

Exponent®
Engineering & Scientific Consulting

Nicholas Hines, Ph.D., CFEI

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Professional Profile

Dr. Hines applies the fundamentals of heat transfer, thermodynamics, material science and mathematical modeling to investigate the performance, degradation, and failure of consumer products and thermal fluid systems. He has expertise in the areas of heat transfer, thermometry, thermodynamics, and micro/nano-scale thermal physics. As a consultant, Dr. Hines has experience in consumer product failure evaluation and analysis, fire and explosion investigation, assessment of commissioning and operational issues related to power generation systems, evaluation of exhaust aftertreatment and emissions systems, and evaluation and application of engineering codes and standards related to construction and industrial equipment.

Dr. Hines also has extensive experience with experimental characterization, uncertainty analysis, and computational modeling of thermal and thermomechanical systems. Experimentally, Dr. Hines has expertise in non-contact, optical thermometry techniques including Raman thermometry, IR thermometry, and thermoreflectance imaging. Additionally, Dr. Hines is proficient in various characterization techniques including Raman spectroscopy, photoluminescence (PL) spectroscopy, Fourier transform infrared (FTIR) spectroscopy, scanning electron microscopy (SEM), and various electrical semiconductor and thermal property characterization techniques. Computationally, Dr. Hines has utilized high performance computing (HPC) resources to conduct various advanced numerical modeling analyses during technical investigations, including steady-state and transient finite element analysis (FEA), nonlinear regression analysis, and Monte Carlo simulation.

Prior to joining Exponent, as a Graduate Research Assistant, Dr. Hines utilized advanced optical and electrical thermometry techniques to characterize the thermal properties of semiconductor materials and the operating temperature of wide bandgap (WBG) semiconductor devices for power and radio frequency (RF) electronics applications. Further, he utilized experimentally validated thermal finite element analysis (FEA) to develop novel device-level thermal management solutions for WBG semiconductor devices. Dr. Hines also utilized non-destructive optical stress metrology techniques to characterize the accumulated residual stress distribution within gallium nitride (GaN) thin films resulting from lattice mismatch and coefficient of thermal expansion (CTE) mismatch during material growth and processing.

Prior to his graduate studies, Dr. Hines worked as a mechanical engineering intern at Corning Incorporated, where he designed and prototyped an experimental apparatus that utilized localized thermal expansion to enhance defect detection in glass films to support and improve product reliability. He also worked in the aerospace industry as a mechanical engineering intern at GE Aerospace, where he contributed to jet engine turbine thermal management and additive manufacturing process control for ceramic core die production for airfoil die casting.

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Academic Credentials & Professional Honors

Ph.D., Mechanical Engineering, Georgia Institute of Technology, 2023

M.S., Mechanical Engineering, Georgia Institute of Technology, 2019

B.S., Mechanical Engineering, Georgia Institute of Technology, 2015

B.S., Applied Physics, Morehouse College, 2015

Bruce Deal & Andy Grove Young Author Award, The Electrochemical Society, 2021

Graduate RISE Scholarship, Georgia Institute of Technology, 2018

GEM PhD Fellowship Award, Corning Incorporated, 2015

President's Fellowship Award, Georgia Institute of Technology, 2015

President's Undergraduate Research Award (PURA), Georgia Institute of Technology, 2014

Licenses and Certifications

Certified Fire and Explosion Investigator (CFEI)

Prior Experience

Graduate Teaching Assistant, Georgia Institute of Technology, 2023

Graduate Research Assistant, Georgia Institute of Technology, 2015-2023

Mechanical Engineering Intern, Corning Incorporated, 2015

Mechanical Engineering Intern, GE Aerospace, 2014

Mechanical Engineering Intern, GE Aerospace, 2013

Professional Affiliations

National Society of Black Engineers (NSBE)

The American Society of Mechanical Engineers (ASME)

National Association of Fire Investigators (NAFI)

Publications

Malakoutian M, Field DE, Hines NJ, Pasayat S, Graham S, Kuball M, Chowdhury S. Record-Low Thermal Boundary Resistance between Diamond and GaN-on-SiC for Enabling Radiofrequency Device Cooling. ACS Applied Materials & Interfaces 2021; 13(50): 60553-60560.

Cheng Z, Li R, Yan X, Jernigan G, Shi J, Liao ME, Hines NJ, Gadre CA, Idrobo JC, Lee E, Hobart KD, Goorsky MS, Pan X, Luo T, Graham S. Experimental observation of localized interfacial phonon modes. Nature Communications 2021; 12(1): 6901.

Hanus R, Rangnekar SV, Mollah S, Hussain K, Hines N, Heller E, Hersam MC, Khan A, Graham S. Thermoreflectance Imaging of (Ultra)wide Band-Gap Devices with MoS2 Enhancement Coatings. ACS Applied Materials & Interfaces 2021; 13(35): 42195-42204.

Hines NJ, Yates L, Foley BM, Cheng Z, Bougher TL, Goorsky MS, Hobart KD, Feygelson TI, Tadjer MJ, Graham S. Steady-state methods for measuring in-plane thermal conductivity of thin films for heat spreading applications. Review of Scientific Instruments 2021; 92(4): 044907.

Bai T, Wang Y, Feygelson TI, Tadjer MJ, Hobart KD, Hines NJ, Yates L, Graham S, Anaya J, Kuball M, Goorsky MS. Diamond Seed Size and the Impact on Chemical Vapor Deposition Diamond Thin Film Properties. ECS Journal of Solid State Science and Technology 2020; 9(5), 053002

Peer Reviews

IEEE Transactions on Electron Devices