

# HONGTAO ZHONG

hongtaoz@stanford.edu    <https://hongtaozhong.github.io/>  
Department of Mechanical Engineering, Stanford University  
Stanford, CA, US

## RESEARCH INTERESTS

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My research focuses on **understanding, modeling, and controlling** novel chemical and energy conversions which are powered by renewable electricity and sustained by plasmas, lasers, and catalysts. **Currently, I am especially excited about** research that can efficiently convert renewable electricity into value-added chemicals such as hydrogen and fertilizers. **My goal** is to enable transformative non-equilibrium technologies for chemical manufacturing and advanced propulsion. **Technical contribution areas** include low-temperature plasma sources, plasma chemistry for energy and sustainability, laser diagnostics, gas-phase kinetics, and new concepts in combustion.

## ACADEMIC EXPERIENCE

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### Stanford University, California, US

Postdoctoral Researcher in Mechanical Engineering Nov 2022 - Present  
Supervisor: Prof. Mark Cappelli at Stanford Plasma Physics Lab  
Research project: Electrification of carbon capture, hydrogen generation, and nitrogen fixation

## EDUCATION

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### Princeton University, New Jersey, US

PhD in Mechanical & Aerospace Engineering Oct 2022  
Advisor: Prof. Yiguang Ju at Princeton Combustion & Low Carbon Energy Conversion Lab  
Dr. Mikhail Shneider at Princeton Applied Physics Lab  
Dissertation title: Chemical kinetics and instability in non-equilibrium reactive plasmas

### Tsinghua University, Beijing, CN

Bachelor of Engineering in Energy & Power Engineering Jun 2017  
Bachelor of Economics Jun 2017

## HONORS AND AWARDS

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- **Finalist**, Stanford Energy Fellowship 2023
- **Recipient**, Student Presentation Award, 2<sup>nd</sup> Energy and Informatics International Forum 2022
- **Finalist**, Princeton Honorific Fellowship 2022
- **Recipient**, Distinguished Paper Award, 38<sup>th</sup> International Symposium on Combustion 2021
- **Recipient**, Graduate School Teaching Award, Princeton University 2021
- **Recipient**, School of Engineering and Applied Science (SEAS) Award for Excellence 2020
- **Recipient**, Britt and Eli Harari Fellowship, Princeton University 2020
- **Recipient**, Gaseous Electronics Conference Student Travel Grant 2019
- **Recipient**, Sayre Award, Princeton University 2018
- **Recipient**, King Peh Kwoh Fellowship, Princeton University 2017

## BOOK CHAPTERS

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- B1. Y. Ju, X. Mao, J. K. Lefkowitz, and **H. Zhong**. Plasma-assisted hydrogen combustion. In *Hydrogen for Future Thermal Engines*, pages 429–458. Springer, 2023 [link](#)

## PEER-REVIEWED JOURNAL PUBLICATIONS

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Complete list of publications: [Google Scholar](#)

- J16. **H. Zhong**, X. Mao, N. Liu, Z. Wang, T. Ombrello, and Y. Ju. Understanding non-equilibrium N<sub>2</sub>O/NO<sub>x</sub> chemistry in plasma-assisted low-temperature NH<sub>3</sub> oxidation. *Combustion and Flame*, 256:112948, 2023 [link](#)

- J15. **H. Zhong**, X. Yang, X. Mao, M. N. Shneider, I. V. Adamovich, and Y. Ju. Plasma thermal-chemical instability of low-temperature dimethyl ether oxidation in a nanosecond-pulsed dielectric barrier discharge. *Plasma Sources Science and Technology*, 31(11):114003, 2022 [link](#)
- J14. **H. Zhong**, M. N. Shneider, X. Mao, and Y. Ju. Dynamics and chemical mode analysis of plasma thermal-chemical instability. *Plasma Sources Science and Technology*, 30(3):035002, 2021 [link](#)
- J13. **H. Zhong**, X. Mao, A. C. Rousso, C. L. Patrick, C. Yan, W. Xu, Q. Chen, G. Wysocki, and Y. Ju. Kinetic study of plasma-assisted n-dodecane/O<sub>2</sub>/N<sub>2</sub> pyrolysis and oxidation in a nanosecond-pulsed discharge. *Proceedings of the Combustion Institute*, 38(4):6521–6531, 2021 [link](#)
- J12. **H. Zhong**, C. Yan, C. C. Teng, G. Ma, G. Wysocki, and Y. Ju. Kinetic study of reaction C<sub>2</sub>H<sub>5</sub> + HO<sub>2</sub> in a photolysis reactor with time-resolved Faraday rotation spectroscopy. *Proceedings of the Combustion Institute*, 38(1):871–880, 2021 [link](#)
- J11. **H. Zhong**, C. Yan, C. C. Teng, T. Y. Chen, G. Wysocki, and Y. Ju. Kinetic studies of excited singlet oxygen atom O(<sup>1</sup>D) reactions with ethanol. *International Journal of Chemical Kinetics*, 53(6):688–701, 2021 [link](#)
- J10. **H. Zhong**, M. N. Shneider, M. S. Mokrov, and Y. Ju. Thermal-chemical instability of weakly ionized plasma in a reactive flow. *Journal of Physics D: Applied Physics*, 52(48):484001, 2019 [link](#)
- J9. X. Mao, **H. Zhong**, Z. Wang, T. Ombrello, and Y. Ju. Effects of inter-pulse coupling on nanosecond pulsed high frequency discharge ignition in a flowing mixture. *Proceedings of the Combustion Institute*, 39(4):5457–5464, 2023 [link](#)
- J8. X. Mao, **H. Zhong**, T. Zhang, A. Starikovskiy, and Y. Ju. Modeling of the effects of non-equilibrium excitation and electrode geometry on H<sub>2</sub>/air ignition in a nanosecond plasma discharge. *Combustion and Flame*, 240:112046, 2022 [link](#)
- J7. N. Liu, **H. Zhong**, T. Y. Chen, Y. Lin, Z. Wang, and Y. Ju. Sensitive and single-shot OH and temperature measurements by femtosecond cavity-enhanced absorption spectroscopy. *Optics Letters*, 47(13):3171–3174, 2022 [link](#)
- J6. T. Y. Chen, X. Mao, **H. Zhong**, Y. Lin, N. Liu, B. M. Goldberg, Y. Ju, and E. Kolemen. Impact of CH<sub>4</sub> addition on the electron properties and electric field dynamics in a Ar nanosecond-pulsed dielectric barrier discharge. *Plasma Sources Science and Technology*, 31(12):125013, 2023 [link](#)
- J5. N. Liu, T. Y. Chen, **H. Zhong**, Y. Lin, Z. Wang, and Y. Ju. Femtosecond ultraviolet laser absorption spectroscopy for simultaneous measurements of temperature and OH concentration. *Applied Physics Letters*, 120(20):201103, 2022 [link](#)
- J4. C. C. Teng, C. Yan, A. Rousso, **H. Zhong**, T. Chen, E. J. Zhang, Y. Ju, and G. Wysocki. Time-resolved HO<sub>2</sub> detection with Faraday rotation spectroscopy in a photolysis reactor. *Optics Express*, 29(2):2769–2779, 2021 [link](#)
- J3. C. Yan, X. Yang, H. Zhao, **H. Zhong**, G. Ma, Y. Qi, B. E. Koel, and Y. Ju. Controlled dy-doping to nickel-rich cathode materials in high temperature aerosol synthesis. *Proceedings of the Combustion Institute*, 38(4):6623–6630, 2021 [link](#)
- J2. C. Yan, C. C. Teng, T. Chen, **H. Zhong**, A. Rousso, H. Zhao, G. Ma, G. Wysocki, and Y. Ju. The kinetic study of excited singlet oxygen atom O(<sup>1</sup>D) reactions with acetylene. *Combustion and Flame*, 212:135–141, 2020 [link](#)
- J1. K. Huang, D. M. Valiev, **H. Zhong**, and W. Han. Numerical study of the influence of the thermal gas expansion on the boundary layer flame flashback in channels with different wall thermal conditions. *Energies*, 16(4):1844, 2023 [link](#)

## ONGOING WORK

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- O7.** H. Xie, N. Liu, Q. Zhang, **H. Zhong**, ..., Y. Ju, and L. Hu. A stable atmospheric pressure plasma for extreme-temperature synthesis. *Nature*, Accepted, 2023
- O6.** X. Mao\*, **H. Zhong\***, N. Liu, Z. Wang, T. Ombrello, and Y. Ju. Ignition enhancement and NO<sub>x</sub> formation of NH<sub>3</sub>/air mixtures by non-equilibrium plasma discharge. *Combustion and Flame*, Accepted, 2023 (\* Equal contribution)
- O5.** T. Yong\*, **H. Zhong\***, E. Pannier, C. Laux, and M. A. Cappelli. High-pressure CO<sub>2</sub> dissociation with nanosecond pulsed discharges. *Plasma Sources Science and Technology*, Accepted, 2023 (\* Equal contribution) link
- O4.** **H. Zhong**, D. Piriaei, J. Kang, G. Liccardo, B. Wang, M. Cargnello, and M. A. Cappelli. Non-equilibrium regeneration of sorbent materials for carbon capture. In preparation
- O3.** **H. Zhong**, C. Yan, G. Wysocki, and Y. Ju. Kinetic studies of excited singlet oxygen atom O(<sup>1</sup>D) reactions with dimethyl ether. In preparation
- O2.** N. Liu, **H. Zhong**, T. Akiba, X. Mao, and Y. Ju. Effect of water addition on plasma thermal-chemical instability of low temperature methane oxidation. In preparation
- O1.** T. Chen, N. Liu, **H. Zhong**, X. Mao, B. Goldberg, C. Kliewer, E. Kolemen, and Y. Ju. Quantitative electric field dynamics of individual plasma breakdown events measured at 500 million frames per second. In preparation

## INVITED TALKS

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| <b>T5.</b> Understanding non-equilibrium chemistry for carbon capture and utilization<br>International Online Plasma Seminar (IOPS)                            | Dec 2023 |
| <b>T4.</b> Chemical kinetics and instability in non-equilibrium reactive plasmas<br>Stanford University Plasma Science and Technology Seminar                  | Feb 2023 |
| <b>T3.</b> Electrified non-equilibrium chemical and energy conversion<br>Peking University College of Engineering  | Jan 2023 |
| <b>T2.</b> Kinetic studies of excited singlet oxygen atoms O( <sup>1</sup> D) reactions with ethanol<br>6 <sup>th</sup> International Flame Chemistry Workshop | Aug 2022 |
| <b>T1.</b> Non-equilibrium chemical conversion for sustainable energy<br>University of Michigan - Shanghai Jiao Tong University Joint Institute                | Mar 2022 |

## CONFERENCE PRESENTATIONS

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- C17.** Hydrogen production from water vapor in atmospheric DBD plasmas. In *APS Annual Gaseous Electronics Meeting*, 2023 link
- C16.** Kinetics of high-pressure CO<sub>2</sub> splitting in nanosecond pulsed discharges. In *APS Annual Gaseous Electronics Meeting*, 2023 link
- C15.** Non-equilibrium CO<sub>2</sub> regeneration from sorbent materials. In *APS Annual Gaseous Electronics Meeting*, 2023 link
- C14.** Kinetic studies of low-temperature ammonia oxidation in a nanosecond repetitively-pulsed discharge. In *AIAA Scitech 2023 Forum*, page 1694, 2023 link
- C13.** Effects of inter-pulse coupling on nanosecond pulsed high frequency discharge ignition in a flowing mixture. In *39<sup>th</sup> International Symposium on Combustion*, 2022
- C12.** Two-dimensional modeling of plasma dynamic contraction in the positive column of glow discharge. In *AIAA Scitech 2022 Forum*, page 1109, 2022 link
- C11.** Two-dimensional modeling of dynamic contraction in chemically reactive non-equilibrium plasma flow. In *APS Annual Gaseous Electronics Meeting*, 2021 link

- C10.** Kinetic studies of excited singlet oxygen atom  $O(^1D)$  reactions with ethanol. In *DOE Low Temperature Plasma Centers and User Facilities Annual Meeting*, 2021
- C9.** Stability analysis of thermal-chemical instability in a weakly ionized plasma. In *AIAA Scitech 2021 Forum*, page 1702, 2021 link
- C8.** Kinetic study of reaction  $C_2H_5 + HO_2$  in a photolysis reactor with time-resolved Faraday rotation spectroscopy. In *38<sup>th</sup> International Symposium on Combustion*, 2021
- C7.** Chemical mode analysis of plasma thermal-chemical instability. In *12<sup>th</sup> US National Combustion Meeting*, 2021
- C6.** Contraction and stability of the positive column of a self-sustained glow discharge in a reactive mixture. In *APS Annual Gaseous Electronics Meeting*, pages UR1–004, 2020 link
- C5.** Thermal-chemical plasma instability in a reacting flow. In *AIAA Scitech 2020 Forum*, page 1661, 2020 link
- C4.** Dynamic contraction of the positive column of a self-sustained glow discharge in a reacting flow. In *APS Annual Gaseous Electronics Meeting*, pages UF2–004, 2019 link
- C3.** An analysis of a new thermal-chemical mechanism for plasma combustion instability in plasma assisted ignition. In *11<sup>th</sup> US National Combustion Meeting*, 2019
- C2.** Kinetic studies of excited singlet oxygen atoms  $O(^1D)$  reactions with fuels in plasma assisted combustion. In *AIAA Scitech 2019 Forum*, page 2065, 2019 link
- C1.** Direct measurements of branching ratios of  $O(^1D)$  reactions with alcohols. In *15<sup>th</sup> International Conference on Fluid Dynamics*, 2018

## TEACHING ASSISTANT EXPERIENCE

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- MAE 335 Fluid Dynamics** Fall 2020, Virtual
- Graded problem sets, and held online Q&A sessions
- MAE 426 Rocket and Air-Breathing Propulsion Technology** Spring 2020, Hybrid
- Designed and graded problem sets, held Q&A sessions and guided final design project
  - Honored with Graduate School Teaching Award
- MAE 221 Thermodynamics** Fall 2019, In-Person
- Designed and graded problem sets, led weekly precepts and Q&A sessions
- MAE 340 Junior Independent Work** Spring 2019, In-Person
- Supervised students to develop a semester-long design project.

## GRANT/PROPOSAL EXPERIENCE

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- NSF CBET** “Highly Sensitive  $HO_2$  Diagnostics and Oxidation Kinetics of Oxygenated Fuels at High Pressure”
- PI: Yiguang Ju, Gerard Wysocki, \$350,000 2017-2018
- Provided experimental data for annual progress reports.
- NSF CBET** “Control of Volumetric Ignition and Thermal-Chemical Instability in Weakly Ionized Plasma for High Pressure Ultra-lean Combustion”
- PI: Yiguang Ju, Mikhail Shneider, \$360,000 2019-2023
- Provided preliminary data and helped write grant proposal
  - Helped plan and execute project
- NSF EFRI DChEM** “Engineering Interfaces between Plasma, Catalysts, and Reactor Design for Natural Gas Conversion to Liquid Products”
- PI: Michele Sarazen, Xiaolin Zheng, Yiguang Ju, Lang Yuan, Tanvir Farouk \$2,000,000 2020-2024
- Provided preliminary data for preparing grant proposal
  - Helped plan and execute project

**DOE Collaborative Research Center** for “Studies of Plasma-Assisted Combustion and Plasma Catalysis”

PI: Igor Adamovich, Yiguang Ju, Bruce Koel, \$3,000,000

2019-2024

- Provided preliminary data for preparing grant proposal
- Helped plan and execute project. Presented poster to funding agency at DOE annual meeting

## MENTORING EXPERIENCE

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### **Research Mentor, Combustion and Low Carbon Energy Conversion Lab at Princeton**

- Vivian S Cheng (Stevens Institute of Technology, ChemE BS), “Kinetic mechanism of excited oxygen atom with methanol” Summer 2018
- Thomas McBride, Yousuf Tariq-Shuaib (Princeton, ME BS), “Development of a non-equilibrium plasma assisted rotating detonation engine” Summer 2022
- Zijian Sun (Princeton, ME PhD), “HO<sub>2</sub> measurements in a photolysis flow reactor” 2022-2023
- Takaki Akiba (Tohoku University, ME PhD), “Kinetics of water addition on low temperature plasma-assisted methane oxidation” 2022-2023

### **Research Mentor, Stanford Plasma Physics Lab**

- Jieun Kang (Korea University, ME MS), “UV-Vis absorption spectroscopy for NO<sub>x</sub> quantification in a plasma reactor” Summer 2023
- Qiyang Jerry Hu (Stanford, ME MS), “Design and testing of a novel multi-phase atmospheric plasma reactor” Summer 2023

## PEDAGOGICAL TRAINING

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- Princeton Mechanical & Aerospace Engineering Climate and Inclusion Open Forum 2021-2022
- Stanford Mechanical Engineering Academic Jobs Workshop 2022
- Stanford Graduate Summer Institute: Preparing for Faculty Careers 2023
- Stanford Postdoc Teaching Workshop 2023

## SERVICE AND PROFESSIONAL MEMBERSHIP

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### **Professional Membership**

Active

- American Physical Society
- American Institute of Aeronautics and Astronautics
- Combustion Institute

### **Peer Review Activity**

Reviewer for following journals:

Since 2022

- ASME Turbo Expo Proceedings
- Combustion and Flame
- AIAA Journal
- Journal of Physics D: Applied Physics
- Plasma Chemistry and Plasma Processing
- High Voltage

### **DOE Low Temperature Plasma Centers and User Facilities Annual Meeting**

Session moderator

Sept 2021

- Coordinate speakers and host meetings.

### **ACSSPU Chinese Lunch Event**

Student-life minister of ACSSPU (Term 2018 - 2019)

May 2018 - May 2019

- Organized weekly Chinese Lunch Event (1, 600 person-times participation).
- Participate in other events (Mid-Autumn gala, airport picking up) organized by Association of Chinese Students and Scholars at Princeton University (ACSSPU).

### **Summer Service and Learning Program (SSLP) in Rural China**

Vice Captain for the SSLP team in Inner Mongolia & Hebei, CN

Jul 2014

- Offered lectures and tutorials in maths, English and science in middle schools and primary schools.
- Assisted volunteers from other overseas universities in teaching students.