

# Xian Shi

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## CURRENT POSITION

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Postdoctoral Scholar, Department of Mechanical Engineering, Stanford University

## EDUCATION

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- Ph.D. (2017)**      **University of California, Berkeley**  
Department of Mechanical Engineering  
Major field: Energy Science and Technology – Combustion  
Minors: Computational and Data Science and Engineering, Fluid Mechanics  
Dissertation: *Fundamental Processes in Combustion of Stratified Mixtures*  
Advisors: Professor Jyh-Yuan Chen, Professor Robert W. Dibble
- M.S. (2014)**      **University of California, Berkeley**  
Department of Mechanical Engineering  
Thesis: *Fuel-dithering Optimization of TWC Efficiency on Natural Gas IC Engines*  
Advisor: Professor Robert W. Dibble
- B.Eng. (2013)**      **Tongji University**  
School of Automotive Studies  
National Scholarship Recipient, Graduated with Highest Honors

## RESEARCH EXPERIENCE

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- Postdoctoral Scholar**, NanoEnergy Lab, Stanford University      09/2017–present  
Advisor: Professor Hai Wang
- Develop concepts and understanding of miniaturized detonation engines for micro propulsion and electric vehicle range extender
  - Examine optical and electronic properties of carbon quantum dots (CQDs)
  - Explore gas-phase graphene synthesis technique enabled by corona discharge
- Graduate Research Assistant**, Combustion Modeling Lab, UC Berkeley      08/2014–08/2017  
Advisor: Professor Jyh-Yuan Chen
- Developed a numerical solver for reacting flow simulation with non-equilibrium plasma to evaluate the impact of electric field on ignition and flames

- Performed compressible reacting flow simulations to investigate the effect of fuel stratification on flame speeds, lean flammability, and modes of combustion
- Designed and implemented a general parallelization scheme for reacting flow simulations using Message Passing Interface (MPI)

**Visiting Researcher**, Clean Combustion Research Center (CCRC), King Abdullah University of Science and Technology (KAUST) 02/2016–05/2016

- Investigated the underlying physics of engine super knock and pre-mature ignitions in an AVL pre-ignition engine

**Graduate Research Assistant**, Combustion Analysis Lab, UC Berkeley 08/2013–08/2014  
Advisor: Professor Robert W. Dibble

- Designed and tested a fuel dithering system with optimized efficiencies for three-way catalytic converters (TWC) in a Cooperative Fuel Research (CFR) engine
- Performed gas-surface reactive simulations to understand the fundamental process of the gas-surface interaction in catalytic converter
- Developed a theoretical model for TWC responses to fuel dithering

**Undergraduate Research Assistant**, Combustion Lab, Tongji University 08/2011–08/2013  
Advisor: Professor Liguang Li

- Developed an image processing program for spray, nozzle, and lift-up flames
- Developed a signal processing program to analyze pressure traces and ion current signals from gasoline engine knocking cycles

## RESEARCH INTERESTS

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**Energy:** energy conversion, propulsion, combustion, shock and detonation, internal combustion engine, energy storage, renewable energy

**Materials:** carbon quantum dot (CQD), carbon nanoparticle synthesis, graphene synthesis, nanodiamond, flame synthesis

**High Performance Computing (HPC):** computational fluid dynamics (CFD), molecular dynamics (MD), computational chemistry, model reduction and optimization, parallel computing

## TEACHING EXPERIENCE

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**Graduate Student Instructor**, Department of Mechanical Engineering, UC Berkeley 2013–2015

- ME 40 Thermodynamics
 

Instructor: Dr. David Rich (Outstanding Graduate Student Instructor Award)	Fall 2015
Instructor: Professor Carlos Fernandez-Pello	Spring 2015
Instructor: Professor Michael Frenklach	Spring 2014
Instructor: Professor Jyh-Yuan Chen	Fall 2013

**Teaching Assistant**, School of Automotive Studies, Tongji University 2013

- Engine Principles

Instructor: Professor Jun Deng

Spring 2013

## SERVICE

### PROFESSIONAL PUBLIC SERVICE

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Session chair (Fires/Soot), 2020 Spring Technical Meeting of the Western States Section of the Combustion Institute (WSSCI) (Canceled due to the COVID-19 Pandemic)	2020
Session chair (Laminar Flames), 11th U.S. National Combustion Meeting	2019

## PROFESSIONAL ACTIVITIES

### HONORS AND AWARDS

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Ernest and Marjory Starkman Fellowship, Department of ME, UC Berkeley	2017
The Hamilton Family Memorial Fund Fellowship, Department of ME, UC Berkeley	2016
Outstanding Graduate Student Instructor Award, Teaching and Resource Center, UC Berkeley	2016
Graduate Division Block Grant Award, Graduate Division, UC Berkeley	2013–2017
Excellent Graduate of Shanghai (Highest Honors), Shanghai Municipal Education Commission	2013
Continental Fellowship, School of Automotive Studies, Tongji University	2011
Weichai Power Fellowship, School of Automotive Studies, Tongji University	2010
National Scholarship, Chinese Ministry of Education	2009, 2012

### PROFESSIONAL MEMBERSHIPS

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Member, the Combustion Institute	2013–present
Member, Society of Automotive Engineers (SAE) International	2012–present

### REVIEWER

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*Progress in Energy and Combustion Science*  
*Combustion and Flame*  
*Proceedings of the Combustion Institute*  
*International Journal of Heat and Mass Transfer*  
*Experimental Thermal and Fluid Science*  
*Journal of Physics D: Applied Physics*  
*Energy & Fuels*  
*Transportation Research Part D: Transport and Environment*  
*Combustion Theory and Modelling*  
*Society of Automotive Engineers (SAE) International*  
*Engineering Reports*  
*Automotive Innovation (AUIN)*

*Science China Technological Sciences*

## RESEARCH GRANTS/CONTRACTS

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1. Grant title: Advanced diagnostics for detonation waves in small tubes and nano carbon formation at high pressures  
Role: Co-author  
Agency: AFOSR, Defense University Research Instrumentation Program (DURIP)  
Amount: \$500,000  
Period: 02/01/2020 to 02/01/2021
2. Grant title: Sensitizing reaction chemistry in detonation: an augmented proposal  
Role: Co-author  
Agency: Air Force Office of Scientific Research (AFOSR)  
Amount: \$300,000  
Period: 06/01/2019 to 09/29/2020
3. Grant title: Extension of lean flammability limit by plasma enhancement in stratified flames  
Role: Contributor  
Agency: National Science Foundation (NSF), Combustion & Fire Systems (CFS)  
Amount: \$300,000  
Period: 07/01/2015 to 06/30/2019

## INVITED TALKS/SEMINARS/LECTURES

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1. “Extension of detonation limits using ozone as an additive”, High Temperature Gasdynamics Laboratory (HTGL) Seminar, Thermoscience Group, Department of Mechanical Engineering, Stanford University, Stanford, CA, USA, May 22, 2019.
2. “Detonation: fundamentals and applications”, Guest Lecture, ME371 Combustion Fundamentals, Department of Mechanical Engineering, Stanford University, Stanford, CA, USA, March 7, 2019.
3. “Super knock: A new IC engine knocking mode”, High Temperature Gasdynamics Laboratory (HTGL) Seminar, Thermoscience Group, Department of Mechanical Engineering, Stanford University, Stanford, CA, USA, October 18, 2017.
4. “Fundamental processes in combustion of stratified mixtures”, Automotive Engineering Academic Seminar, Tongji University, Shanghai, China, September 7, 2017.
5. “Unraveling the mystery of stratification: From laminar flame speed to modes of combustion”, NanoEnergy Lab Invited Talk, Stanford University, Stanford, CA, USA, November 1, 2016.
6. “Numerical study of laminar flame speeds of methane, propane, and *n*-heptane/air stratified flames”, Advanced Engine Combustion (AEC) Program Review Meeting, Sandia National Laboratory, Livermore, CA, USA, February 08–11, 2016.

## PUBLICATIONS, CONFERENCE PROCEEDINGS AND PRESENTATIONS

PEER-REVIEWED JOURNAL PUBLICATIONS

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## Submitted/Under review

16. Shi, X., Yu, L., Wan, K., Liu, C., Saggese, C., Zheng, H., Wang, H., CuNPs, not nanodiamonds: surfactant-enabled copper nanoparticle formation on copper TEM grids, submitted to *Nature Communications*.

## Accepted/In press

15. Shi, X., Crane, J., Wang, H., Detonation and its limit in small tubes with ozone sensitization, *Proceedings of the Combustion Institute*, accepted.
14. Crane, J., Shi, X., Lipkowicz, J. T., Kempf, A. M., Wang, H., Geometric modeling and analysis of detonation cellular stability, *Proceedings of the Combustion Institute*, accepted.
13. Wan, K., Shi, X., Wang, H., Quantum confinement and size resolved modeling of electronic and optical properties of small soot particles, *Proceedings of the Combustion Institute*, accepted.
12. De Falco, G., Mattiello, G., Commodo, M., Minutolo, P., Shi, X.\*, D'Anna, A., Wang, H., Electronic Band Gap of Flame-Formed Carbon Nanoparticles by Scanning Tunneling Spectroscopy, *Proceedings of the Combustion Institute*, accepted.
11. Ryu, J., Shi, X., Chen, J.-Y., Modes of detonation wave propagation in water vapor concentration gradients, *Combustion Science and Technology*, in press.
10. Crane, J., Shi, X.\*, Singh, A., Tao, Y., Wang, H., Isolating the effect of induction length on detonation structure: hydrogen-oxygen detonation promoted by ozone, *Combustion and Flame* **200**, 44–52 (2019).
9. Shi, X., Chen, J.-Y., Numerical analysis and model development for laminar flame speed of stratified methane/air mixtures, *Combustion and Flame* **184**, 233–245 (2017).
8. Shi, X., Ryu, J., Chen, J.-Y., Dibble, R. W., Modes of reaction front propagation and end-gas combustion of hydrogen/air mixtures in a closed chamber, *International Journal of Hydrogen Energy* **42**, 10501–10512 (2017).
7. Shi, X., Chen, J.-Y., Chen, Y., Laminar flame speeds of stratified methane, propane, and *n*-heptane flames, *Combustion and Flame* **176**, 38–47 (2017).
6. Shi, X., Chen, J.-Y., Chen, Z., Numerical study of laminar flame speed of fuel-stratified hydrogen/air flames, *Combustion and Flame* **163**, 394–405 (2016).
5. Shi, X., Seiser, R., Chen, J.-Y., Dibble, R. W., Cattolica, R., Fuel-Dithering Optimization of Efficiency of TWC on Natural Gas IC Engine, *SAE International Journal of Engines* **8**(3), 1246–1252 (2015).
4. Shi, X., Deng, J., Wu, Z., Li, L., Effect of Injection Parameters on Spray Characteristics of Urea-SCR System, *SAE International Journal of Engines* **6**(2), 873–881 (2013).
3. Liu, Y., Shi, X., Deng, J., Wu, Z., Li, L., Experimental Study on the Characteristics of Knock

- under DI-HCCI Combustion Mode with Ethanol/Gasoline Mixed Fuel, *SAE Technical Paper*, 2013–01–0544, 2013.
2. Deng, J., **Shi, X.**, Liu, Y., Wu, Z., Li, L., Experimental Studies on Knocking Characteristics of DI-HCCI With Gasoline/ethanol Fuels, *Journal of Automotive Safety and Energy* **4**(4), 367–371 (2013).
  1. Liu, Y., Deng, J., **Shi, X.**, Wu, Z., Li, L., Research on Cycle-by-Cycle Real-Time A/F Ratio Characteristics for Ethanol DI-HCCI Combustion, *Chinese Internal Combustion Engine Engineering* **34**(2), 1–6 (2013).

\* Corresponding author

## CONFERENCE PROCEEDINGS

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11. Crane, J., **Shi, X.**, Wang, H., A comparison of methane and natural gas detonation limit behaviors, Paper presented at the AIAA SciTech 2020 Forum, Orlando, FL, USA, January 6–10, 2020.
10. Crane, J., **Shi, X.**, Wang, H., Effect of boundary conditions on detonation simulations: A geometric model study, Paper 1H05 presented at the 11th U.S. National Combustion Meeting, Pasadena, CA, USA, March 24–27, 2019.
9. Scudiere, C., Chen, J.-Y., **Shi, X.**, Leberz. N., Yu, S., Stratified spherical flame propagation of low molecular weight fuels in the presence of electric fields, Paper 1H18 presented at the 11th U.S. National Combustion Meeting, Pasadena, CA, USA, March 24–27, 2019.
8. **Shi, X.**, Crane, J., Wang, H., Extension of Detonation Limits Using Ozone as an Additive, Paper 1H18 presented at the 11th U.S. National Combustion Meeting, Pasadena, CA, USA, March 24–27, 2019.
7. Pineda, D. I., Casey, T. A., **Shi, X.**, Chen, J.-Y., Uncertainty of transport parameters in flame models: a database from virial coefficient measurements, Paper 29KI-0026 presented at the 2017 Fall Technical Meeting of the Western States Section of the Combustion Institute, University of Wyoming, Laramie, WY, USA, October 2–3, 2017.
6. **Shi, X.**, Chen, J.-Y., Model development for laminar flame speed of stratified methane/air mixtures, Paper 2H13 presented at the 10th U.S. National Combustion Meeting, University of Maryland, College Park, MD, USA, April 23–26, 2017.
5. Pineda, D. I., **Shi, X.**, Casey, T. A., Chen, J.-Y., Analysis of the errors associated with molecular transport parameters in combustion modeling and their effects on one-dimensional flame simulations, Paper 1D12 presented at the 10th U.S. National Combustion Meeting, University of Maryland, College Park, MD, USA, April 23–26, 2017.
4. Sierra Aznar, M., Pineda, D. I., Cage, B. S., **Shi, X.**, Corvello, J. P., Chen, J.-Y., Dibble, R. W., Working fluid replacement in gaseous direct-injection internal combustion engines: A fundamental and applied experimental investigation, Paper 2F09 presented at the 10th U.S. National Combustion Meeting, University of Maryland, College Park, MD, USA, April 23–26, 2017.
3. Sierra Aznar, M., Pineda, D. I., Cage, B. S., Corvello, J. P., **Shi, X.**, Chen, J.-Y., Dibble, R. W.,

- Experimental investigation of port and direct injection strategies for internal combustion engines with argon as the working fluid, Proceeding of the 8th European Combustion Meeting, Dubrovnik, Croatia, April 18–21, 2017.
2. Ryu, J., **Shi, X.**, Chen, J.-Y., Influence of Water Content and its Gradient in Unburned Mixtures on the Extinction of a Developed Detonation, Paper 1B12 presented at the 2016 Spring Technical Meeting of the Western States Section of the Combustion Institute, University of Washington, Seattle, WA, USA, March 21–22, 2016.
  1. Seiser, R., **Shi, X.**, Chen, J.-Y., Dibble, R. W., Cattolica, R., Emission Reduction using Three-way Catalyst on Methane-fueled Engine, Paper No.087, IC-0052 presented at the 2014 Spring Technical Meeting of the Western States Section of the Combustion Institute, California Institute of Technology, Pasadena, CA, USA, March 24–25, 2014.

### CONFERENCE PRESENTATIONS, POSTERS, AND ABSTRACTS

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9. **Shi, X.**, Crane, J., Singh, A., Wang, H., Sensitizing H<sub>2</sub>/O<sub>2</sub> detonations using ozone, Work in Progress Poster (WiPP) 2P146 at the 37th International Symposium on Combustion, Dublin, Ireland, July 29–August 3, 2018.
8. Scudiere, C., **Shi, X.**, Chen, J.-Y., Dibble, R. W., Stratified flame propagation of low molecular weight fuels in the presence of electric fields, Work in Progress Poster (WiPP) 1P066 at the 37th International Symposium on Combustion, Dublin, Ireland, July 29–August 3, 2018.
7. Pineda, D. I., **Shi, X.**, Cage, B., Zheng, C., Gangopadhyay, S., Chen, J.-Y., Dibble, R. W., Development of a two-mixture combustion experiment in a constant volume chamber to study stratified mixture flame propagation, Poster P18 at the 10th U.S. National Combustion Meeting, University of Maryland, College Park, MD, USA, April 23–26, 2017.
6. Pineda, D.I., **Shi, X.**, Wolk, B., Vuilleumier, D., Saxena, S., Chen, J.-Y., Dibble, R. W., Berkeley-MIT Research Program: Advancing Low Temperature Combustion and Lean Burning Engines for Light and Heavy-Duty Vehicles with Advanced Spark Ignition and Fuel Stratification, Presentation at Advanced Engine Consortium (AEC) Program Review Meeting, Southfield, MI, USA, August 16–19, 2016.
5. **Shi, X.**, Chen, J.-Y., Chen, Y., Laminar Flame Speeds of Stratified Methane, Propane, and n-Heptane Flames, Work in Progress Poster (WiPP) at the 36th International Symposium of Combustion, Seoul, South Korea, July 31–August 5, 2016.
4. **Shi, X.**, Chen, Y., Chen, J.-Y., Numerical Study of Laminar Flame Speeds of Methane, Propane, and n-Heptane/Air Stratified Flames, Presentation at Advanced Engine Combustion (AEC) Program Review Meeting, Sandia National Laboratory, Livermore, CA, USA, February 08–11, 2016.
3. **Shi, X.**, Seiser, R., Chen, J.-Y., Dibble, R. W., Cattolica, R., Fuel-Dithering Optimization of Efficiency of TWC on Natural Gas IC Engine, Presentation presented at SAE World Congress and Exhibition, Detroit, MI, USA, April 21–23, 2015.
2. **Shi, X.**, Deng, J., Wu, Z., Li, L., Effect of Injection Parameters on Spray Characteristics of Urea-

SCR System, Presentation presented at SAE World Congress and Exhibition, Detroit, MI, USA, April 16–18, 2013.

1. Liu, Y., **Shi, X.**, Deng, J., Wu, Z., Li, L., Experimental Study on the Characteristics of Knock under DI-HCCI Combustion Mode with Ethanol/Gasoline Mixed Fuel, Presentation presented at SAE World Congress and Exhibition, Detroit, MI, USA, April 16–18, 2013.

## REFERENCES

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