Rahul P Panat
Associate Professor,
Department of Mechanical Engineering
Carnegie Mellon University, Pittsburgh PA
Phone: (480) 415 6093
Email: rpanat@andrew.cmu.edu
URL: https://www.meche.engineering.cmu.edu/directory/bios/panat-rahul.html
Lab: https://advancedmanufacturing.us

RESEARCH INTERESTS:

- Advanced additive manufacturing
- 3D nanoparticle printing for
  - Biomedical devices
  - Physical and chemical sensors
  - Li-ion batteries
- Flexible electronics
- Mechanical behavior of materials

EDUCATION:

PhD	Theoretical and Applied Mechanics, University of Illinois, Urbana, IL	99-04
MS	Mechanical Engineering, University of Massachusetts at Amherst, MA	97-99
BS	Mechanical Engineering**,** Pune University, India	93-97

WORK EXPERIENCE:

- Aug 2017 – Present: Associate Professor, Department of Mechanical Engineering, Carnegie Mellon University, Pittsburgh PA
- Aug 2014 – July 2017: Associate Professor, School of Mechanical and Materials Engineering, Washington State University (WSU), Pullman WA
- July 2004-July 2014: Senior Engineer/Engineering Manager, Assembly Technology and Test Development, Intel Corporation, Chandler AZ

TEACHING EXPERIENCE:

- Taught courses through Intel University while at Intel
- Courses taught at universities
  - 'Design of Machine Elements', spring 2019 (CMU)
  - 'Advanced Mechanical Design', fall 2017/2018 (CMU)
  - 'Advanced Fracture Mechanics' in spring 2017 (WSU)
  - 'Design for Machine Components' in fall 2016 (WSU)
  - 'Materials Laboratory' in fall 2016 and spring 2017 (WSU)
  - 'Design for Manufacturing' in spring 2016 (WSU)
  - 'Machine Design' in fall 2015 (WSU)
  - 'Manufacturing Processes' in fall 2014 and spring 2015 (WSU)

PUBLICATIONS:

1. Md T. Rahman, C. H. Cheng, B. Karagoz, M. Renn, M. Schrandt, A. Gellman, and R. Panat, "High Performance Flexible Temperature Sensors via Nanoparticle Printing", **ACS Applied Nano Materials,** Vol. 2, Issue 5, pp. 3280-3291 (2019). PDF
2. R. Danaei, T. Varghese, M. Ahmadzadeh, J. McCloy, C. Hollar, M. Sadeq Saleh, J. Park, Y. Zhang, R. Panat, "Ultrafast Fabrication of Thermoelectric Films by Pulsed Light Sintering of Colloidal Nanoparticles on Flexible and Rigid Substrates", **Advanced Engineering Materials**, Vol. 21, pp 1800800 (2019). PDF

3. S. Manandhar, A. Battu, S. Tan, R. Panat, V. Shutthanandan, C. V . Ramana, "Effect of Ti Doping on the Crystallography, Phase, Surface/Interface Structure and Optical Band Gap of Ga_2O_3 Thin Films", **Journal of Materials Science**, 54, pp.11526–11537 (2019). PDF
4. Y. Arafat, S. T. Sultana, I. Dutta, R. Panat, "Effect of Additives on the Microstructure of Electroplated Tin Films", **Journal of the Electrochemical Society**, 165 (16), D816-D824 (2018). PDF
5. J. Li, X. Liang, R. Panat, and J. Park, "Enhanced Battery Performance through Three-Dimensional Structured Electrodes: Experimental and Modeling Study" **Journal of the Electrochemical Society**, 165 (14), A3566-A3573 (2018). PDF
6. R. Panat, J.Park, M. S. Saleh, and J. Li, "3D-Printed Lattice Batteries"**, Homeland Defense Information Analysis Center (HDIAC) Journal**, 5 (4), pp. 11 (2018). PDF
7. M. Sadeq Saleh, Jie Li, Jonghyun Park, and Rahul Panat, "3D Printed Hierarchically-Porous Microlattice Electrode Materials for Exceptionally High Specific Capacity and Areal Capacity Lithium Ion Batteries", **Additive Manufacturing**, Vol.23, pp 70-78 (2018). PDF
8. M. T. Rahman, R. Moser, H. Zbib, C. V. Ramana, and R. Panat, "3D Printed High Performance High Temperature Sensors", **Journal of Applied Physics**, 123, 024501, (2018). PDF
9. M. Sadeq Saleh, Mehdi HamidVishkasougheh, H. Zbib, and R. Panat, "Polycrystalline Micropillars by a Novel 3-D Printing Method and Their Behavior under Compressive Loads", **Scripta Materialia**, Volume 149, 144–149 (2018). PDF
10. Y. Arafat, R. Panat, I. Dutta, "Highly Stretchable Metal Films on Polymer Substrates: Mechanics and Mechanisms", **IEEE ITherm2018**, pp. 32-36 (2018) PDF
11. M. Sadeq Saleh, C. Hu, R. Panat, "Three Dimensional micro-architected materials and devices using nanoparticle assembly by pointwise spatial printing" **Science Advances,** 3, e1601986 (2017). Link
12. J. Geng, M. T. Rahman, R. Panat, and L. Li, "Self-assembled Axisymmetric Microscale Periodic Wrinkles on Elastomer Fibers", **ASME Journal of Micro and Nano-manufacturing**, Vol. 5, Issue 2, pp. 021006 (2017). Link
13. M. T. Rahman, J. Gomez, K. Mireles, P. Wo, J. Marcial, M. Kessler, J. McCloy, C. Ramana, and R. Panat, "High temperature physical and chemical stability and oxidation reaction kinetics of Ni-Cr nanoparticles", **Journal of Physical Chemistry – C,** Vol.121 (7), pp. 4018–4028 (2017). Link
14. J. Li, M. Leu, R. Panat and J. Park, "A hybrid 3-D structured electrode for Lithium-ion batteries via 3D printing", **Materials and Design,** Vol. 119, pp. 417-424 (2017). Link
15. R. Sun, H. Yang, M. Rock, R. Danaei, R. Panat, M. Kessler, and L. Li, "Manufacturing PDMS Micro Lens Array using Spin Coating under a Multiphase System", **Journal of Micromechanics and Microengineering**, Vol. 27(5), pp.1 (2017). Link
16. Y. Arafat, I. Dutta, R. Panat, "On the deformation mechanisms and electrical behavior of highly stretchable metallic interconnects on elastomer substrates", **Journal of Applied Physics,** Vol. 120, Issue 11, pp. 115103-1 to 11 (2016). Link
17. M. T. Rahman, J. McCloy, C. V. Ramana, and R. Panat, "Structure, electrical characteristics and high-temperature stability of Aerosol Jet printed silver nanoparticle films", **Journal of Applied Physics**, Vol. 120, Issue 7, pp. 075305-1 to 11 (2016). Link
18. B. Paul, R. Panat, C. Mastrangelo, D. Kim, and D. Johnson "Manufacturing of Smart Goods: Current state, future potential and research recommendations" **ASME Journal of Nano and Micro-Manufacturing**, Vol. 4, Issue 4, pp. 044001-1 to 044001-12 (2016). PDF
19. M. T. Rahman, A. Rahimi, S. Gupta, and R. Panat, "Microscale additive manufacturing and simulations of interdigitated capacitive touch sensors", **Sensors and Actuators A: Physical**, Vol. 248, 94-103 (2016). Link

20. H. Yang, M. T. Rahman, D. Du, R. Panat, and Y. Lin, "Electrochemical sensors for biological applications using 3-D printed adjustable microelectrode arrays", **Sensors and Actuators B: Chemical**, Vol. 230, 600-606 (2016) Link
21. Y. Arafat, I. Dutta, R. Panat, "Super-stretchable metallic interconnects on polymer with a linear strain of up to 100%" **Applied Physics Letters**, 107 081906 (2015) Link
22. M. T. Rahman, L. Renaud, M. Renn, D. Heo, R. Panat, "Aerosol based direct-write micro-additive fabrication method for sub-mm 3-D metal-dielectric structures", **Journal of Micromechanics and Microengineering,** Vol. 25 (10), pp. 107002 (2015) Link
23. R. Panat, "A model for crack initiation in the Li-ion battery electrodes", **Thin Solid Films**, Vol. 596, pp. 174-178 (2015) Link
24. Y. Arafat, I. Dutta, R. Panat, "Highly stretchable interconnects for flexible electronics applications" **ASME 2015 International Technical Conference and Exhibition on Packaging and Integration of Electronic and Photonic Microsystems**, Paper No. IPACK2015-48187, pp. V003T03A002 (2015) Link
25. M. T. Rahman, L. Renaud, M. Renn, D. Heo, R. Panat, "3-D Antenna Structures Using Novel Direct-Write Additive Manufacturing Method", **ASME 2015 International Technical Conference and Exhibition on Packaging and Integration of Electronic and Photonic Microsystems,** Paper No. IPACK2015-48130, pp. V002T02A029 (2015) Link
26. Z. Song, T. Ma, R Tang, Q. Cheng, X. Wang, D. Krishnaraju, R. Panat, C. K. Chan, H. Yu, and H. Jiang, "Origami Lithium ion batteries", **Nature Communications**, 5:33140 10.1038/ncomms4140, (2014). Link
27. R. Panat, S. Dattaguru, H. Balkan, Y. Min, H. Seh, X. Zhao, "Mechanical reliability of embedding of components in ultra-high performance microprocessors", **IEEE Transactions on Device and Materials Reliability**, Vol 4 (5), 857 (2014). Link
28. R. Panat, E. Parks, and J. Wang, "On the effects of triboelectrostatic changing between polymer surfaces in manufacturing and test of integrated circuit packages", **IEEE Transactions on Components, Packaging and Manufacturing** Vol. 4 (5), 943 (2014) Link
29. R. Panat, V. Dimitrova, S. Selvamundiany, K. Ishiko, and D. Sun, "The application of Lean Six Sigma to the configuration control in Intel's manufacturing R&D environment", **International Journal of Lean Six Sigma**, Vol. 5 (4), 444-459 (2014). Selected by the journal as a 'Highly Commended Paper of 2014'. Link.
30. R. Panat, "On the data and analysis of research output of India and China: India has significantly fallen behind China", **Scientometrics** (Springer), Vol. 100 (2), 471-481 (2014). Link
31. Y. Min, R. Olmedo, M. Hill, K. Radhakrishnan, K. Aygun, M. Kabiri-badr, R. Panat, S. Dattaguru, and H. Balkan, "Embedded capacitors in the next generation processors", **63rd ECTC Conference, IEEE**, 1225-1229 (2013). Link
32. N. Raravikar, R. Panat, and S. Jadhav, "A tombstone initiation model for small form factor surface mount passives" **IEEE Transactions on Components, Packaging and Manufacturing**, Vol. 2 (9), 1486-1491 (2012). Link
33. Li Yan, R. Panat, R. Mulligan, P. Srinath, and A. Raman, "The application of 2D X-ray hot stage in flip chip package failure analysis", **IEEE Transactions on Device and Materials Reliability**, Vol. 11 (1), 141-147 (2011). Link
34. **R. Panat**, et al "Solving the solder bridging issue in large die processors", **Intel Assembly and Test Technology Journal**, Vol. 13, 249-260 (2010) (Intel's internal confidential journal)
35. H. Balkan, others, **R. Panat**, "Passive technology requirements for future flip-chip packages", **Intel Assembly and Test Technology Journal**, Vol. 11, 405-413 (2008) (Intel's internal confidential journal)
36. R. Panat, K.J. Hsia and D.G. Cahill, "Evolution of surface waviness in thin films via volume and surface diffusion", **Journal of Applied Physics**, 97, 013521 (2005). Link

37. R. Panat, K.J. Hsia and J. Oldham, "Observation of rumpling instability in thermal barrier systems under isothermal conditions in vacuum", **Philosophical Magazine,** 85 (1), 45-64 (2005). Link
38. R. Panat and K.J. Hsia, "Experimental investigation of the bond coat rumpling instability under cyclic and isothermal temperature histories in thermal barrier systems," **Proceedings of the Royal Society of London, Series A**, Vol. 460, 1957-1979 (2004). Link
39. R. Panat, S. Zhang and K.J. Hsia, "Bond coat surface rumpling in thermal barrier coatings" **Acta Materialia**, Vol. 51, 239-249 (2003). Link
40. S. Zhang, R. Panat and K.J. Hsia, "Influence of surface morphology on the adhesion strength of aluminum/epoxy interfaces", **Journal of Adhesion Science and Technology**, Vol. 17 (12), 1685-1711 (2003). Link
41. R. Panat, K. Jakus, J.E. Ritter and P. Shah, "Erosion and strength degradation of an elastic modulus graded alumina-glass composite," **Ceramic Engineering and Science Proceedings**, Vol. 21 (3), 635 (2000). Link
42. J.E. Ritter, K. Jakus, R. Panat, "Impact damage and strength degradation of fused silica," **MRS Symposium Proceedings**, 531, pp. 53 (1998). Link

PATENTS (Total of 8: 5 issued and 3 applications):

- R. Panat, E. Yttri, and M. S. Saleh, "Three dimensional electrode array", Patent application #PCT/US 2019/016050, Feb. 2019.
- R. Panat and D. Heo, "Three-dimensional sub-mm wavelength sub-THz frequency antennas on flexible and in-situ cured dielectric using printed metal structures", U.S. Patent # 10086432, issued Oct 2018. PDF
- R. Panat and D. Heo, "Three-dimensional passive components", U.S. Patent #9969001, issued May 2018. PDF
- R. Panat and L. Lei, "Low-cost fiber optic sensor for large strain", US Patent #9846276 , issued December 2017. Link
- I. Dutta and R. Panat," Highly stretchable interconnect devices and systems", US Patent #9770759, issued Sept 2017. Link
- R. Panat and B. Jaiswal, "Nanowires coated on traces in electronic devices", US Patent #9627320, issued April 2017. PDF
- N. Raravikar and R. Panat, "Nanolithographic method of manufacturing an embedded passive device for a microelectronic application, and microelectronic device containing the same", US Patent #8068328, issued May 2014. Link
- R. Panat and M. S. Saleh, "Additive manufacturing of porous scaffold structures", U. S. Patent Application # 14/957,849, filed Dec 2015. Link

R&D ACCOMPLISHMENTS:

- **2018:** Developed a 3D printing method to create neural probes with high degree of customization and an order of magnitude higher recording density when compared to the current state of the art technologies.
- **2016:** Developed a new fabrication technique for hierarchical 3-D porous materials with structural control over 5 orders of magnitudes in length scales for applications such as energy storage, surface modification, bio-scaffolds/implants, actuation, etc.
- **2013:** Integrated Embedded Array Capacitors (EACs) into ultra-high performance Intel chips. This work significantly impacted high performance chip market by enabling Intel chips to operate efficiently at high frequencies not possible until that time (paper).
- **2006:** Lead process engineer for a team that developed industry's first halogen free integrated circuit chip in flash memory packages. The technology was later adopted in logic chips (also at Intel) and by other companies worldwide.

- **2004:** As a PhD student at Illinois, co-developed and validated a model to predict surface evolution of thick coatings at low stress and high temperatures via volume and surface diffusion (with KJ Hsia/DG Cahill) (paper)

RESEARCH FUNDING ($4 million as PI; $2.05 million my share since 2015):

- 2019: **NIH R01**, "Customizable, Ultra-high Density Optic Fiber-paired Multielectrode Array by 3D Nanoparticle Printing", $1,910,998 **PI: Rahul Panat** (ME) and co-investigator: Eric Yttri (Biological Sciences), at CMU. *Award under contract negotiations*
- 2019: **DOE-NETL**, "A Novel Access Control Blockchain Paradigm for Cybersecure Sensor Infrastructure in Fossil Power Generation Systems", $400,000. **PI: Rahul Panat** (ME); co-PI: Vipul Goyal (Computer Science) at CMU. *Award under contract negotiations*
- 2019: **Allegheny Health Network research grant** to "3D Printed Electronic Decals for in-situ Monitoring of Cardiac Parameters", $70,000. PI: Gary Fedder (ECE); **co-PI: Rahul Panat** (ME), CMU.
- 2019: **Pennsylvania Manufacturing Innovation Program**, "3D Printed Conformal Sensors for In-situ Monitoring of Cracks in Critical Freight Car Components", $64,060. **PI: Panat** (ME), CMU
- 2018: **NIH R21**, "Rapid 3-D Nano-Printing to Create Multi-Thousand-Channel Microelectrode Arrays", $414,204. **Multiple PIs: Rahul Panat** (ME) and Eric Yttri (Biological Sciences), CMU
- 2018: **David Scaife Foundation**, "Seed Grant for CMU Array: Using Rapid 3D Printing of Metal Nanoparticles to Improve Neuronal Sampling Abilities by an Order of Magnitude", $110,000. PI: Eric Yttri (Biological Sciences); **co-PI: Rahul Panat** (ME). My share $55,000.
- 2018: Equipment grant from CIT ($50,000) to upgrade the 3D printer by adding multi-material printing capability. **PI: Panat**
- 2017: "A Breakthrough Additive Manufacturing Method for High-Strength Lightweight 3D Micro-Architectured Materials" **NSF/CMMI**. **PI: Rahul Panat,** CMU; co-PI: Prof. Hussein Zbib, WSU. (Total funding : $309,943; my share: $209,000).
- 2016: "GOALI/Collaborative Research: Additive Manufacturing of Mechanically Strong and Electrochemically Robust Porous Electrodes for Ultra-High Energy Density Batteries" **NSF/CMMI**. **PI: Rahul Panat,** WSU; co-PI: Prof. Jonghyun Park, MUST, Rolla; GOALI Partner: Dr. Michael Renn, CTO, Optomec Inc., Minneapolis MN. (Total funding: $300,000; my share: $150,000)
- 2015: "Low-Cost, Efficient and Durable High Temperature Wireless Sensors by Direct Write Additive Manufacturing for Application in Fossil Energy Systems", **DOE/NETL**. **PI: Rahul Panat,** WSU, and co-PI: Prof. C. V. Ramana, University of Texas, El Paso. (Total funding: $399,932**)**.
- 2015: "NSF Workshop: Advanced Manufacturing for Smart Goods; Vancouver, Washington, May 2015", **NSF/CMMI.** PI: Brian Paul, **co-PI**: **Rahul Panat,** David Johnson, Christina Mastrangelo, Dae-Wook Kim. ($33,401)
- 2015: **PI: Rahul Panat.** Grant from the **Washington Research Foundation (WRF)** on, "A low-cost super-stretchable polymer optical fiber strain sensor and Fiber-Bragg-Grating (FBG)". ($25,000)
- 2015: **PI: Rahul Panat.** Grant from **WRF** on, "Three dimensional sub-mm wavelength antennas using photonic curing of printed metal nanopowders on flexible substrates" ($25,000)

- 2014: **PI: Rahul Panat.** Equipment grant from the VCEA (**Northern Trust Program**) to add Laser/UV capability to printed electronics equipment and plasma cleaning equipment ($39,000)

MEDIA:

2015: Research on stretchable Indium conductors was highlighted in several tech magazines
Robot Magazine: Indium-Plastic Film Could Lead to Stretchier Skin for Robots
Physics.org: Researchers create super-stretchable metallic conductors for flexible electronics
Space Daily: Super-stretchable metallic conductors for flexible electronics
Gizmodo: A New Stretchable Conductor Can Extend to Twice Its Length
Semiconductor Engineering Mag: Stretchy Metal
Manufaturing.net: Study: New Metal Fabric Can Stretch To Double Its Original Size

2017: Research on 3D microarchitectures was highlighted in several tech magazines
WSU News: https://news.wsu.edu/2017/03/03/novel-3-d-manufacturing/
German Media: Huge Nanostructures
I4U News: Researchers 3D Print Lightweight But Ultra-Strong New Material Like Wood And Bone
Materials Today: Novel 3D printing method goes up and down the scale
3-D Printing Industry: "Groundbreaking advance" in nanoparticle 3D printing mimics natural construction in the desert
Science Daily: https://www.sciencedaily.com/releases/2017/03/170303143221.htm
Yahoo News: https://sg.news.yahoo.com/scientists-create-ultra-light-super-190700874.html
Physics.org: https://phys.org/news/2017-03-d-highly-complex-bio-like-materials.html

2018: Research on 3D printed batteries highlighted in several tech magazines and popular media

Forbes: See How This New 3D Printing Method Could Make Your Smartphone Last Longer
Green Car: CMU-led team develops 3D printing method for exceptionally high capacity batteries
Printed electronics: 3D printing the next generation of batteries
3D Printing Industry: 3D Printing creates major advance for longer lasting batteries
CMU news: 3D Printing the next generation of batteries
German Media: New "Aerosol Jet" method relies on 3D printing for electrodes of lithium-ion batteries and promises longer battery life

AWARDS AND HONORS:

- Divisional recognition award at Intel for outstanding efforts in development of new solder paste metallurgy, 2010
- Divisional recognition award at Intel for tape-out and production of Intel's first six core Xeon® server microprocessor, 2008
- Technology and Manufacturing Group (TMG) excellence award for innovation in packaging to achieve $2.6 billion in package, assembly and test savings, 2008
- Divisional recognition award at Intel for developing manufacturing process for world's first halogen free integrated circuit (IC) chip, 2007
- Lean Six Sigma Green Belt Certification at Intel, 2014
- Henry L. Langhaar Graduate Award, UIUC, 2004
- Stanley J. Weiss Outstanding Dissertation Award, UIUC 2004
- Dissertation Completion Fellowship 2003-04, UIUC
- Materials Research Society (MRS) Gold Medal, 2002
- Mavis Memorial Fund Scholarship Award, 2002 and 2003, UIUC
- Research Fellowship, TAM Department, UIUC (1999–2000)
- National Merit Scholarship by the Government of India (1991)

CONFERENCES/TALKS:

1. Invite talk at 2019 Multifunctional 3D Printing Symposium at RIT, NY, June 2019
2. Poster presentation at the NIH annual grantees meeting, April 2019
3. Invited talk in the CEE department at CMU, April 2019
4. Invited talk at multifunctional printing conference at the Rochester Institute of Technology, NY, June 2019
5. Two invited talks at TMS 2019
6. Invited talk at the National Energy Technology Laboratory, Pittsburgh PA, January 2019.
7. Invited Seminar at the Mechanical, Industrial, and Manufacturing Engineering Department, Oregon State University, Corvallis, OR, Nov 2016.
8. Invited Seminar at the Air Force Research Laboratory, Dayton, OH, June 2016.
9. Seminar at the NextManufacturing center at the Carnegie Mellon University (CMU) - ME department, Pittsburgh, PA, titled "Printed and Flexible Microelectronics Manufacturing for Smart Devices and Systems", April 2016
10. Poster presentation at DOE/NETL crosscutting project review meeting, Pittsburgh PA, April 2016
11. Seminar at the 43rd ICMCTF *(*International Conference of Metallurgical Coatings and Thin Films*) in San Diego, CA,* "Electrical Characterization of Additively Manufactured Metal Films for High Temperature Sensor Applications", April 2016
12. Department Seminar **"**Printed and Flexible Microelectronics Manufacturing for Smart Devices and Systems**"** at the School of Mechanical and Materials Engineering, WSU, Nov 2015
13. Two presentations at the ASME InterPACK Conference, San Francisco, CA, July 2015
14. Invited Seminar at the Sharp Labs, Camas, WA, "Some Problems in Flexible and Printed Electronics and Flexible Li-ion Batteries" June 2015
15. Invited Seminar at the 42nd ICMCTF *(*International Conference of Metallurgical Coatings and Thin Films*) in San Diego, CA,* "On the Surface Evolution in Stressed Films: From Metal Films at High Temperature to Electrode Films in LiBs", April 2015
16. Invited Seminar at the Mechanical Engineering Department, University of Washington, Seattle, WA, "On the Integration of Microelectronic Devices on Rigid and Flexible Platforms", April 2015
17. Invited Seminar at the NSF PERM seminar series, University of Texas at El Paso, "Energy Storage Devices for Ultra-High Performance Microprocessors and Flexible Electronic Devices", June 2014
18. Invited Seminar at the Mechanical and Aerospace Seminar Series, Arizona State University "Mechanics of Microelectronic Packaging", Aug 2010
19. "Bond coat surface rumpling in thermal barrier coatings"
    - MRS, Boston, MA (Dec. 2002) – won MRS gold medal for this presentation.
    - 'Materials Interest Group' seminar given at the Department of Mechanical Engineering, UIUC, Urbana, IL (Oct. 2003)
    - Seminar in the Department of Civil Engineering, Cornell University, Ithaca (June 2004)
    - Seminar in the Department of Physics, Pune University, Pune, India (June 2005)
20. "Sharp particle impact damage in functionally graded ceramics" oral presentation at the *American Ceramic Society* meeting, Indianapolis, IN, April 1999

SERVICE AND OUTREACH:

- Guest Editor, IEEE CPMT, since June 2019
- Carnegie Mellon Faculty Senate (2019- present)
- Co-organizer of a workshop on Smart Goods Manufacturing, sponsored by the CMMI division of NSF, 2015
- **Faculty search committee chair,** School of MME, WSU, 2015. Hired 2 tenure track assistant professors in the areas of robotics and energy.
- Faculty mentor for Louis Stokes Alliance for Minority Participation (LSAMP) at WSU
- **Symposium chair** at the 2015 ASME Applied Mechanics and Materials Conference, Seattle, WA (session: Mechanics of Materials in Energy Technologies), July 2015.

- Proposal reviewer for NSERC (Natural Sciences and Engineering Research Council of Canada), Ottawa, Canada, 2015
- NSF panelist (CMMI division), 2006
- Reviewer for IEEE Adv Mat Tech, Transactions on Advanced Packaging, IEEE Transactions on Device and Materials Reliability, Journal of Materials Sciences and Engineering A, and Journal of Engineering Tribology

STUDENT ADVISING:

Seven PhD students (2 completed, 5 current), 4 MS students (three completed, 1 current), 3 UG students (3 past).