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)

Experience

Interim Department Chair- Mechanical and Civil Engineering Department
Purdue University Northwest (PNW), Hammond, IN, July 2022 – June 2023
- Led the department for strategic planning, curriculum and facility development.
- In charge of the department's budget, scheduling, and faculty workload distribution

Assistant Department Chair- Mechanical and Civil Engineering Department
Purdue University Northwest (PNW), Hammond, IN, August 2021 – June 2022
- Assist department chair with ABET accreditation, Department recruiting, and student-related activities

ABET/HLC Department Coordinator - Mechanical and Civil Engineering Department
Purdue University Northwest (PNW), Hammond, IN, August 2020 – June 2022
- Served as a department coordinator of external reviews: ABET (Accreditation Board for Engineering and Technology) and HLC (Higher Learning Commission)

Associate Professor- Research (Modeling and experiments of solar cells), Teaching, and Advising
Purdue University Northwest (PNW), Hammond, IN, August 2020 – Current
- Utilizing Finite Element Method (FEM) for characterizing CIGS/Perovskite/Silicon solar cells
- Managing experimental laboratory: Atomic Force Microscopy (AFM), universal testing machine, environmental chamber for accelerated testing, and solar cell characterization equipment
- Taught Machine design, Dynamics of Physical Systems, FEM, Modeling of Micro/Nano Systems, Modeling of Batteries and Solar Cells, Engineering Drawing I (AutoCAD), Engineering Drawing II (SolidWorks)
- Advised Senior Design Project, Thesis graduate students, and ASME (American Society of Mechanical Engineering, till 2022)

Assistant Professor- Modeling and experiments of energy/electronic materials, Teaching, and Advising
Purdue University Northwest, Hammond, IN, July 2014 – July 2020
- Utilizing Molecular Dynamics (MD) and Finite Element Method (FEM) for characterizing energy/electronic materials
- Managing experimental laboratory: Atomic Force Microscopy (AFM), universal testing machine, environmental chamber for accelerated testing, and solar cell characterization equipment
- Taught Machine design, Dynamics of Physical Systems, FEM, Modeling of Micro/Nano Systems, Modeling of Batteries and Solar Cells, Elementary Engineering design, Engineering Experimentation,
- Advised Senior Design Project, Thesis graduate students, and ASME

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 researchers 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 were 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 (Ph.D) – 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 (MSME) – 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

Kim, H and Cias, S., Effect of oxide diffusion barrier and substrate on the reliability of stainless-steel-based CIGS solar cells. Solar Energy Materials and Solar Cells, Vol 272, 112888, 2024

Kim, H, Panchal, T., Theril, K., Determination of critical energy release rate at the EVA/Si cell interface of a flexible silicon solar cell, Elsevier MethodX, Vol 13, 103004, 2024

Kim, H and Xu, D., Effects of Layer Thickness on the Residual Stresses of CIGS Solar Cells with Polyimide Substrate. Advances in Materials Physics and Chemistry, 12, 195-206, 2022

Garcia, A and **Kim, H**, "The Effects of Axial Stress on CIGS Solar Cell Performance," 2019 IEEE 46th Photovoltaic Specialists Conference (PVSC), Chicago, IL, USA, 0931-0934, 2019

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 Nanoparticl-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-Si_3N_4 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, Timsina, S, "Effect of Interface Delamination on the Performance of Perovskite Solar Cells: FEM Analysis ", PV reliability Workshop organized by National Renewable Energy Laboratory, (Lakewood CO, Feb 2024)

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 – Engineering Experimentation: ME345 (Undergraduate)
Purdue University Northwest, Hammond, IN, Aug– Dec 2019 (Every year since 2024)

- Taught lectures
- Topics: Statistical and uncertainty analysis of experimental data, Time and frequency analysis of 0^{th}, 1^{st}, and 2^{nd} order systems, theory and principles of measurements: pressure, temperature, strain, torque, and force.

Instructor – Modeling of Batteries and Solar Cells ME597 (Undergraduate and Graduate)
Purdue University Northwest, Hammond, IN, January – May 2018 (Every 2 year since 2017)

- 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 since 2017)

- 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 2022

- 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 nanoparticles and polymer nanocomposites), 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

<u>Academic Advisor</u> –Thesis graduate students
Purdue University Northwest, Hammond, IN, Fall 2016 – current
- Supervised 7 thesis graduate students since 2016
- Guide students with weekly meeting

<u>Academic Advisor</u> –American Society Mechanical Engineering Student Chapter
Purdue University Northwest, Hammond, IN, May 2015 – Dec. 2022
- 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

<u>Advisor</u> –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

<u>Advisor</u> –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

<u>Senior design project Advisor</u> –Capstone project class (2 semesters, ME/ECE Departments)
Purdue University Northwest, Hammond, IN, May 2014 - current
- Supervised ~50 students since 2014
- Guide students with weekly meeting and help them writing undergraduate research proposals

Grant/Award

Indiana Space Grant for Research and Outreach for higher education: Building an energy-efficient EV and participating in a competition (PI, 2024)

Acquisition of Tabletop Scanning Electron Microscope (one of 4 Co-PIs, PI: Prof. Ran Zhou), NSF, 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

Reviewer of Solar Energy Journal (2024 – current)

Served as the chair of a faculty search committee for the Materials area (2024)

Reviewer of Advances in Chemical Engineering and Science (2023 – current)

ABET committee for Mechanical and Civil Engineering Department at PNW (2020 – 2022)

Organized Engineering Summer Camp for 6-12 grade students at Purdue University Northwest (2015 – 2017, 2022)

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

Reviewer of IEEE Journal of Photovoltaics (2019 – current)

Reviewer of IEEE Transactions on Device and Materials Reliability (2019 – current)

Serving as a committee member of Promotion and Tenure (P&T) guideline committee for School of Engineering (2019 - 2021)

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 – 2020)

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)

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

Web editor of PNW 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)

Technical Skills/Software

3D manufacturing: 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), ALTA/Weibull++ (Statistics)