**WILLIAM P. KING, PH.D.**
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## Summary of Professional Experience

- 30 years' experience working on design and analysis of thermal, electrical, and mechanical systems, new product development, and new technology development
- Distinguished academic with track record of research success and awards, development of new technologies, and translating technologies into commercial products
- Expert in heat transfer, manufacturing and metrology technologies, computer vision, nanotechnology, semiconductors, microsystems, electronic and electro-mechanical systems, advanced materials, product design, systems engineering, modeling and simulation, finite element analysis, and the use of machine learning and artificial intelligence to solve engineering problems
- Consulted for companies in computing, semiconductor, energy generation, aerospace, automotive, manufacturing, and materials industries
- Former advisor to the Defense Advanced Research Projects Agency (DARPA). Held civilian equivalent rank of two-star general. Extensive experience with defense technologies
- Co-founder of three companies in the manufacturing and materials industry
- Co-founder and Chief Technology Officer at MxD, a public-private partnership focused on digital manufacturing and Industry 4.0 technologies. Led a portfolio of technology development projects worth $100M. Worked with large manufacturing companies, U.S. Department of Defense, and dozens of universities
- 20+ years' experience teaching in the university classroom; courses include heat transfer, product design, materials, manufacturing, experimental methods
- Published more than 300 journal articles; holds 28 U.S. patents
- Given more than 100 keynote speeches and invited lectures

## Education

- Ph.D., Mechanical Engineering, Stanford University, 2002
- M.S., Mechanical Engineering, Stanford University, 1998
- B.S. Mechanical Engineering, University of Dayton, 1996
- Program for Leadership Development, Harvard Business School, 2012 (Alumni Status Program)

## Professional Experience

Professor and Ralph A. Andersen Endowed Chair, Department of Mechanical Science and Engineering, Department of Materials Science and Engineering, Department of Electrical and Computer Engineering, Carle-Illinois College of Medicine; University of Illinois Urbana-Champaign, 2007- present http://kinglab.mechse.illinois.edu

Board of Directors, Dedicated Computing, 2024-present https://www.dedicatedcomputing.com/

Board of Governors, American Society of Mechanical Engineers (ASME), 2024-present https://www.asme.org/

Senior Advisor, EDM Intelligent Systems Inc., 2012- present http://www.edmdept.com

Senior Advisor, Sybridge Technologies Inc., 2023-2024 https://sybridge.com/

Chief Scientist and co-Founder, Fast Radius Inc., 2016-2022 http://www.fastradius.com

Senior Advisor, McKinsey and Company, 2014-2020 http://www.mckinsey.com

Advisor and co-Founder, Anasys Instruments Inc., 2005-2018 http://www.anasysinstruments.com

Chief Technology Officer, MxD Digital Manufacturing and Design Innovation Institute, 2014-2015 http://www.mxd.ord

Defense Sciences Research Council, Advisor to the Defense Advanced Research Projects Agency (DARPA), 2007-2014, Co-Chair 2012-2014 http://www.darpa.mil

Research Staff Member, IBM Zurich Research Laboratory, group of Nobel Laureate Gerd Binnig, 1999-2001
http://www.research.ibm.com/labs/zurich

**Awards and Honors**

ASME Ennor Award for Distinguished Accomplishment in Manufacturing, 2023
Fellow, SME (Society of Manufacturing Engineers), 2022
Fellow, National Academy of Inventors, 2022
Fellow, Institute of Electrical and Electronics Engineers, 2022
World Economic Forum Lighthouse Factory Award, 2018
Fellow, American Physical Society, 2015
Fellow, American Association for the Advancement of Science, 2014
ASME Gustus Larson Award for Accomplishment in Mechanical Engineering, 2013
Fellow, American Society of Mechanical Engineers, 2011
ASME Bergles-Roshenow Young Investigator Award in Heat Transfer, 2009
R&D 100 Award, 2007 and 2008
Office of Naval Research Young Investigator Award, 2007
TR35 – Technology Review's list of the most innovative people under the age of 35, 2006
Presidential Early Career Award for Scientists and Engineers (PECASE), 2005
National Science Foundation CAREER Award, 2003
IBM Graduate Research Fellow, 2000-2002

**Areas of Expertise**

1. ***Heat Transfer and Thermal Management***

- Designed, built, and tested thermal management and cooling solutions for workstation computers, rack servers, GPU computing systems, semiconductor packages, power electronics, gallium nitride devices, light emitting diodes (LEDs), and silicon devices
- Designed and analyzed air coolers, cold plates, heat pipes, heat exchangers, single-phase and two-phase systems, thermal interface materials, phase change materials, and thermoelectric coolers
- Designed and analyzed heat transfer devices made from copper, aluminum, steel, polymers, and thermoelectric materials. Working fluids include air, water, ethylene glycol, R134a, and many other refrigerants and dielectric liquids
- Designed and analyzed systems for conduction heat transfer, convection heat transfer, boiling and condensation heat transfer, liquid-solid phase change heat transfer
- Designed and analyzed thermal management solutions for defense electronics and commercial products
- Designed and built thermal and mechanical test equipment used in the semiconductor and computing industries
- Designed, analyzed, built, and tested cooling solutions for data centers including cooling of computer systems for conventional computing and GPU cooling
- Designed, analyzed, built, and tested high performance heat exchangers made using additive manufacturing
- Worked with many companies on heat transfer and thermal management including IBM, Intel, Hewlett-Packard (HP), Raytheon, Texas-Instruments, Motorola, Freescale, and Meta
- Analyzed heat transfer and thermal management in computers for crypto currency including Bitcoin and Ethereum
- Worked with U.S. Navy, U.S. Air Force, and Department of Energy
- Taught undergraduate and graduate courses in heat transfer

2. ***Additive Manufacturing***

- Designed and built commercial factory for additive manufacturing. The factory had >25 polymer machines including digital light synthesis (Carbon), multi-jet fusion (HP), fused deposition modeling (Stratasys), and stereolithography (FormLabs, 3D Systems). This factory made more than 3M parts for

enterprise customers. The factory was certified AS9100 and was the first factory to be certified for additive manufacturing production at dozens of Fortune 500 companies. The factory was awarded "Lighthouse Factory" status by the World Economic Forum as one of the world's most technologically advanced factories.

- Designed and produced tens of thousands of additively manufactured parts and measured their properties. Studied manufacturing accuracy, repeatability, and scalability of polymer additive manufacturing
- Developed technologies for smart manufacturing including machine sensors and data analysis
- Worked with or consulted for many companies on this topic including General Motors, Ford, Aptiv, Johnson and Johnson, Becton Dickenson, Boeing, Airbus, Oakley, Steelcase, Rawlings, Colgate-Palmolive, Bastian Solutions, Axial 3D, TE Connectivity, Husqvarna, Carbon 3D, HP, and Desktop Metal
- Worked with U.S. Army on this topic

***3. Computer Vision for Manufacturing***

- Developed computer vision systems for factory applications including non-destructive inspection (NDI) and process monitoring. Experience with video, still images, X-Ray computed tomography (CT), laser scanning, variable focus methods, structured light, tactile sensors, and point clouds
- Developed metrology technology used in the aerospace industry for turbine blade inspection
- Developed software for measuring and analyzing dimensions of manufactured components using computer vision and machine learning technologies for metrology automation
- Experience with convolutional neural networks, supervised and unsupervised learning methods, and anomaly detection
- Worked with U.S. Army on this topic

***4. Materials Characterization and Nanometer-Scale Measurements***

- Developed technologies for atomic force microscopy (AFM) including scanning thermal microscopy, infrared measurements, characterization of materials properties, and electronic measurements
- Developed AFM-based materials property characterization tools that were integrated into commercial products from Bruker Inc. that are widely used in the manufacturing, automotive, pharmaceutical, and materials industries
- Worked on AFM-based high density data storage systems that used arrays of AFM probes for write / read erase

***5. Micro-Manufacturing, Nano-Manufacturing, and Nano Lithography***

- Developed technologies for nanometer-scale manufacturing using scanning probe lithography, electron beam lithography, and nano imprint lithography
- Synthesized and characterized nanomaterials including carbon nanotubes, graphene, molybdenum sulfide, nanoparticles
- Designed and fabricated micro- and nano-electronic devices with integrated nanomaterials including batteries, sensors, actuators, and coatings
- Developed ultra high power microbatteries with microfabricated electrodes
- Developed technologies that were integrated into commercial products sold by Heidelberg Instruments, Hoowaki Inc., and 1900 Engineering Inc.

***6. Microelectromechanical Systems (MEMS)***

- Developed sensor and actuator technologies based on micro-cantilevers
- Designed, fabricated, and tested hundreds of MEMs devices for force sensing, displacement sensing, actuation, temperature sensing, mechanical sensing, electrical measurements
- Designed, fabricated, and tested electronic devices integrated with MEMS devices including resistors, transistors, and diodes
- Extensive experience measuring and modeling the performance of MEMS devices
- Developed technologies for characterizing the electrical, mechanical, and thermal properties and performance of MEMS devices

- Developed technologies for integrating new materials into MEMS devices including thin film diamond, polymer films, and battery electrode materials

***7. Product Design and New Product Development***

- Consulted for many companies on new product development, new technology development, research and development portfolio management
- Taught undergraduate and graduate courses in product design and new product development

***8. Intellectual Property***

- Holds 28 U.S. patents on manufacturing, materials technologies, heat transfer, and thermal management technologies. Most of these patents are used in commercial products and services
- Consulted for more than a dozen companies on intellectual property strategy, patent portfolio strategy, and technology road mapping

**Publications**

More than 300 journal articles and hundreds of conference papers and presentations. This work has been cited more than 20,000 times according to Google Scholar.

Full list of publications: https://scholar.google.com/citations?user=JvqBxB0AAAAJ&hl=en&oi=ao

**Key Publications – Heat Transfer and Thermal Management**

1. Pinkus, I., W.Y. Park, V. Ganesan, O.M. Zaki, T.G. Aguirre, K. Nawaz, N. Miljkovic, and W.P. King, "Ultra-Low Thermal Resistance and Pressure Drop Copper and Copper-Tungsten Diamond-Shaped Pin Fin Cold Plates for Liquid Cooling of Electronics," International Journal of Heat and Mass Transfer 256, 128080, 2026.
2. Lad, A.A., E. Roman, Y. Zhao, W.P. King, and N. Miljkovic, "Fin Design Topology Optimization for Direct Liquid Cooling of Multi-Chip Power Modules," IEEE Transactions on Components, Packaging, and Manufacturing Technology, 2024.
3. Kim, S., T. Yang, N. Miljkovic, and W.P. King, "Phase Change Material Integrated Cooling for Transient Thermal Management of Electronic Devices," International Journal of Heat and Mass Transfer 213, 124263, 2023.
4. Fu, W., Y. Gurumukhi, X. Yan, W.P. King, and N. Miljkovic, "Ultrahigh power and energy density dynamic phase change materials using pressure-enhanced close contact melting," Nature Energy, 2022.
5. Moon, H., D.J. McGregor, N. Miljkovic, and W.P. King, "Ultra-power-dense heat exchanger development through genetic algorithm design and additive manufacturing," Joule 5, 3045-3056, 2021.
6. Kwon, B., T. Foulkes, T. Yang, N. Miljkovic, and W.P. King, "Air Jet Impingement Cooling of Electronic Devices Using Additively Manufactured Nozzles," IEEE Transactions on Components and Packaging Technology 10, 220-229, 2020.
7. Kwon, B., N. Maniscalco, A.M. Jacobi, and W.P. King, "High Power Density Two-Phase Cooling in Microchannel Heat Exchangers," Applied Thermal Engineering 148, 1271-1277, 2019.
8. Kwon, B., N.I. Maniscalco, A.M. Jacobi, and W.P. King, "High Power Density Air-Cooled Microchannel Heat Exchanger," International Journal of Heat and Mass Transfer 118, 1276-1283, 2018.
9. Kim, F., B. Kwon, Y. Eom, J.E. Lee, S. Park, S. Jo, S.H. Park, B.S. Kim, H.J. Im, M.H. Lee, T.S. Min, K.T. Kim, H.G. Chae, W.P. King, and J.S. Son, "3D printing of shape-conformable thermoelectric materials using all-inorganic Bi2Te3-based inks," Nature Energy 4, 301-309, 2018.

**Key Publications – Additive Manufacturing**

1. Conway, C.H., D.J. McGregor, T. Antonsen, C. Wood, C. Shao, and W.P. King, "Geometry repeatability and prediction for personalized medical devices made using multi-jet fusion additive manufacturing," Additive Manufacturing Letters 9, 100200, 2024.
2. McGregor, D.J., M.V. Bimrose, C. Shao, S. Tawfick, and W.P. King, "Using machine learning to predict dimensions and qualify diverse part designs across multiple additive machines and materials," Additive Manufacturing 55, 102848, 2022.

3. Lim, J., R. Stavins, V. Kindratenko, J. Baek, L. Wang, K. White, J. Kumar, E. Valera, W.P. King, and R. Bashir, "Microfluidic Point-Of-Care Device for Detection of Early Strains and B.1.1.7 Variant of SARS-CoV-2 Virus," Lab on Chip 22, 7, 1297-1308, 2022.
4. McGregor, D.J., S.Rylowicz, A. Brenzel, D. Baker, C. Wood, D. Pick, H. Deutchman, C. Shao, S. Tawfick, and W.P. King, "Analyzing part accuracy and sources of variability for additively manufactured lattice parts made on multiple printers," Additive Manufacturing 40, 101924, 2021.
5. McGregor, D.J., S. Tawfick, and W.P. King, "Mechanical Properties of Hexagonal Lattice Structures Fabricated Using Continuous Liquid Interface Production Additive Manufacturing," Additive Manufacturing 25, 10-18, 2019.
6. Yang, Y., D.J. McGregor, S. Tawfick, W.P. King, and C. Shao, "Hierarchical data models improve the accuracy of feature level predictions for additively manufactured parts," Additive Manufacturing 51, 102621, 2022.

**Key Publications – Computer Vision for Manufacturing**

1. Bimrose, M.V., D.J. McGregor, C. Wood, S. Tawfick, and W.P. King, "Additive Manufacturing Source Identification from Photographs using Deep Learning" npj Advanced Manufacturing 2, 20, 2025.
2. Bimrose, M.V., T. Hu, D.J. McGregor, J. Wang, S. Tawfick, C. Shao, Z. Liu, and W.P. King, "Detecting and Classifying Hidden Defects in Additively Manufactured Parts using Deep Learning and X-ray Computed Tomography," Journal of Intelligent Manufacturing, 2024.
3. McGregor, D.J., M.V. Bimrose, S. Tawfick, and W.P. King, "Large batch metrology on internal features of additively manufactured parts using X-ray computed tomography," Journal of Materials Processing Technology 306, 117605, 2022.
4. McGregor, D.J., S. Tawfick, and W.P. King, "Automated Metrology and Geometric Analysis of Additively Manufactured Lattice Structures," Additive Manufacturing 28, 535-545, 2019.

**Key Publications - Materials Characterization and Nanometer-Scale Measurements**

1. Rosenberger, M.R., J.P. Jones, E.R. Heller, S. Graham, and W.P. King, "Nanometer-Scale Strain Measurements in AlGan/GaN High-Electronic Mobility Transistors during Pulsed Operation," IEEE Transactions on Electron Devices 63, 2742-2748, 2016.
2. Lee, B., C.B. Prater, and W.P. King, "Magnetic Actuation of a Heated Atomic Force Microscope Cantilever using Lorentz Force," Nanotechnology 23, 055709, 2012.
3. Grosse, K.L., M.H. Bae, F. Lian, E. Pop, and W.P. King, "Nanoscale Joule Heating, Peltier Cooling and Current Crowding in Graphene-Metal Contacts," Nature Nanotechnology 6, 287-290, 2011.
4. Kjoller, K., J.R. Felts, D. Cook, C.B. Prater, and W.P. King, "High-Sensitivity Nanometer-Scale Infrared Spectroscopy using a Contact Mode Microcantilever with Internal Resonator Paddle," Nanotechnology 21, 185705, 2010.
5. Lee, J., A. Liao, E. Pop, and W. P. King, “Electrical and Thermal Coupling to a Single-wall Carbon Nanotube Device using an Electro-thermal Nanoprobe,” Nano Letters, 0:4, 1356-1361, 2009.
6. Nelson, B. A. and W. P. King, “Measuring Material Softening with Nanoscale Spatial Resolution using Heated Silicon Probes,” Review of Scientific Instruments, 78, 023702, 2007.
7. Rowland, H. D., W. P. King, J. B. Pethica, and G. L. W. Cross, “Molecular Confinement Accelerates Deformation of Entangled Polymers During Squeeze Flow,” Science, 322, 720-724, October 2008.
8. King, W. P., S. Saxena, B. A. Nelson, and B. Weeks, “Nanoscale Thermal Analysis of an Energetic Material,” Nano Letters, 6, 2145-2149, 2006.
9. King, W. P., T. W. Kenny, K. E. Goodson, G. L. W. Cross, M. Despont, U. Dürig, H. Rothuizen, G. Binnig, and P. Vettiger, “Atomic Force Microscope Cantilevers for Combined Thermomechanical Data Writing and Reading,” Applied Physics Letters, 78, 1300-1302, 2001.

**Key Publications – Micro-Manufacturing, Nano-Manufacturing, Nano Lithography**

1. Chen, S., S. Kim, W. Chen, J. Yuan, R. Bashir, J. Lou, A.M. van der Zande, and W.P. King, "Monolayer MoS2 Nanoribbon Transistors Fabricated by Scanning Probe Lithography," Nano Letters 19, 2092-2098, 2019.

2. Ramesh, A., W. Akram, S.P. Mishra, A.H. Cannon, A.A. Polycarpou, and W.P. King, "Friction Characteristics of Microtextured Surfaces under Hydrodynamic Lubrication," Tribology International 57, 170–176, 2013.
3. Wei, Z., D. Wang, S. Kim, S.-Y. Kim, Y. Hu, M.K. Yakes, A.R. Laracuente, Z. Dai, S.R. Marder, C. Berger, W.P. King, W.A. deHeer, P.E. Sheehan, and E. Riedo, "Nanoscale Tunable Reduction of Graphene Oxide for Graphene Electronics," Science 328, 1373-1376, 2010.
4. Gallant, N. D., J. L. Charest, W. P. King, and A. J. García, "Micro- and Nano-Patterned Substrates to Manipulate Cell Adhesion," Journal of Nanoscience and Nanotechnology, 7:3, 803-807, 2007.
5. Szoszkiewicz, R., T. Okada, S. C. Jones, T.-D. Li, W. P. King, S. R. Marder, and E. Riedo, "High-Speed, Sub-15 nm Feature Size Thermochemical Nanolithography," Nano Letters, 7, 1064-1069, 2007.
6. Nelson, B. A., W. P. King, A. R. Laracuente, P. A. Sheehan, and L. J. Whitman, "Direct Nanoscale Deposition of Continuous Metal Nanostructures using Thermal Dip Pen Nanolithography," Applied Physics Letters, 88, 033104, 2006.
7. Rowland, H. D., A. C. Sun, P. R. Schunk, and W. P. King, "Impact of Polymer Film Thickness and Cavity Size on Polymer Flow during Nanoimprint Lithography," Journal of Micromechanics and Microengineering, 15, 2414-2425, 2005.
8. Sheehan, P. A., L. J. Whitman, W. P. King, and B. A. Nelson, "Nanoscale Deposition of Solid Inks via Thermal Dip Pen Nanolithography," Applied Physics Letters, 85, 1589-1591, 2004. Republished online in the Virtual Journal of Nanoscience & Nanotechnology, 10, 2004.
9. Charest, J. L., L. E. Bryant, A. Garcia, and W. P. King, "Hot Embossing for Micro Patterned Cell Substrates," Biomaterials, 25, 4767-4775, 2004.

**Key Publications - Microelectromechanical Systems (MEMS)**

1. King, W. P., T. W. Kenny, K. E. Goodson, G. L. W. Cross, M. Despont, U. Dürig, H. Rothuizen, G. K. Binnig, and P. Vettiger, "Design of Atomic Force Microscope Cantilevers for Combined Thermomechanical Writing and Ready in Array Operation," Journal of Microelectromechanical Systems, 11, 765-774, 2002.
2. Lee, J., T. L. Wright, T. Beecham, B. A. Nelson, S. Graham, W. P. King, "Electrical, Thermal, and Mechanical Characterization of Silicon Microcantilever Heaters," Journal of Microelectromechanical Systems, 15, 1644-1655, 2006.
3. Park, K., J. Lee, Z. M. Zhang, and W. P. King, "Frequency-Dependant Electrical and Thermal Response of Heated Atomic Force Microscope Cantilevers," Journal of Microelectromechanical Systems, 16, 213-222, 2007.
4. Goericke, F. T., J. Lee, and W. P. King, "Microcantilever Hotplates with Temperature-compensated Piezoresistive Strain Sensors," Sensors and Actuators A, 143, 181-190, 2008.
5. Privorotskaya, N.L., H. Zheng, J.A. Carlisle, R. Bashir, and W.P. King, "Piezoresistive Microcantilevers from Ultrananocrystalline Diamond," Journal of Microelectromechanical Systems 19, 1234-1242, 2010.
6. Pikul, J.H., H.G. Zhang, J. Cho, P.V. Braun, and W.P. King, "High Power Lithium Ion Micro Batteries from Interdigitated Three-Dimensional Bicontinuous Nanoporous Electrodes," Nature Communications 4, 1732, 2013.
7. Pikul, J.H., J. Liub, P.V. Braun, and W.P. King, "Integration of High Capacity Materials into Interdigitated Mesostructured Electrodes for High Energy and High Power Density Primary Microbatteries," Journal of Power Sources 315, 308-315, 2016.
8. Park., M., J.Y. Yoo, T. Yang, Y.H. Jung, A. Vázquez-Guardado, S. Li, J.H. Kim, J. Shin, W.Y. Maeng, G. Lee, S. Yoo H Luan, J.T. Kim, H.S. Shin, M.T. Flavin, H.J. Yoon, N. Miljkovic, Y. Huang, W.P. King, and J.A. Rogers, "Skin-integrated systems for power efficient, programmable thermal sensations across large body areas," Proceedings of the National Academy of Sciences 120, e2217828120, 2023.
9. Fletcher, P.C., B.S. Bhatia, Y. Wu, M.A. Shannon, and W.P. King, "Electro-Thermal Atomic Force Microscope Cantilever with Integrated Heater and NPN Back-To-Back Diodes," Journal of Microelectromechanical Systems 20, 644-653, 2011.
10. Fletcher, P.C., J.R. Felts, Z. Dai, T.B. Jacobs, H. Zeng, W.K. Lee, P.E. Sheehan, J.A. Carlisle, R.W. Carpick, and W.P. King, "Wear Resistant Diamond Nanoprobe Tips with Integrated Silicon Heater for Tip-Based Nanomanufacturing," ACS Nano 4, 3338-3344, 2010.