

**DAVID B. BROWN**  
Engineering IV  
420 Westwood Plaza  
Los Angeles, CA 90095-1597

phone: (404) 245 – 3023  
email: [dbrown3@ucla.edu](mailto:dbrown3@ucla.edu)

## RESEARCH INTERESTS

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Experimental and numerical study of fundamental energy transport/conversion mechanisms and material properties, across multiple length scales, with applications in thermal management of current/next-generation electronic devices, ultra-high speed aerospace vehicles, and other industrial processes.

## EDUCATION

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**Georgia Institute of Technology** Atlanta, GA  
*Doctor of Philosophy in Mechanical Engineering* May 2019  
Dissertation Title: Experimental Characterization of Thermal Transport in Two-Dimensional Materials and Thin Films  
Advisors: Satish Kumar and Baratunde A. Cola

*Bachelor of Science in Mechanical Engineering* May 2012

## ACADEMIC EXPERIENCE

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**University of California, Los Angeles** Los Angeles, CA  
*Postdoctoral Fellow (Advisor: Timothy S. Fisher)* October 2020 – Present

- Developed multiphase thermal model and measured high temperature thermal diffusivity and work function for cooling hypersonic leading edges through thermionic emission and evaporative cooling.

**University of Michigan** Ann Arbor, MI  
NextProf Nexus Future Faculty Workshop October 2021

- Three-day workshop aimed at strengthening and diversifying the next generation of academic leaders across engineering disciplines. The program provided a clearer understanding of the academic job search, navigating first faculty positions, and building a research program while networking with peers and future colleagues.

**Sloan Scholar Mentoring Network** Atlanta, GA  
*Academic Job Market/New Faculty Boot Camp* October 2019

- Participated in workshop series on preparing effective application materials, campus interviews, negotiating salary and startup packages, and developing grant proposals.

**University of Notre Dame** South Bend, Indiana  
*College of Engineering Future Faculty Workshop* April 2018

- Networked with faculty and attended panels/presentations designed to assist with the academic job search. Topics included identifying a university home, preparing research and teaching statements, and completing the interview process. The event also included a poster session with College of Engineering faculty and students.

**Georgia Institute of Technology**

Atlanta, GA

*Graduate Research Assistant*

August 2012 – January 2019

- Investigated the effect of chemisorption and physisorption on thermal boundary conductance at metal-graphene interfaces for next-generation graphene-based electronic devices.
- Estimated the thermal boundary conductance at vertically stacked hexagonal boron nitride-graphene interfaces in van der Waals heterostructures.
- Determined the spatial variation and demonstrated the effect of the metal contact on thermal boundary conductance at metal-molybdenum diselenide-silicon dioxide interfaces, the representative contact geometry in electronic devices featuring two-dimensional transition-metal dichalcogenides.
- Explored the impact of thickness and structure on thermal conductivity and heat capacity of thin film hafnia, a transition metal oxide used as an ultra-thin gate dielectric in silicon transistors and hafnia-based memristors.

*Undergraduate Researcher*

January 2012 – May 2012

Professor Satish Kumar

- Developed computational models to investigate the performance of embedded thermoelectric devices for on-chip hotspot cooling and energy harvesting using COMSOL Multiphysics.

*Undergraduate Researcher*

August 2011 – December 2011

Professor Evan Zamir

- Conducted standard mechanical testing to determine the modulus of elasticity of Sylgard 527 and Sylgard 184 Silicone Dielectric Gels, two-part, polydimethylsiloxane (PDMS) substrates used for in vitro cell culture.

**INDUSTRY EXPERIENCE**

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**Raytheon Intelligence & Space**

El Segundo, CA

*Sr. Mechanical Engineer*

January 2019 – September 2020

- Worked with multidisciplinary team of engineers to perform thermal analysis which drove design of spacecraft payloads and electronic units.
- Created detailed models of electronic modules with board layout and printed wiring board stack-up from electrical design team. The modules were fully integrated with chassis and frame from mechanical design team.
- Shift lead on thermal vacuum test for spacecraft hardware including thermal cycling, functional test, and characterization of sensors and cryogenic thermal switch.

**Carbice Corporation**

Atlanta, GA

*Product Engineering Intern*

June 2018 – August 2018

- Gathered performance data for specification document by estimating the modulus of elasticity and thermal resistance of thermal gasket using compression testing and Mentor Graphics T3Ster, respectively, and compared with commercially available alternatives.

- Contributed to design and development of minimum viable product of thermal storage technology suitable for environmental qualification as well as mechanical and thermal testing in a potential customer's application. Product has since reached the International Space Station.

### **Doosan Power Systems Americas**

Atlanta, GA

Summer Intern

June 2011 – August 2011, June 2012 – August 2012

- Developed plant upgrade proposals for engineered products including verifying engineering calculations and drawings, schedule development, and cost estimation.
- Analyzed market data for proposed boiler upgrade projects, biomass plant installations/conversions, and air quality control systems installations.
- Created technical specifications for new forced draft fans and assisted in design of shell-and-tube heat exchanger.
- Generated list of potential steam turbine service partners in the U.S. and prepared personnel for upcoming projects prior to new technology acquisitions.

### **JOURNAL PUBLICATIONS**

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- 5) **Brown, D. B.**, Bougher, T. L., Zhang, X., Ajayan, P., Cola, B. A., and Kumar, S., 2019, "Thermal boundary conductance and phonon transmission in hexagonal boron nitride/graphene heterostructures," *physica status solidi (a)*, **216**(23), 1900446. DOI: 10.1002/pssa.201900446
- 4) **Brown, D. B.**, Shen, W., Li, X., Xiao, K., Geohegan, D., B., and Kumar, S., 2019, "Spatial mapping of thermal boundary conductance at metal-molybdenum diselenide interfaces," *ACS Applied Materials and Interfaces*, **11**(15), pp. 14418-14426. DOI: 10.1021/acsami.8b22702
- 3) **Brown, D. B.**, Bougher, T. L., Cola, B. A., and Kumar, S., 2018, "Oxidation limited thermal boundary conductance at metal-graphene interface," *Carbon*, **139**, pp. 913-921. DOI: 10.1016/j.carbon.2018.08.002
- 2) Lee, K. Y., **Brown, D.**, and Kumar, S., 2014, "Silicon nanowire arrays based on-chip thermoelectric generators," *IEEE Trans. Compon. Packag. Manuf. Technol.*, **5**(8), pp. 1100-1107. DOI: 10.1109/TCPMT.2015.2450234
- 1) Ramos-Alvarado, B., **Brown, D.**, Chen, X., Feng, B., and Peterson, G. P., 2013, "On the assessment of voids in the thermal interface material on the thermal performance of a silicon chip package", *Microelectronics Reliability*, **53**(12), pp. 1987-1995. DOI: 10.1016/j.microrel.2013.05.006

### **CONFERENCE PROCEEDINGS**

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- 3) **Brown, D. B.**, Li, X., Xiao, K., Geohegan, D., and Kumar, S., 2018, "Thermal boundary conductance mapping at metal-MoSe<sub>2</sub> interface," *The Intersociety Conference on Thermal and Thermomechanical Phenomena in Electronic*

Systems, Institute of Electrical and Electronics Engineers. DOI: 10.1109/ITHERM.2018.8419470 (**Outstanding Paper Award**)

- 2) **Brown, D. B.**, Bougher, T. L., Cola, B. A., and Kumar, S., 2015, “Thermal boundary conductance at metal-graphene-metal interfaces using time-domain thermoreflectance method,” *The International Technical Conference and Exhibition on Packaging and Integration of Electronic and Photonic Microsystems and 13<sup>th</sup> International Conference on Nanochannels, Microchannels, and Minichannels*, American Society of Mechanical Engineers. DOI: 10.1115/IPACK2015-48444
- 1) Lee, K. Y., **Brown, D.**, and Kumar, S., 2014, “Performance evaluation of silicon nanowire arrays based thermoelectric generators,” *The Intersociety Conference on Thermal and Thermomechanical Phenomena in Electronic Systems*, Institute of Electrical and Electronics Engineers. pp. 1394-1403. DOI: 10.1109/ITHERM.2014.6892443

## SELECTED PRESENTATIONS

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- 8) **Brown, D. B.**, “Frontiers in thermal engineering: Low dimensions and extreme conditions,” *Future Leaders in Mechanical & Aerospace Engineering: Celebrating Diversity and Innovation*, February 2021.
- 7) **Brown, D. B.**, Li, X., Xiao, K., Geohegan, D., and Kumar, S., “Spatial mapping of thermal boundary conductance at metal-MoSe<sub>2</sub> interface,” *The International Mechanical Engineering Congress and Exhibition*, American Society of Mechanical Engineers, Pittsburgh, PA, November 2018.
- 6) **Brown, D. B.**, Li, X., Xiao, K., Geohegan, D., and Kumar, S., “Thermal boundary conductance mapping at metal-MoSe<sub>2</sub> interface,” *The Intersociety Conference on Thermal and Thermomechanical Phenomena in Electronic Systems*, Institute of Electrical and Electronics Engineers, San Diego, CA, May 2018.
- 5) **Brown, D. B.**, Bougher, T. L., Zhang, X., Ajayan, P., Cola, B. A., and Kumar, S., “Thermal boundary conductance across vertically stacked graphene/h-BN interface,” *The International Mechanical Engineering Congress and Exhibition*, American Society of Mechanical Engineers, Tampa, FL, November 2017.
- 4) **Brown, D. B.**, Bougher, T. L., Zhang, X., Ajayan, P., Cola, B. A., and Kumar, S., “Interfacial thermal transport in graphene/h-BN vertically stacked heterostructures,” poster presentation, *Fall Meeting and Exhibition*, Materials Research Society, Boston, MA, December 2016.
- 3) **Brown, D. B.**, Bougher, T. L., Cola, B. A., and Kumar, S., “Effect of chemisorption and physisorption on thermal boundary conductance at metal-graphene-metal interfaces using time-domain thermoreflectance,” *The Academy for Co-Creative Education of Environment and Energy Science Fourth International Education*

*Forum on Environment and Energy Science*, Tokyo Institute of Technology, Lahaina, HI, December 2015.

- 2) **Brown, D. B.**, Bougher, T. L., Cola, B. A., and Kumar, S., "Thermal boundary conductance at metal-graphene-metal interfaces using time-domain thermoreflectance method," *The International Technical Conference and Exhibition on Packaging and Integration of Electronic and Photonic Microsystems and 13<sup>th</sup> International Conference on Nanochannels, Microchannels, and Minichannels*, American Society of Mechanical Engineers, San Francisco, CA, July 2015.
- 1) **Brown, D. B.**, Bougher, T. L., Cola, B. A., and Kumar, S., "Thermal boundary conductance measurements at metal-graphene-metal interfaces," *Heat Lab Thermal Science Seminar Series*, Georgia Institute of Technology, Atlanta, GA, February 2015.

### **AWARDS/CERTIFICATIONS**

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University of California (Los Angeles) Chancellor's Postdoctoral Fellowship	2021
ASME Micro & Nano Forum of IMECE Travel Award	2018
IEEE ITherm Outstanding Paper Award	2018
Center for Organic Photonics and Electronics Graduate Student Fellowship	2016
Alfred P. Sloan Foundation Minority Ph.D. Fellowship	2015
National Science Foundation Graduate Research Fellowship	2013
Georgia Tech Institute for Electronics and Nanotechnology Seed Grant	2013
National Science Foundation Graduate Research Diversity Supplement	2012
Engineer In-Training License (Georgia)	2012

### **TEACHING EXPERIENCE**

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**Georgia Institute of Technology** Atlanta, GA  
*Graduate Teaching Assistant* August 2016 – December 2018

- Guided undergraduate students through collecting, analyzing, and interpreting experimental data using mechanical, thermal, and electrical sensors and convey their results in technical reports and other assignments.
- Resolved teaching assistant and student scheduling conflicts and arbitrated grading disputes.
- Managed weekly lab setup and equipment functionality test, teaching assistant training sessions, and course grade book.

*Teaching Practicum* August 2016 – December 2016

- Worked with a faculty mentor in a graduate course designed to familiarize students with microelectromechanical systems (MEMS).
- Delivered lecture comparing etch rates/profiles and temperature/concentration dependence of two wet, anisotropic silicon etches.
- Prepared and delivered lecture discussing MEMS characterization techniques for measuring thin film thickness, surface topography, and imaging.

- Led lab sections allowing students to design a photolithography mask in AutoCAD, create a polymer mold, and use laser ablation to create three-dimensional designs in an acrylic sheet.

*Undergraduate Tutor – System Dynamics and Control* June 2011 – May 2012

- Helped students gain understanding of assigned homework and prepare for tests & quizzes pertaining to modeling and response of mechanical, electrical, and hydraulic systems as well as analyzing feedback control systems in the time and frequency domains.

## ACADEMIC SERVICE

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*Army Education Outreach Program* July 2021 – August 2021

- The Army Education Outreach Program's apprenticeship program provides high school and undergraduate students with an authentic science and engineering research experience alongside researchers in a university or Army/Department of Defense lab. During the program, I introduced a high school senior to the three modes of heat transfer (conduction, convection, and radiation) using a one-dimensional, multi-mode analysis, while also developing her coding skills in Python using the open-source applications Jupyter Notebook and Google Colaboratory.

### Reviewer

*ACS Applied Materials and Interfaces*, American Chemical Society 2022

*Transactions on Components, Packaging, and Manufacturing Technology*, Institute of Electrical and Electronics Engineers 2020

*The International Mechanical Engineering Congress and Exhibition*, American Society of Mechanical Engineers 2018

*The Intersociety Conference on Thermal and Thermomechanical Phenomena in Electronic Systems*, Institute of Electrical and Electronics Engineers 2018

*Microelectronic Engineering*, Elsevier 2015

*Atlanta Public Schools Gifted Mentor/Internship Program* January 2016 – May 2016

- Participated in a semester-long mentorship program which exposed senior high school students to university lab work. The student came to campus once a week throughout the semester and performed thermal metrology experiments. He left with a basic understanding of how heat conduction varies by material and the role of material selection plays in thermal management of electronic devices.

*Louis Stokes Alliance for Minority Participation* August 2012 – May 2013

- Mentored two undergraduate students in the Mechanical Engineering department as part of a National Science Foundation funded program which aimed to increase the participation and improve the performance of underrepresented minority students in STEM fields.

## SKILLS

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**Software:** Microsoft Office, LaTeX, MATLAB, Python, COMSOL Multiphysics, ANSYS Fluent, Thermal Desktop, Siemens NX, AutoCAD, SolidWorks

**Lab:** Thermal metrology, Vacuum systems

**Cleanroom/Semiconductor:** Electron-Beam Evaporation, Sputtering, Chemical Vapor Deposition, Photolithography, Optical Microscopy, Wet/Dry Etching, Scanning Electron Microscopy, Atomic Force Microscopy, X-Ray Photoelectron Spectroscopy

**Communication:** Technical writing/presentations