

EDUCATION

University of Virginia

Charlottesville, Virginia

Doctor of Philosophy, Mechanical & Aerospace Engineering

January 2019 – August 2024

- Dissertation: “Transforming Ultra-High Molecular Weight Polyethylene Fibers: Sustainable Production Methods, Nanocomposites, and Carbon Fibers”
- Committee: Liheng Cai, David Green, Tao Sun, Xiaodong Li (Advisor), Baoxing Xu (Chair)

Clemson University

Clemson, South Carolina

Bachelor of Science, Mechanical Engineering w/ General Honors

August 2010 – May 2015

- FE Exam Passed November 2015

Esslingen University of Applied Sciences

Esslingen, Germany

INTAP Automotive Engineering Exchange Program

September – December 2013

RESEARCH EXPERIENCE

Postdoctoral Research Associate

August 2024 - Present

University of Virginia, Dept. of Mechanical & Aerospace Engineering

Charlottesville, VA

- Unveiling process-structure property relationships of multifunctional polymer composites of recycled matrix, recycled carbon fiber, and nanoparticle materials for electric vehicle lightweighting
- Designed and fabricated a lab-scale reaction injection molding system
- Created a lifecycle assessment model to assess the greenhouse gas emissions and embodied energy of the recycled multifunctional multicomponent composites mentioned above
- Managing US Department of Energy funded project (Award DE-EE0010602) and leading associated research team of six graduate research assistants and one undergraduate research assistant
- Communicating research progress to stakeholders and external audiences through monthly, quarterly, and annual reports and presentations

Graduate Research Assistant

January 2019 – August 2024

University of Virginia, Dept. of Mechanical & Aerospace Engineering

Charlottesville, VA

- Researched low-cost carbon fiber production and high performance, polymer nanocomposite fibers with a focus on sustainable production methods resulting in 13 publications and a pending patent
- Developed process-structure-property relationships underlying experimental materials via broad-spectrum material characterization methods, such as X-ray crystallography, spectroscopic methods, electron microscopy, and mechanical testing, coupled with computational tools such as MATLAB
- Trained and experienced operating optical and scanning electron microscopes, Fourier transform infrared spectrometer, Raman spectrometer, differential scanning calorimeter and thermogravimetric analyzer, universal mechanical testing machines with digital image correlation, and inert atmosphere glove box
- Designed and fabricated several systems for fiber melt and gel spinning, continuous fiber bath treatment applications, carbon fiber synthesis and testing using CAD software and manufacturing methods including manual and CNC milling and turning, waterjet and laser cutting, and fused filament deposition and masked stereolithography additive manufacturing.
- Drafted several NSF and US Department of Energy grant applications with two awarded totaling > \$5M
- Prepared and delivered monthly, quarterly, and annual reports and presentations on grant-funded project progress for internal and external audiences
- Engaged with US Department of Energy program managers in Vehicle Technologies Office and Fuel Cell Technologies Office to initiate and coordinate projects
- Collaborated with researchers from Oak Ridge, Savannah River, and Argonne national laboratories
- Led laboratory space establishment, organization, safety, and sustainability efforts for lab of 20+ members

Advisor: Dr. Robert Prucka

- Developed a simulation-based vehicle dynamics learning module for graduate students
- Designed wheel force transducers for the MTS 7-post Vehicle Dynamics “Shaker” Rig
- Outfitted an offroad vehicle with data acquisition system and sensors for vehicle dynamics data collection

PUBLICATIONS

- [1] **K.R. Brown**, Z. Xue, R. Cordier, C. Love-Baker, E.R. Crater, A. Sushchenko, E. Knight, A. Scherschel, M. Price, R.B. Moore, X.Li, *1,4-Cineole: A bio-derived solvent for highly stable graphene nanoplatelet suspensions and well-dispersed UHMWPE nanocomposite fibers*, 7:160 (2024). doi: 10.1007/s42114-024-00977-5.
- [2] **K.R. Brown**, C.A. Love-Baker, Z. Xue, X. Li, *Ultra-High Molecular Weight Polyethylene Micro-Ribbon Fibers Gel Spun Using Orange Terpenes*, Polym. Eng. Sci. 64 (2024) 1743–1755. doi: 10.1002/PEN.26656.
- [3] **K.R. Brown**, C. Love-Baker, T.M. Harrell, X. Li, *Effect of tension during sulfonation stabilization for UHMWPE-derived carbon fibers*, J. Polym. Res. (2023) 3012. 30 (2023) 1–14. doi: 10.1007/S10965-023-03829-W.
- [4] **K.R. Brown**, T.M. Harrell, L. Skrzypczak, A. Scherschel, H.F. Wu, X. Li, *Carbon fibers derived from commodity polymers: A review*, Carbon N. Y. 196 (2022) 422–439. doi: 10.1016/J.CARBON.2022.05.005.
- [5] **K.R. Brown**, X. Li, *Continuous Fiber Bath Treatments at Pilot Scale: A Novel Testbed System*, Poster presented at SAMPE 2022, Charlotte, NC.
- [6] A. Scherschel, T. Harrell, A. Sushchenko, E. Knight, **K.R. Brown**, X. Li, *Tuning Microstructure of Mesophase Pitch Carbon Fiber by Altering the Carbonization Ramp Rate*, Adv. Eng. Mater. (2024) 2400110. doi: 10.1002/ADEM.202400110.
- [7] A. Sushchenko, A. Scherschel, C. Love-Baker, T.M. Harrell, Ryan Cordier, **K.R. Brown**, X. Li, *Evaluating consumer 3D printing nozzles as a low-cost alternative for mesophase pitch-derived carbon fiber production*, Carbon (2024). doi: 10.1016/j.carbon.2024.119088
- [8] C.A. Love-Baker, T.M. Harrell, Alexander Scherschel, Z. Gao, N. Song, **K.R. Brown**, F. Vautard, Ilia Ivanov, J. Klett, Xiaodong Li, *Unveiling the microstructural evolution of carbon fibers derived from polyamide-6*, J. Polym. Res. 2023 302. 30 (2023) 1–13. doi: 10.1007/S10965-023-03455-6.
- [9] A. Scherschel, C.A. Love-Baker, A. Sushchenko, T.M. Harrell, **K.R. Brown**, X. Li, *Compatibility of Mesophase Pitch and Linear Low-Density Polyethylene for Low-Cost Carbon Fiber*, J. Polym. Res. 2023. doi: 10.1007/s10965-023-03466-3
- [10] T.M. Harrell, C.A. Love-Baker, **K.R. Brown**, C.H. Bumgardner, X. Li, *Extracting single fiber transverse and shear moduli from off-axis misalignment fiber tensile testing*, Composites Part A. (2022). doi: 10.1016/j.compositesa.2022.107204.
- [11] C.A. Love-Baker, T.M. Harrell, **K.R. Brown**, C.H. Bumgardner, X. Li, *Analyzing the effect of misalignment on single-filament carbon fiber tensile testing via stereoscopic computer vision imaging*, Meas. Sci. Technol. 32 (2021) 065904. doi: 10.1088/1361-6501/ABECEB.
- [12] Z. Gao et al., *Graphene reinforced carbon fibers*, Sci. Adv., vol. 6, no. 17, 2020, doi: 10.1126/sciadv.aaz4191.
- [13] J. Zhu et al., *Unveiling Carbon Ring Structure Formation Mechanisms in Polyacrylonitrile-Derived Carbon Fibers*, ACS Appl. Mater. Interfaces, vol. 11, no. 45, 2019, doi: 10.1021/acsami.9b15833.

Submitted

- [1] Z. Xue, **K.R. Brown**, X. Li, *Graphene Reinforced UHMWPE Fibers*, Accepted to Journal of Polymer Research, September 2024.

PATENTS

- [1] X. Li, Z. Gao, J. Zhu, Y. Murty, **K.R. Brown**, C. Bumgardner, *System and method of accelerating polymer fiber stabilization via irradiation treatment*, US20220235516A1, 2020, *Pending*.

GRANTS AWARDED

Low-Cost, Multifunctional Composites from Recycled Materials for Lighter and Smarter Vehicles

Department of Energy, Vehicle Technologies Office, Award DE-EE0010602 - \$2,500,00 awarded May 2023

- Led grant application drafting team and authored several proposal documents including technical volume
- Prepared award negotiation documentation

Low-Cost, High-Performance Carbon Fiber for Compressed Natural Gas Storage Tanks

Department of Energy, Fuel Cell Technologies Office, Award DE-EE0009239 – \$2,701,552 Awarded July 2020

- Led grant application drafting team and authored several proposal documents including technical volume

HONORS AND AWARDS

- Best Poster and Best Presentation Awards – *University of Virginia Engineering Research Symposium* 2024
- SAE Doctoral Engineering Scholarship 2023
- SAMPE University Research Symposium Semi-Finalist 2022
- UVA Society of P.R.I. recognition for community service 2020
- James H. Sams Outstanding Senior Award– *Clemson Mechanical Engineering Department* 2015
- Clemson Formula SAE Team MVP Award 2015
- E. Wayne Kay Scholarship – *Society of Manufacturing Engineers* 2014
- Fresenius Medical Care Scholarship 2013
- Frank H. Slocum Jr. Endowed Scholarship in Motorsports and Automotive Studies 2013
- Mark Van Bellamy Brooks Endowed Scholarship - *Robert H. Brooks Sports Science Institute* 2012
- Earl and Myrtle Walker Scholarship – *Society of Manufacturing Engineers* 2011
- North Carolina Young Entrepreneurs Award – *National Federation of Independent Business* 2010

PROFESSIONAL EXPERIENCE

NASCAR Design Engineer

June 2015 – December 2018

Team Penske

Mooresville, NC

- Designed vehicle components and systems to achieve racing performance goals
- Utilized additive manufacturing and composite materials in component design
- Conducted finite element analysis to optimize strength-to-weight ratio and system function of parts
- Organized and performed physical component testing to evaluate designs
- Analyzed available competitor vehicle data to assess and exploit relative performance gaps
- Developed innovative manufacturing tools, fixtures, patterns, and molds

This work resulted in one NASCAR Cup Series championship, and two NASCAR Xfinity Series championships

Tire Design Engineering Co-Op

January – June 2014

Michelin Americas Research Center

Greenville, SC

- Conducted finite element analysis on tire tread designs to analyze rolling resistance and wet traction
- Evaluated simulations and presented results to tire design engineering team

Objective Test Engineering Co-Op

May – August 2013

Michelin Laurens Proving Grounds

Mountville, SC

- Administered test component design and data analysis for objective test engineering team
- Created data analysis tools for team using Visual Basic for Applications

Competitor Analysis Engineering Co-Op

August - December 2012

Michelin Americas Research Center

Greenville, SC

- Analyzed data collected from physical tire testing and visual assessment of competitor tires
- Prepared internal reports of competitor tire characteristics to inform design team priorities
- Organized tire sample testing and led technicians in data collection efforts

TEACHING

Guest Lecturer, University of Virginia

Spring 2020 - Present

Course: Introduction to Engineering (ENGR 1624)

Spring 2020, '21, '22

- Provided a case study in practical, high-performance design engineering
- Taught the power of computer aided design as a communication tool

Seminar: The Fast and the Curious (UVA Scholar's Lab)

Fall 2024

- Provided a survey of the physics and engineering of straight-line automotive performance

Invited Speaker, UVA Darden School of Business

April 2022

Course: Additive Manufacturing 101

- Designed and lead a two-hour course featuring a lecture and hands-on demonstration to teach the basic concepts of additive manufacturing and the safe and effective operation of desktop 3D printers

MENTORING

Mentor, Virginia Motorsports Education Experiential Learning

January 2019 – Present

- Providing academic and professional development support for students interested in careers in the automotive and motorsports engineering fields, as well as graduate school
- Advising on student competition vehicle engineering design

Research Mentor, Li Lab Undergraduate Research Assistants

February – May 2020

- Oversaw projects for two Li Lab undergraduate research assistants
- Mentored assistants with their engineering design and fabrication efforts

SERVICE

Ad Hoc Reviewer

November 2022 – Present

- Journal of Applied Physics A, reviewed 5 manuscripts since November 2022
- Journal of Materials Science, reviewed 1 manuscript since February 2024
- Journal of Polymer Research, reviewed 1 manuscript since September 2024

Lab Sustainability Coordinator

January 2019 – Present

- Organizing Li Lab participation in UVA Green Labs Initiative events such as the “Shut the Sash” challenge to reduce energy waste

UVA Engineering for COVID Team

March - December 2020

- Designed and 3D printed custom camera mounts for UVA hospital COVID unit
- 3D printed face shields for healthcare providers in Virginia and beyond