Shomik Verma

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EDUCATION

Massachusetts Institute of Technology, Cambridge, Massachusetts, USA.……...*Expected Graduation: August 2025*
PhD in Mechanical Engineering; GPA 5.0/5.0

Imperial College London, UK.……...*Graduated: October 2021*
MPhil in Materials Science

University of Cambridge, Cambridge, UK.……...……...*Graduated: October 2020*
MPhil in Materials Science

Duke University, Durham, North Carolina, USA.……..……..*Graduated: May 2019*
BSE in Mechanical Engineering, GPA: 3.96; Minors in Energy Engineering and Mathematics. Summa Cum Laude. MechE Faculty Award, Pi Tau Sigma, Tau Beta Pi, Grand Challenge Scholar, Pratt Research Fellow

Clements High School, Sugar Land, Texas, USA.……*Graduated: June 2015*
GPA: 4.0; Rank: 10/609 (Top 2%)

AWARDS AND ACHIEVEMENTS

General Academics

- 2023 PD Soros Fellow
- 2019 NSF GRFP Fellow
- 2019 Marshall Scholar
- 2018 Goldwater Scholar
- 2018 Udall Scholar

Engineering

- Guinness World Record holder for most efficient prototype electric vehicle, with Duke EV's electric vehicle Eta (27,482 MPGe)
- Guinness World Record holder for most fuel-efficient prototype vehicle, with Duke EV's hydrogen fuel cell car Maxwell (14,573 MPGe)

RESEARCH EXPERIENCE

MIT Atomistic Simulation & Energy Research Group: Graduate Student..……*September 2021 – Present*

- Working with Dr. Asegun Henry on multi-scale modeling of high-efficiency thermophotovoltaic systems.
- Designing a novel high-efficiency combustor with CFD and chemical reaction kinetics for TPV power conversion.
- Analyzing sub-bandgap absorption in TPV cells with DFT to improve IR reflectivity.

Imperial College Walsh Materials Design Group: Masters Student.…….……...*October 2020 – September 2021*

- Worked with Drs. Aron Walsh and David Scanlon on high-throughput virtual screening for photon conversion.
- Utilized active learning and excited state computational chemistry for candidate molecule suggestion.
- Generated a machine learning model to increase accuracy of ultrafast computational chemistry techniques.

Cambridge University Functional Photoactive Materials Group: Masters Student.……...*October 2019 – September 2020*

- Worked with Dr. Rachel Evans on performance analysis of 3D printed luminescent solar concentrators.
- 3D printed LSCs of various unconventional shapes and characterized their optical efficiency.
- Expanded the existing ray tracing software pvTrace to analyze efficiency of unconventionally shaped LSCs.

Georgia Tech Nanoscale Thermal Radiation Lab: Research Assistant..……..……...*June 2019 – August 2019*

- Worked with Dr. Zhuomin Zhang in the Nanoscale Thermal Radiation Laboratory.
- Investigated a ceramic proppant as a solar absorber for a falling particle concentrating solar thermal plant.
- Conducted high temperature emissometry to determine near- and mid-IR emissivity of particles.

Duke University Thermodynamics and Sustainable Energy Lab: Undergrad Researcher..…….*January 2017 – May 2019*

- Worked with Dr. Nico Hotz at T-SEL, designed a concentrated solar collector for dry methane reforming.
- Developed a multiphysics model to determine various properties' influence on temperature and conversion.
- Fabricated a high-temperature solar selective absorption coating.

Duke Gendell Center for Engineering, Energy, and the Environment: Undergrad Researcher…….*August 2017 – May 2019*

- Worked with Dr. Josiah Knight on PEM fuel cell optimization and integration into an electric vehicle.
- Optimization of various operational parameters to increase efficiency while providing sufficient power output.

PUBLICATIONS

- "High-temperature thermal conductivity measurements of macro-porous graphite"
  S. Verma, M. Adams, M. Foxen, B. Sperry, S. Yee, A. Henry. *IHTC-17 Proceedings*. (2023)
- "Ray trace modeling to characterize efficiency of unconventional luminescent solar concentrator geometries."
  S. Verma, D. J. Farrell, R. C. Evans. *ACS Appl. Opt. Mater.* (2023)
- "Machine learning for accurate and fast bandgap prediction of solid-state materials"
  S. Verma, S. Kajale, R. Gomez-Bombarelli. *IEEE HPEC*, September 2022.
- "Machine learned calibrations to high-throughput molecular excited state calculations."
  S. Verma, M. Rivera, D. O. Scanlon, A. Walsh. *J. Chem. Phys*. 156, 134116 (2022)
- "Thermophotovoltaic efficiency of 40%."
  A. LaPotin, K. L. Schulte, M. A. Steiner, K. Buznitsky, C. C. Kelsall, D. J. Friedman, E. J. Tervo, R. M. France, M. R. Young, A. Rohskopf, **S. Verma**, E. N. Wang, A. Henry. *Nature* **604,** 287–291 (2022).
- "A Study of Energy Losses in the World's Most Fuel-Efficient Vehicle."
  P. Grady, G. Chen, **S. Verma**, A. Marellapudi, N. Hotz. *IEEE VPPC,* October 2019.
- "Modeling and design optimization of a concentrated solar thermal collector for dry methane reforming."
  [Best Paper Award] **S. Verma**, N. Hotz. *COMSOL Conference*, October 2018.

PRESENTATIONS

- "End-to-end performance analysis of 3D printed luminescent devices for energy conversion applications"
  S. Verma, R. Evans. *Fall MRS*, December 2023
- "Design of an all-ceramic hydrogen combustor paired with thermophotovoltaic power generation"
  [Honorable Mention] **S. Verma,** M. Pishahang, K. Buznitsky, A. LaPotin, A. Henry. *TPV-14*, May 2023
- "Clean, dispatchable power generation with hydrogen combustion and thermophotovoltaics"
  [Best Student Pitch] **S. Verma**, A. LaPotin, K. Buznitsky, M. Pishahang, A. Henry. *ARPA-E Summit*, March 2023
- "Optimizing Performance of Low-Quality Graphite for High-Temperature Thermal Storage"
  S. Verma, C. C. Kelsall, K. Buznitsky, A. LaPotin, A. Henry. *Fall MRS*, December 2022.
- "A Unified Active Learning Framework for Designing Energy-Relevant Molecules"
  S. Verma, J. Li, K. Greenman, R. Gomez-Bombarelli, X. Wang, A. Walsh. *Fall MRS*, December 2022.

POSTERS

- "Additively-manufactured ceramic combustor for dispatchable clean electricity generation"
  [Best Poster Award Finalist] **S. Verma,** N.D. Orf, B.C. LaCourse, A. Henry. *Fall MRS*, December 2023
- "Finite element modeling of a concentrated solar collector for hydrogen production."
  [3rd Place Poster Award] **S. Verma**, N. Hotz. *Duke University Energy Conference*, November 2018.
- "Design and optimization of the hydrogen fuel cell drivetrain of the world's most fuel-efficient vehicle."
  S. Verma, G. Chen, J. Knight, N. Hotz. *Duke University Energy Conference*, November 2018.
- "Optimizing and fabricating a high-temperature selective absorption coating for a concentrated solar collector."
  S. Verma, Q. Xiao, N. Hotz. *NC Energy Conference*, April 2018.

TEACHING AND MENTORING PORTFOLIO

MIT Communications Laboratory: Fellow..…..……*March 2023 – Present*

- Coaching students on communication best practices, through 1:1 sessions and leading workshops

MIT Educational Studies Program: Teacher...……..……*March 2023 – August 2023*

- Taught middle school students about atomistic science and high schoolers about industrial decarbonization

MIT Undergraduate Research Opportunities Program (UROP): Research Mentor....……*August 2022 – Present*

- Mentoring MIT undergraduates in independent research projects. Topics include:
  - High-temperature thermal diffusivity and microstructure characterization of low-quality graphite,
  - Improving emissivity of oxidation-resistant materials with surface engineering

Polygence: Research Mentor...…….*January 2022 – Present*

- Mentoring talented high school students on research projects. Topics include:
  - Designing high-efficiency multijunction solar cells for space applications,
  - Machine learning for music accompaniment generation,
  - Designing a passive filtration device for purification of agricultural runoff

Duke University Pratt School of Engineering: Teaching Assistant.....*August 2016 – May 2019*

- TA for EGR 201 (Statics and Mechanics of Materials) in the Civil and Environmental Engineering Department.
- Led recitation section to review concepts and work through practice problems.
- Held office hours, graded, and supervised physical labs involving tension, torsion, and buckling tests.

LEADERSHIP ACTIVITIES

MIT Energy and Climate Club: VP of Community and Education

- Led organization of Energy Career Fair, including inviting energy companies and organizing day-of logistics.
- Started the MITEC Speaker Series for graduate students to present and discuss their research.
- Organizing lab tours and mixers with local VCs and startups.

MIT Graduate Association of Mechanical Engineers: Lunch Seminar Chair

- Organizing twice-yearly Seminar Week for MechE grad students to present their work and get feedback.

MIT Ashdown (Graduate Housing): Tech and Inventory Chair, Communications Officer

- Created 3AM Anno, automatically generating weekly emails based on events submitted through a Google Form.
- Attended weekly Executive Committee meetings to take minutes.

MIT Sangam (Indian Students Association): Treasurer

- In charge of submitting funding applications for, as well as organizing and volunteering at, various cultural events.

Duke Energy Club: President

- Pioneered POWER program to Provide Opportunities With Energy Research for undergraduates.
- Led projects in data visualization for energy consumption and analyzing thermal insulation per building at Duke.
- Interfaced with Duke Energy Initiative to promote undergraduate participation in energy.

Duke Electric Vehicles: Co-President, Hydrogen Fuel Cell Vehicle Team Lead

- Led development of a hybrid H2 vehicle using a fuel cell with supercapacitor storage.
- Created carbon fiber-based electric vehicles from scratch.
- Used SolidWorks/CAM to design and machine sprocket, steering components, and dynamometer parts.

Duke Smart Home: Co-President, Team Lead, 2016-2017 Resident

- Managed projects and providing technical assistance with 3D modeling and FEA/CFD analysis.
- Led the Smart Shelters project to build sustainable shelters for refugees and the homeless with basic amenities.

Duke Sangeet (Indian classical music club): President

- President of Indian classical music group and tabla (classical percussion instrument) performer.
- Organized several performances per year, showcasing members of the club as well as outside artists.

Duke Pi Tau Sigma (Mechanical Engineering Honor Society): Co-President

- Managed annual induction process of top 25% of each mechanical engineering class.
- Supported new initiatives including faculty recognition awards and seed grants for individual projects

INDUSTRY EXPERIENCE

Heat Transfer Engineering Intern: ExxonMobil Research and Engineering, Houston, TX.....*May – August 2017*

- Improved proprietary fired heater numerical model by updating convective finned tube heat transfer correlations.
- Designed horizontal cabin fired heater for vacuum distillation column in planned refinery.
- Developed a prediction tool for NO_x emissions as a function of fuel H_2 content to drive NO_x reduction.

Research Intern: Schlumberger Carbon Services, Houston, TX.....*January – May 2015*

- Collaborated with industry professionals to evaluate sites for carbon sequestration suitability.
- Utilized CarbonSCORE software to determine the ideal site for storage out of several suitable sites.
- Compared depleted oil and gas reservoirs and deep saline formations in a case-by-case basis.

Research Intern: Geostock Sandia LLC, Houston, TX.....*January – May 2015*

- Analyzed seismic data, well logs, and previous scout ticket data to better determine conditions of wells.
- Created documents demonstrating production well integrity beyond the Area of Review around an injection well.
- With team, compiled well permit documents necessary for waste injection or carbon sequestration.

SERVICE ACTIVITIES

Engineering Intern: National Park Association, Salta, Argentina (DukeEngage)……..*June – August 2016*

- Interned at environmental conservation/engineering nonprofit in Salta, Argentina.
- Built various structures at a nature reserve (toll booth, barrier, bird-watching station, improved viewpoints).
- Planned installation of solar water heaters for impoverished families to promote cultural/ecological tourism.

Grid Alternatives: Volunteer

- Installed solar panels for Chemehuevi Native American tribe (2016), Fresno (2017), and LA (2018) communities.
- Learned about the concrete impacts the solar panels have on the livelihood by freeing up income for education, healthy food, and improving quality of life.

Bihar Association of North America: Youth Activity Leader

- Coordinated with Executive Committee for annual Academic Fest to write middle school mathematics tests.
- Tutored middle school mathematics students in TMSCA (Texas Math and Science Coaches Association) events including Number Sense, Calculator, Mathematics, and Science.
- Delivered opening speech at Academic Fest as alumnus and volunteered at Academic Fest.

SKILLS

- Experience with various computational materials science techniques including DFT and its approximations.
- Strong command of Python and MATLAB. Experience in Java, C++, C#, HTML/CSS, XML, Mathematica.
- Extensive familiarity with CFD/FEA/multiphysics software including COMSOL and ANSYS, and CAD software including SolidWorks and Fusion 360.
- Trained on various experimental techniques/equipment: Fourier transform IR spectrometer, UV/Vis spectrometer, sputtering, plasma-enhanced chemical vapor deposition, profilometer, rapid annealing, scanning electron microscopes.
- Skilled in 3D printing, machining, and laser cutting.
- Professional proficiency in Spanish; conversational proficiency in Hindi.