

Hansung Kim

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Education

Ohio State University	Mechanical Engineering	BSME 1999
Ohio State University	Mechanical Engineering	MSME 2002
Ohio State University	Mechanical Engineering	Ph.D 2008
University of Notre Dame	Mechanical Engineering	Post-doctoral (2008-2009)
Purdue University	School of Aeronautics and Astronautics	Post-doctoral (2010)
Northwestern University	Mechanical Engineering	Post-doctoral (2010-2012)

Research Experience

Assistant Professor- Multi-scale modeling and experiments of bio/nano/energy materials

Purdue University Northwest, Hammond, IN, July 2014 – Current

- Utilizing Molecular Dynamics (MD), and Finite Element Method (FEM) for characterizing bio/nano/energy materials
- Managing experimental laboratory for material characterization using Atomic Force Microscopy (AFM), universal testing machine, and solar cell characterization equipment

Computational engineer/Grant manager- Multi-scale modeling and simulations of gas adsorption in porous materials (Natural gas vehicle and semiconductor manufacturing applications)

NuMat Technologies, Skokie, IL, Jan. 2013 – Oct. 2013

- Utilized Density Functional Theory (DFT), Monte Carlo (MC) simulations, and Molecular Dynamics (MD) for the development of new materials for clean energy technologies by investigating gas adsorption in porous materials
- Led interactions with industry partners in computationally assessing viability of materials in applications of interest
- Managed NSF Small Business Innovation Research (SBIR) grant

Project Leader/ Post-Doctoral Researcher - Multi-scale modeling and experiments in gene/drug delivery using nanomaterials

Northwestern University, Evanston, IL, July 2010 – Dec. 2012

- Led three interdisciplinary gene/drug delivery research groups {including Mechanical engineering, Biomedical engineering, Chemistry groups: total 10 researchers}
- Utilized Density Functional Theory (DFT), Molecular Dynamics (MD), and Immersed Finite Element Method (IFEM) for gene/drug delivery simulations
- Involved in writing proposals on gene delivery research submitted to NIH (National Institutes of Health)

Research Project Manager – Multi-scale modeling and design of polymer nanocomposites funded by Goodyear Tire Company

Northwestern University, Evanston, IL, July 2010 – December 2011

- Managed interdisciplinary project that involved 6 faculty members (Mechanical and Materials Science Engineering) and 20 post-doc candidates and Ph.D students
- Utilized molecular dynamics and Finite Element Method
- Wrote two proposals, in charge of deliverables, reports, and arranging all conferences, including bi-weekly conferences with Goodyear Tire company

Post-Doctoral Researcher – Modeling and simulations of nanowires and nanocrystalline materials (Material properties and fracture)

Purdue University, West Lafayette, IN, January 2010 – July 2010

(Continued research from University of Notre Dame with collaborating professor Vikas Tomar)

University of Notre Dame, South Bend, IN, September 2008 – December 2009

- Investigated elastic, plastic, and fracture behaviors of silicon nanocomposites and nanowires using multi-scale simulations

Post-Doctoral Researcher – Multi-scale design and simulation of nanocomposite for improved soldier crash safe survivability

University of Notre Dame, South Bend, IN, September 2008 – December 2009

- Funded by U.S. Army Tank Automotive Research, Development and Engineering Center (TARDEC) : 8 faculty members are involved
- Involved in development of new computational design methodologies subject blast loadings using multi-scale simulations: Molecular Dynamics (MD) and Finite Element Method (FEM)

Graduate Research Assistant – Multi-scale simulations of behavior of nanocrystalline materials and MEMS/NEMS thin films

Ohio State University, Columbus, OH, September 2002 – June 2008

- Utilized Density Function Theory (DFT), MD, and FEM to investigate properties of MEMS/NEMS materials
- Research also included microstructure-property relationship, statistical analysis, hands-on experience of Transmission Electron Microscopy (TEM), and making use of multi-scale software packages: ABAQUS (FEM), ANSYS(FEM), Hypermesh (FEM mesh), SolidWorks, CAD, Python, FORTRAN, MATLAB, VASP (DFT), Unix shell scripts, Minitab (Statistics)
- **Dissertation: Prediction of elastic properties of micro- and nano-scale thin films**

Graduate Research Assistant – Hybrid Electric Vehicle (HEV) energy storage systems

Ohio State University, Columbus, OH, September 1999 – August 2002

- Modeling and simulations of energy storage systems, control of energy storage systems in HEV applications. Relevant coursework: Digital control, Analog control, Estimation, HEV (including energy storage systems), Power train control, Internal combustion engine, Measurement
- Participated in national HEV competitions as a team captain of energy storage systems of OSU HEV team (Dearborn MI, 2000 and Mesa AZ, 2001)
- **Thesis: Dynamic battery modeling in Hybrid Electric Vehicles**

Patent/Intellectual Properties

Hansung Kim, Mitch Weston, Patrick Fuller, and Paul Wai-Man Siu “Metal Organic Frameworks for Electronic Gas Storage” US9138720B2, Grant date: September 22, 2015

Publications

Garcia, A, **Kim, H**, “The Effects of Axial Stress on CIGS Solar Cell Performance”, Conference Proceeding, 46th IEEE Photovoltaic specialist conference, 2019 (in-press)

Kim, H, Xu, D, John, C, Wu, Y, "Modeling Thermo-Mechanical Stress of CIGS Solar Cells," IEEE Journal of Photovoltaics, 9(2). 499-505, 2019.

Kim, H, B. G. Wojkovich, “Effects of Mechanical Damage and Temperature on the Electrical Performance of CIGS Thin-Film Solar Cells”, IEEE Journal of Photovoltaics, 8(5), 1331-1336, 2018

Kim, H., MD. Tofail, MD. T, John, C, “The Effect of Interface Cracks on the Electrical Performance of Solar Cells”, *Journal of the Minerals, Metals & Materials Society*, 70(4), 473-478, 2018

Kim, H., Efficient Microstructure simulation of thin films and its effect on elastic properties focusing on grain size distribution, 4th Annual International conference on Materials Science, Metal & Manufacturing, Conference proceeding, 23-27, 2017

Man, H.B., **Kim, H.**, Kim, H.J, Robinson, E., Liu, W, Chow, E., Ho, D, “Synthesis of Nanodiamond-Daunorubicin Conjugates to Overcome Multidrug Chemoresistance in Leukemia” *Nanomedicine*, Vol 10, 359-369, 2014

Li, Y., Stroberg Y., Lee, T., **Kim, H.**, Man, H, Ho, D. Decuzzi, P. Liu, W., “ Multiscale Modeling and Uncertainty Quantification in Nanoparticle-mediated Drug/Gene Delivery” Special Issue of Computational Mechanics in Nanomedicine, 53:511-537, 2014

Liu, W., Kopacz, A. M., Lee, T., **Kim, H.**, Decuzzi, P., “Immersed Molecular Electrokinetic Finite Element Method for Nano-devices in Biotechnology and Gene Delivery” *Meshfree Methods for Partial Differential Equations VI*. 235, Springer US, 2013 (Book Chapters, ISBN: 978-3-642-32978-4)

Mejia-Rodriguez, G, Renaud, J, **Kim, H.**, Tomar, V, “Sequential approximate optimization-based robust design of SiC–Si₃N₄ nanocomposite microstructures” *Engineering Optimization*, Vol 45, 287-309, 2013

Kim, H., Man H.B., Saha, B., Kopacz, A. M., Lee, O., Ho, D, Schatz, G., Liu, W., “Multiscale Simulation as a Framework for the Enhanced Design of Nanodiamond-Polyethylenimine-based Gene Delivery” *Journal of Physical Chemistry Letters*, Vol 3, 3719-3797, 2012

Kim, H., Tomar, V., Nanometer to micron scale mechanics of [100] silicon nanowires using atomic simulations at accelerated time steps, *Physica Status Solidi A*, 208(9), 2115-2123, 2011

Kim, H., Tomar, V., Nanometer to micron scale mechanics of silicon using atomic simulations at accelerated time steps, *Journal of Nanomechanics and Micromechanics*, 1(4) , 2011

Tomar, V., Samvedi, V., and **Kim, H.**, Atomistic understanding of the particle clustering and particle size effect on the room temperature strength of SiC-Si₃N₄ nanocomposites, *International Journal for Multiscale Computational Engineering*. Vol 8, issue 5, 463-472, 2010

Tomar, V, Gan, M., **Kim, H.**, Effect of temperature and morphology on mechanical strength of Si-C-O and Si-C-N nanocomposites, *the Journal of European Ceramic Society*, Vol 30, 2223 – 2237, 2009

Kim, H., Windl, W., Efficient ab-initio calculation of the elastic properties of nanocrystalline silicon. *Journal of Computational and Theoretical Nanoscience* 4: 65-70. 2007.

Kim, H., Windl, W., Choi, J., Lee, J. K., Lee, N. K., Multiscale simulations of the elastic properties of polycrystalline silicon. *Proc. 9th International Conference on Numerical Methods in Industrial Forming Processes (NUMIFORM 07)*, Vol 908, 1381 – 1386, 2007

Choi, J., **Kim, H.**, Lee, J. K., Lattice based microstructure evolution model for Monte Carlo finite element analysis for polycrystalline materials. *Proc. 8th International Conference on Numerical Methods in Industrial Forming Processes (NUMIFORM 04)*, Vol 712, 1824-1829, 2004

Paganelli, G., Guezennec, Y.G., **Kim, H.**, Brahma, A., Battery dynamic modeling and real-time state of charge estimation in a Hybrid Electric Vehicle application, *SME International Mechanical Engineering Congress and Exposition Proceedings*. Vol., 2. 1101-1107, 2001.

Hopka, M., Brahma, A. Dilmi, S., Ercole, G., Hubert, C., Huseman, S., **Kim, H.**, Paganelli, G., Tateno, M., The Ohio State University Future Truck. SAE special publication SP-1617, SAE Congress, 2001.

Conference/Webinar Presentations

Effect of Layer Thickness on the Residual Stresses of CIGS Solar Cells due to Hotspot, 5th World Congress on Integrated Computational Materials Engineering (ICME) (Indianapolis IN, 2019)

Effect of Mechanical Damage and Temperature on the Electrical performance of solar cells, Webinar presentation to International PV Quality Assurance Task Force group (PVQAT TG7, Wind load effect on solar cells) organized by NREL (2019)

Efficient Microstructure simulation of thin films and its effect on elastic properties focusing on grain size distribution at 4th Annual International conference on Materials Science, Metal & Manufacturing, Singapore, 2017

Modeling and Simulations of Complex Materials for Gene Delivery: Nanodiamond-Polyethylemine800-siRNA at 48th Annual Technical Conference of the Society of Engineering Sciences (Evanston IL, 2011)

Molecular Dynamic Simulations of Nanodiamond-PEI800-siRNA Complex Formation for Gene Delivery at USNCCM, (Minneapolis MN, 2011)

Understanding scaling relations in fracture and mechanical deformation of single crystal and polycrystalline silicon by performing atomistic simulation at meso-scale at USNCCM (Columbus OH, 2009)

Nano/ Micro Scale Simulation of Elastic Properties of Polycrystalline Silicon at USNCCM (San Francisco CA, 2007)

Elastic Properties and Mechanical Behavior Simulations of MEMS Thin Films at USNCCM (San Francisco CA, 2007)

Poster Presentations

Kim, H., Xu, D, Lingaraju, A, Kpoffon, H, Abramowitz, H, “Effect of Temperature on the Elastic Properties of Hydrogel: Modeling and AFM Experiments”, 5th World Congress on Integrated Computational Materials Engineering (ICME) (Indianapolis IN, July 2019)

Kim, H., Xu, D, John, C, Wu, Y, "Modeling Thermo-Mechanical Stress of CIGS Solar Cells", PV reliability Workshop organized by National Renewable Energy Laboratory, (Lakewood CO, Feb 2019)

Kim, H., Wojkovich, B. G., “Effects of Mechanical Damage and Temperature on the Electrical Performance of CIGS Thin Film Solar Cells”, PV reliability Workshop organized by National Renewable Energy Laboratory, (Lakewood CO, Feb 2018)

Kim, H., “Microstructure Simulation of Polycrystalline Thin Films”, PV reliability Workshop organized by National Renewable Energy Laboratory, (Lakewood CO, Feb 2017)

Teaching Experience

Instructor – **Alternative Energy Systems: ME597** (Undergraduate and Graduate)
Purdue University Northwest, Hammond, IN, January – May 2018 (Every 2 year)

- Taught lectures and computer lab sections

- Topics: Computational and analytical modeling of electrochemical batteries and solar cells, hands-on characterization of batteries using battery charger/discharger with data acquisition system, hands-on characterization of solar cells using solar analyzer.

Instructor - Modeling of Micro/Nano Systems: ME597 (Undergraduate and Graduate)

Purdue University Northwest, Hammond, IN, January – May 2015, 2017 (Every 2 year)

- Taught lectures and computer lab sections
- Topics: Computational design of micro/nano systems, Molecular dynamics, Micromechanics, and hands-on characterization of micro/nano systems using Atomic Force Microscopy (AFM)

Instructor – Finite Element Method (FEM): ME404 (Undergraduate)

Purdue University Northwest, Hammond, IN, January 2015 – May 2015 (Every year after)

- Taught lectures and computer lab sections
- Topics: Formulation of FEM equations and Computational FEM analysis: Solid, Heat transfer, and Fluid dynamics, FE analysis using commercial software: ANSYS, Autodesk Inventor, and Fluent.

Instructor- Dynamics of Physical Systems: ME315 (Undergraduate)

Purdue University Northwest, Hammond, IN, August 2014 – December 2014 (Every year after)

- Taught lectures
- Topics: Analysis of translational, rotational systems, Advanced analysis of physical systems using the Laplace transform, computational simulations of dynamic physical systems

Instructor- Elementary Engineering design: ENGR190 (Undergraduate)

Purdue University Northwest, Hammond, IN, January 2015 – May 2018 (Every semester)

- Taught lectures and supervised laboratories
- Topics: Force analysis of static structures, building a truss bridge made of basswood based on force analysis, 3D modeling, 3D printing, Introduction to modeling and simulation, writing a formal report, Experimental study of materials (Young's modulus, Yield strength)

Instructor- Machine Design: ME461 (Undergraduate)

Purdue University Northwest, Hammond, IN, August 2014 – December 2014 (Every year after)

- Taught lectures and experimental/computer lab sections
- Topics: Design of machine components through computational/experimental design. Prototype development through 3D printing, Multi-scale design of nano/micro systems.

Instructor - Multi-scale Modeling and Simulation in Mechanics: ME495 (Graduate)

Northwestern University, Evanston, IL, September 2011 – December 2011

- Taught lectures and computer lab sections
- Topics: Basic finite element method and advanced mechanics focusing on nano/bio/energy applications (Thin films, drug/gene delivery using nano-particles and polymer nano-composites), using molecular dynamics and finite element method

Instructor – Molecular Modeling and Interface to Micromechanics: ME317 (Undergraduate and Graduate).

Northwestern University, Evanston, IL, September 2010 – December 2010

- Taught lectures and computer lab sections
- Topics: Hamiltonian and Lagrangian mechanics, Thermodynamics, lattice mechanics, nanowires, polymer mechanics, micromechanics, molecular dynamics

Graduate Teaching Assistant – Statics (Undergraduate)

Ohio State University, Columbus, OH, September 2005 – March 2006

- Taught students in the recitation and worked closely with faculty to help teach principles, concepts, and analytical skills to students.

Graduate Teaching Assistant – Hybrid Electric Vehicles Battery Systems (Undergraduate and Graduate)
Ohio State University, Columbus, OH, January 2001 – March 2002

- Led the lab sections on battery management systems (LABVIEW data acquisition systems)

Advising

Academic Advisor –American Society Mechanical Engineering Student Chapter

Purdue University Northwest, Hammond, IN, May 2015 - current

- Supervised fabrication of solar car since 2015
- Invited industry guest speakers (BP, Mortola, Unilevel) for advising students for career preparation
- Presented “How to prepare a career during college” in 2016, 2018

Advisor –PNW-Munster high school internship program for Mechanical Engineering

Purdue University Northwest, Hammond, IN, Aug, 2018 – Dec, 2018

- Supervised two high school senior students everyday

Advisor –Revolutionary aerospace concept design team

University of Notre Dame, South Bend, IN, April 2009 – June 2009

- Attended Revolutionary Aerospace Systems Concept-Academic Linkage (RASC-AL) national competition as an advisor of University of Notre Dame, May 31, 2009- June 2, 2009, Cocoa Beach, FL

Senior design project Advisor –Capstone project class (2 semesters, ME/ECE Departments)

Purdue University Northwest, Hammond, IN, May 2014 - current

- Supervised ~40 students since 2014
- Guide students with weekly meeting and help them writing undergraduate research proposals

Title	Date	PNW Funding received
Design of minimum inclusion entrapment casting conditions in a continuous caster (Christopher Bacon , Anthony Contreras)	Sp 2019 -	
Solar car: electrical systems and Mechanical systems (Kyle Buikema , Christian Willis Cristina Cabascango , and Jame Weisman)	Sp 2019 -	\$600
3D modeling and prediction of lifetime of electronic device (Haihua Huang and Francisco J Martinez)	Fall 2018 - Sp 2019	\$600
Solar cell: Reliability Evaluation of Solar Cells: Temperature and loading effect investigation (Albert Garcia , Ayoub Ifkerne)	Sp, Fall 2018	\$1200
Solar car building (Daniel Kerrick , Giulio Fantasia , Sayat Zabikh , Alexander Morales)	Sp, fall 2018	\$1200
Solar tracking system (Sahil Nanda , Brenno Dasilva)	Sp, fall 2018	
Solar car: Powertrain Design for Solar Car (Christian Villavicencio , Arturo Garcia)	Fall 2017- Sp 2018	\$1200
Reliability Evaluation of Solar Cells: Temperature and Crack Effect Investigation (Adnan Alsadah , Benjamin Wojkovich , Hussain Almajid)	Sp, Fall, 2017	\$1200
Solar Car: Suspension and Steering systems (Brandon Kretchmer , Nnadozie Njoku , Nicolau Monteiro , Aldo Garcia)	Fall 2016 - Sp, 2017	\$1800
Solar Car: Electric Motor/Battery/Control (Michael Lahey , Ryan Monahan , Brian Sims , Eric Garner)	Fall 2016 - Sp, 2017	\$1200
Designing and Building a Solar Car: An Electrical analysis (Colin Parker , Matthew Costalunga)	Fall, 2015 – Sp, 2016	\$1200
Designing and Building a Solar Car: A Mechanical and structural analysis (Sadiq Al Saleel , Akeel Bo Marah)	Fall, 2015 – Sp, 2016	\$600
Temperature-Dependent crack tracking system for solar cell application (Nicholas Jukes , Mohannad Albuzaid , Thomas Swope ,	Fall, 2015 – Sp, 2016	\$1200

Nicholas Trogdon)		
Coil Car Design Calculator (Students: Dana Plant and Andrew Swipe)	Fall 2014 – Sp 2015	
Measuring temperature-dependent properties of hydrogels using the Atomic Force Microscope (AFM) with a controlled environment. (Aditya Lingaraju and Herve Kpoffon)	Fall 2014 – Sp 2015	\$1200

Grant/Award

Acquisition of Table Top Scanning Electron Microscope (one of 4 Co-PIs, PI: Prof. Ran Zhou), NSF, Pending final approval (As of Aug 26, 2019)

3D Modeling and Simulation for Lifetime Predictions of an Electronic Component (Co-PI, PI: Prof. Chenn Zhou), Department of Defense (NAVAL SURFACE WARFARE CTR CRANE DIV) (2018)

Indiana Space Grant for Research and Outreach for higher education: Hands-on Renewable Energy and Automotive Experience (PI, 2018)

Indiana Space Grant for Research and Outreach for higher education: Hands-on Multi-physics Simulation Training for Solar Energy Applications (PI, 2016)

Indiana Space Grant for Research and Outreach for higher education: Hands-on Multi-physics Simulation Training for Multiple STEM Classes (PI, 2015)

Purdue University Research Foundation Grant (PI, 2015)

NSF fellowship for summer institute on cancer nanotechnology at the Methodist Hospital Research Institute (Houston, TX, 2011)

NSF fellowship for summer institute on nano mechanics and materials at Northwestern University (Evanston, IL, 2007)

Graduate Fellowship at 9th U.S. National Congress of Computational Mechanics (2007)

Services

Organized Engineering Summer Camp for 6-12 grade students at Purdue University Northwest (2015 – 2017)

Served as a committee member of 1) Nanomechanical Material behavior committee and 2) Mechanical Behavior of Materials committee for TMS conference (2015-2016)

Served as a committee member of faculty search committee for solid mechanics area (2015 -2019)

Serving as a committee member of Promotion and Tenure (P&T) guideline committee for School of Engineering (2019 - current)

Serving as a committee member of graduate curriculum committee for ME/CE department (2018 – current)

Serving as an active member of International PV Quality Assurance Task Force group (PVQAT TG7, Wind load effect on solar cells) organized by NREL (2018 – current)

Served as a committee member of Teaching Incentive Program (TIP) award selection committee for college of ES (2018)

Organized Nanotechnology Workshop for K-12 science teachers at Purdue University Northwest (2015)

Web editor of ME/CE department preparing for ABET accreditation (2015 -2016)

Faculty representative of Mechanical Engineering on “Career Day” of Merrillville High School (Oct 16, 2016)

Faculty representative of Mechanical/Civil Engineering on College Major fair Day and PNW open house (2014 – 2017, every semester)

Acted as a reviewer for the Journal of Applied Physics (JAP)

Actively participated in paper evaluation process for 23rd International Congress of Theoretical and Applied Mechanics (Beijing, China 2012)

Served as an assistant organizer of the 48th Annual Technical Conference of the Society of Engineering Sciences at Northwestern University (Evanston IL, 2011)

Presented a seminar addressing the multi-scale simulation of gene/drug delivery systems including hands-on computer lab section at Sungkyunkwan University (Suwon, South Korea 2011)

Served as an assistant organizer of the Northwestern University- Argonne National Lab joint workshop (NU-ANL Multiscale Institute) at Northwestern University (Evanston IL 2010)

Served as an assistant organizer of the 8th International Conference on Numerical Methods in Industrial Forming Processes (NUMIFORM) at Ohio State University, managing equipment as well as welcoming attendees and offering them assistance (Columbus OH, 2004)

Experimental Experience

Hands-on experience in Solar cell characterization, Transmission Electron Microscopy (TEM), Scanning Electron Microscopy (SEM), Optical Microscopy, and Atomic Force Microscopy (AFM)

Hands-on experience in coating gold/palladium on silicon (ceramic) substrate

Hands-on experience in Dip pen Nanolithography machine (NLP 2000)

Hands-on experience in Universal Testing Machine for fracture and fatigue experiments

Hands-on experience in battery lab development (Data acquisition hardware and Labview software)

Hands-on experience in battery system development of Hybrid Electric Vehicles: MS thesis is "Dynamic battery modeling in Hybrid Electric vehicles", which includes experimental battery cycling tests at different temperatures and electrical impedance spectroscopy (theoretical).

Technical Skills/Software

3D Design: 3D printing, Laser cutting

Molecular Dynamics: LAMMPS, DLPOLY, GULP, Amber, Materials Studio

Density Function Theory: VASP, DMol3

Finite Element Analysis: ABAQUS, Hypermesh, ANSYS, COMSOL, Autodesk Inventor, MATLAB, FORTRAN, Python, CAD, SolidWorks, Shell Script, LABVIEW (Data acquisition), Minitab (Statistics)