2</sub> Evolution.** *Journal of the American Chemical Society*  
Holm, A., Goodman, E. D., Stenlid, J. H., Aitbekova, A., Zelaya, R., Diroll, B. T., Johnston-Peck, A. C., Kao, K. C., Frank, C. W., Pettersson, L. G., Cargnello, M.  
2020; 142 (34): 14481-14494

- **Dynamics of Copper-Containing Porous Organic Framework Catalysts Reveal Catalytic Behavior Controlled by the Polymer Structure** *ACS CATALYSIS*  
Wu, Z., Zhang, X., Goodman, E. D., Huang, W., Riscoe, A. R., Yacob, S., Cargnello, M.  
2020; 10 (16): 9356–65
- **Enhanced Catalytic Activity for Methane Combustion through in Situ Water Sorption** *ACS CATALYSIS*  
Huang, W., Zhang, X., Yang, A., Goodman, E. D., Kao, K., Cargnello, M.  
2020; 10 (15): 8157–67
- **Chemically Controllable Porous Polymer-Nanocrystal Composites with Hierarchical Arrangement Show Substrate Transport Selectivity** *CHEMISTRY OF MATERIALS*  
Riscoe, A. R., Wrasman, C. J., Menon, A., Dinakar, B., Goodman, E. D., Kunz, L. Y., Yacob, S., Cargnello, M.  
2020; 32 (13): 5904–15
- **Formic acid oxidation boosted by Rh single atoms.** *Nature nanotechnology*  
Kim, D., Cargnello, M.  
2020
- **Dilute Pd/Au Alloys Replace Au/TiO<sub>2</sub> Interface for Selective Oxidation Reactions** *ACS CATALYSIS*  
Wrasman, C. J., Riscoe, A. R., Lee, H., Cargnello, M.  
2020; 10 (3): 1716–20
- **A Combined Theory-Experiment Analysis of the Surface Species in Lithium-Mediated NH<sub>3</sub> Electrosynthesis** *CHEMELECTROCHEM*  
Schwalbe, J. A., Statt, M. J., Chosy, C., Singh, A. R., Rohr, B. A., Nielander, A. C., Andersen, S. Z., McEnaney, J. M., Baker, J. G., Jaramillo, T. F., Norskov, J. K., Cargnello, M.  
2020
- **Design of Organic/Inorganic Hybrid Catalysts for Energy and Environmental Applications.** *ACS central science*  
Goodman, E. D., Zhou, C. n., Cargnello, M. n.  
2020; 6 (11): 1916–37
- **Revealing the structure of a catalytic combustion active-site ensemble combining uniform nanocrystal catalysts and theory insights.** *Proceedings of the National Academy of Sciences of the United States of America*  
Yang, A. C., Choksi, T. n., Streibel, V. n., Aljama, H. n., Wrasman, C. J., Røling, L. T., Goodman, E. D., Thomas, D. n., Bare, S. R., Sánchez-Carrera, R. S., Schäfer, A. n., Li, Y. n., Abild-Pedersen, et al  
2020
- **Transition state and product diffusion control by polymer-nanocrystal hybrid catalysts** *NATURE CATALYSIS*  
Riscoe, A. R., Wrasman, C. J., Herzing, A. A., Hoffman, A. S., Menon, A., Boubnov, A., Vargas, M., Bare, S. R., Cargnello, M.  
2019; 2 (10): 852–63
- **Engineering of Ruthenium-Iron Oxide Colloidal Heterostructures Leads to Improved Yields in CO<sub>2</sub> Hydrogenation to Hydrocarbons.** *Angewandte Chemie (International ed. in English)*  
Cargnello, M., Aitbekova, A., Goodman, E., Wu, L., Boubnov, A., Hoffman, A., Genc, A., Cheng, H., Casalena, L., Bare, S.  
2019
- **Catalyst deactivation via decomposition into single atoms and the role of metal loading** *NATURE CATALYSIS*  
Goodman, E. D., Johnston-Peck, A. C., Dietze, E. M., Wrasman, C. J., Hoffman, A. S., Abild-Pedersen, F., Bare, S. R., Plessow, P. N., Cargnello, M.  
2019; 2 (9): 748–55
- **A Versatile Method for Ammonia Detection in a Range of Relevant Electrolytes via Direct Nuclear Magnetic Resonance Techniques** *ACS CATALYSIS*  
Nielander, A. C., McEnaney, J. M., Schwalbe, J. A., Baker, J. G., Blair, S. J., Wang, L., Pelton, J. G., Andersen, S. Z., Enemark-Rasmussen, K., Colic, V., Yang, S., Bent, S. F., Cargnello, et al  
2019; 9 (7): 5797–5802
- **A rigorous electrochemical ammonia synthesis protocol with quantitative isotope measurements.** *Nature*  
Andersen, S. Z., Colic, V., Yang, S., Schwalbe, J. A., Nielander, A. C., McEnaney, J. M., Enemark-Rasmussen, K., Baker, J. G., Singh, A. R., Rohr, B. A., Statt, M. J., Blair, S. J., Mezzavilla, et al  
2019
- **Artificial inflation of apparent photocatalytic activity induced by catalyst-mass-normalization and a method to fairly compare heterojunction systems** *ENERGY & ENVIRONMENTAL SCIENCE*

- Kunz, L. Y., Diroll, B. T., Wrasman, C. J., Riscoe, A. R., Majumdar, A., Cargnello, M.  
2019; 12 (5): 1657–67
- **Colloidal Nanocrystals as Building Blocks for Well-Defined Heterogeneous Catalysts** *CHEMISTRY OF MATERIALS*  
Cargnello, M.  
2019; 31 (3): 576–96
  - **Colloidal nanocrystals for heterogeneous catalysis** *NANO TODAY*  
Losch, P., Huang, W., Goodman, E. D., Wrasman, C. J., Holm, A., Riscoe, A. R., Schwalbe, J. A., Cargnello, M.  
2019; 24: 15–47
  - **Supported Catalyst Deactivation by Decomposition into Single Atoms Is Suppressed by Increasing Metal Loading.** *Nature catalysis*  
Goodman, E. D., Johnston-Peck, A. C., Dietze, E. M., Wrasman, C. J., Hoffman, A. S., Abild-Pedersen, F., Bare, S. R., Plessow, P. N., Cargnello, M.  
2019; 2
  - **Synthesis of Colloidal Pd/Au Dilute Alloy Nanocrystals and Their Potential for Selective Catalytic Oxidations.** *Journal of the American Chemical Society*  
Wrasman, C. J., Boubnov, A., Riscoe, A. R., Hoffman, A. S., Bare, S. R., Cargnello, M.  
2018
  - **Deconvoluting Transient Water Effects on the Activity of Pd Methane Combustion Catalysts** *INDUSTRIAL & ENGINEERING CHEMISTRY RESEARCH*  
Huang, W., Goodman, E. D., Losch, P., Cargnello, M.  
2018; 57 (31): 10261–68
  - **In Situ X-ray Scattering Guides the Synthesis of Uniform PtSn Nanocrystals.** *Nano letters*  
Wu, L., Fournier, A. P., Willis, J. J., Cargnello, M., Tassone, C. J.  
2018
  - **Low-Temperature Restructuring of CeO<sub>2</sub>-Supported Ru Nanoparticles Determines Selectivity in CO<sub>2</sub> Catalytic Reduction.** *Journal of the American Chemical Society*  
Aitbekova, A. n., Wu, L. n., Wrasman, C. J., Boubnov, A. n., Hoffman, A. S., Goodman, E. D., Bare, S. R., Cargnello, M. n.  
2018; 140 (42): 13736–45
  - **Systematic Identification of Promoters for Methane Oxidation Catalysts Using Size- and Composition-Controlled Pd-Based Bimetallic Nanocrystals.** *Journal of the American Chemical Society*  
Willis, J. J., Goodman, E. D., Wu, L., Riscoe, A. R., Martins, P., Tassone, C. J., Cargnello, M.  
2017; 139 (34): 11989-11997
  - **High-temperature crystallization of nanocrystals into three-dimensional superlattices** *NATURE*  
Wu, L., Willis, J. J., McKay, I., Diroll, B. T., Qin, J., Cargnello, M., Tassone, C. J.  
2017; 548 (7666): 197+
  - **Elucidating the synergistic mechanism of nickel-molybdenum electrocatalysts for the hydrogen evolution reaction** *MRS COMMUNICATIONS*  
Mckay, I. S., Schwalbe, J. A., Goodman, E. D., Willis, J. J., Majumdar, A., Cargnello, M.  
2016; 6 (3): 241-246
  - **Polycatenar Ligand Control of the Synthesis and Self-Assembly of Colloidal Nanocrystals** *JOURNAL OF THE AMERICAN CHEMICAL SOCIETY*  
Diroll, B. T., Jishkariani, D., Cargnello, M., Murray, C. B., Donnio, B.  
2016; 138 (33): 10508-10515
  - **Revealing particle growth mechanisms by combining high-surface-area catalysts made with monodisperse particles and electron microscopy conducted at atmospheric pressure** *JOURNAL OF CATALYSIS*  
Zhang, S., Cargnello, M., Cai, W., Murray, C. B., Graham, G. W., Pan, X.  
2016; 337: 240-247
  - **Engineering titania nanostructure to tune and improve its photocatalytic activity** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*  
Cargnello, M., Montini, T., Smolin, S. Y., Priebe, J. B., Jaen, J. J., Doan-Nguyen, V. V., Mckay, I. S., Schwalbe, J. A., Pohl, M., Gordon, T. R., Lu, Y., Baxter, J. B., Brueckner, et al  
2016; 113 (15): 3966-3971
  - **Substitutional doping in nanocrystal superlattices** *NATURE*

- Cargnello, M., Johnston-Peck, A. C., Diroll, B. T., Wong, E., Datta, B., Damodhar, D., Doan-Nguyen, V. V., Herzing, A. A., Kagan, C. R., Murray, C. B. 2015; 524 (7566): 450-?
- **Substitutional doping in nanocrystal superlattices.** *Nature*  
Cargnello, M., Johnston-Peck, A. C., Diroll, B. T., Wong, E., Datta, B., Damodhar, D., Doan-Nguyen, V. V., Herzing, A. A., Kagan, C. R., Murray, C. B. 2015; 524 (7566): 450-3
  - **Efficient Removal of Organic Ligands from Supported Nanocrystals by Fast Thermal Annealing Enables Catalytic Studies on Well-Defined Active Phases** *JOURNAL OF THE AMERICAN CHEMICAL SOCIETY*  
Cargnello, M., Chen, C., Diroll, B. T., Doan-Nguyen, V. V., Gorte, R. J., Murray, C. B. 2015; 137 (21): 6906-6911
  - **Dynamic structural evolution of supported palladium-ceria core-shell catalysts revealed by in situ electron microscopy.** *Nature communications*  
Zhang, S., Chen, C., Cargnello, M., Fornasiero, P., Gorte, R. J., Graham, G. W., Pan, X. 2015; 6: 7778-?
  - **Solution-Phase Synthesis of Titanium Dioxide Nanoparticles and Nanocrystals** *CHEMICAL REVIEWS*  
Cargnello, M., Gordon, T. R., Murray, C. B. 2014; 114 (19): 9319-9345
  - **Enhanced Energy Transfer in Quasi-Quaternary Nanocrystal Superlattices** *ADVANCED MATERIALS*  
Cargnello, M., Diroll, B. T., Gaudling, E. A., Murray, C. B. 2014; 26 (15): 2419-2423
  - **Control of Metal Nanocrystal Size Reveals Metal-Support Interface Role for Ceria Catalysts** *SCIENCE*  
Cargnello, M., Doan-Nguyen, V. V., Gordon, T. R., Diaz, R. E., Stach, E. A., Gorte, R. J., Fornasiero, P., Murray, C. B. 2013; 341 (6147): 771-773
  - **Exceptional Activity for Methane Combustion over Modular Pd@CeO<sub>2</sub> Subunits on Functionalized Al<sub>2</sub>O<sub>3</sub>** *SCIENCE*  
Cargnello, M., Delgado Jaen, J. J., Hernandez Garrido, J. C., Bakhmutsky, K., Montini, T., Calvino Gamez, J. J., Gorte, R. J., Fornasiero, P. 2012; 337 (6095): 713-717
  - **Multiwalled Carbon Nanotubes Drive the Activity of Metal@oxide Core-Shell Catalysts in Modular Nanocomposites** *JOURNAL OF THE AMERICAN CHEMICAL SOCIETY*  
Cargnello, M., Grzelczak, M., Rodriguez-Gonzalez, B., Syrgiannis, Z., Bakhmutsky, K., La Parola, V., Liz-Marzan, L. M., Gorte, R. J., Prato, M., Fornasiero, P. 2012; 134 (28): 11760-11766
  - **Nonaqueous Synthesis of TiO<sub>2</sub> Nanocrystals Using TiF<sub>4</sub> to Engineer Morphology, Oxygen Vacancy Concentration, and Photocatalytic Activity** *JOURNAL OF THE AMERICAN CHEMICAL SOCIETY*  
Gordon, T. R., Cargnello, M., Paik, T., Mangolini, F., Weber, R. T., Fornasiero, P., Murray, C. B. 2012; 134 (15): 6751-6761
  - **Synthesis of Dispersible Pd@CeO<sub>2</sub> Core-Shell Nanostructures by Self-Assembly** *JOURNAL OF THE AMERICAN CHEMICAL SOCIETY*  
Cargnello, M., Wieder, N. L., Montini, T., Gorte, R. J., Fornasiero, P. 2010; 132 (4): 1402-1409