

Ravi S. Prasher, Ph.D.
Lawrence Berkeley National Lab
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Summary:

- Technologist, researcher and educator with demonstrated accomplishments in industrial (Intel Corp.), technology start-up (Sheetak Inc.), academic (ASU), government sectors (ARPA-E) and national lab (LBNL)
- **Area of Expertise:** Nano to macroscale thermal energy process and systems, thermal storage, concentrated solar power, electronics cooling, waste heat harvesting, thermoelectrics
- **Research Experience:**
 - 96 archival journal publications (24 solo author) in top science and engineering journals (e.g. Nature Nanotechnology, Physical Review Letters)
 - More than 35 patents in the area of thermal energy based devices
 - **h-index:** 59 (based on Google Scholar)
 - **Citations:** more than 15,000 (based on Google Scholar)
 - Research funding received from: DOE, NSF and Office of Naval Research
 - Advised/served Ph.D. students/committees at Stanford, Berkeley and ASU
- **Teaching Experience:** Developed and taught two graduate level courses on nanoscale thermal transport and thermal properties production and taught undergraduate thermodynamics at ASU
- **Other**
 - Reviewer for multiple top science and engineering journals such as Science, Nature Materials, Nature Energy, Physical Review Letters & J. of Heat Transfer
 - Fellow of ASME (elected 2009, one of the youngest fellows at the age of 36)
 - and Sr. Member of IEEE
 - Intel Achievement Award (highest award for technical achievement in Intel) for electronics thermal management
 - Outstanding Engineer Award from IEEE Components and Packaging Society
 - Associate Editor: J. Heat Transfer, Nanoscale and Microscale thermophysical Engineering & Annual Reviews of Environment and Resources, IEEE Transactions on Components and Packaging Technology (2005-2016), ASME Journal of Thermal Science Engineering and Applications (2010 – 2013)

Employment:

Lawrence Berkeley National Laboratory, Berkeley, CA

Associate Lab Director, Energy Technology Area, July 2018 – Present

- Reporting directly to the Director, responsible for providing strategic leadership and management
- Energy Technology Area (ETA) at the Lawrence Berkeley National Laboratory researches batteries and fuel cells, electricity grid technologies and energy-efficient building technologies
- Yearly budget ~ \$125 M, Total number of staff ~450

University of California, Berkeley

Adjunct Professor, Department of Mechanical Engineering

- Conducting research in nano to macro scale thermal science and engineering for various applications such as batteries, building insulation, microelectronics thermal management and solar energy
- Conducting research on experimentally validate modeling of roll-to-toll manufacturing processes for various applications as Lithium ion batteries and fuel cells

Lawrence Berkeley National Laboratory, Berkeley, CA

Director, Energy Storage and Distributed Resources Division, June 2015 – Present

- Establish and sustain partnership with the wider science and technology ecosystem
- Accountable for Division budgets, funding, workforce planning, human resources management
- Actively shepherding three major new multidisciplinary research initiatives: 1) Cost-effective desalination 2) Science of scaling/manufacturing 3) Grid initiative
- Lab lead for science of manufacturing program for Advanced Manufacturing Office of DOE
- Established Thermal Energy Science and Technology Lab (TEST-Lab)

Sheetak Inc., Austin, Texas

Vice President, Product Development, Nov. 2012 – May 2015

- Sheetak is a device-to-systems thermoelectrics company focused on making low cost energy harvesters and converters based on its proprietary thermoelectrics material and devices
- Sheetak has been funded by private venture and various US government agencies due to its innovative thermoelectric chip and system
- I am responsible for developing an appliance that produces electricity based on thermoelectrics in collaboration with a major appliance maker
- Started the India subsidiary of Sheetak by relocating to India for 1.5 years

Advanced Research Projects Agency-Energy, US Department of Energy

Program Director: March 2010- November 2012

- I was one of the first program directors at ARPA-E. I was actively involved in creating the basic DNA of the agency. Due to the operational structure of ARPA-E, I got a panoramic view of the whole energy field
- As a program director my job involved program creation to define technology whitespace and opportunities, figuring out the right cost for new technology, convincing the ARPA-E director to appropriately fund the programs, selecting teams to develop technologies, active program management and developing technology commercialization strategies.
- Created and managed two programs on cooling/heating of buildings and thermal energy storage for applications such as automobiles, concentrated solar power, and fuel production from sunlight.
- Total value of the portfolio was ~ \$ 100M with more than 30 teams.
- Outreach activities for success of these programs involved significant interactions with venture capital community, other government agencies, large corporations & other entities.
- Cooling/heating program target was to develop disruptive cooling/heating technologies for buildings to increase the efficiency by > 50%
- Thermal storage program target was to deliver technologies that can increase the range of electric vehicles by ~40%, decrease cost of concentrated solar power < \$1/W and make sunlight to fuel efficiency > 10x of biofuels. The synopsis of the research behind the creation of this program was published in Science (Vol. 335, 1454, 2012).
- Technical advisory board member of the SunShot (DOE program on making solar electricity cost competitive with fossil fuel-based electricity) I advised the team on project selection and changing the technical direction to be in line with the goals of the program. I also actively participated in project selection.

Arizona State University (ASU), 2004-2013

Adjunct Professor, Dept. of Mech. and Aero. Eng.

- **Courses:**
 - Co-developed two graduate courses “*Nanoscale Thermal Transport*” and “*Thermal Properties Prediction*”
 - Taught undergraduate *thermodynamics & electronics cooling* section of the graduate course on *electronics packaging*
- **Research Funding:**

- System-level approach for multi-phase, nanotechnology-enhanced cooling of high-power microelectronic systems, \$500k (ASU portion), 05/01/07 - 04/31/12, Office of naval research, MURI
- Transport in nanoscale colloidal systems, \$307,218, 04/15/2004 - 03/31/07, National science foundation
- Nanoparticle-filled liquid fuels for efficient energy conversion, \$110,000, 09/01/06 - 08/31/07, national science foundation,
- Thesis committee member/co-advisor of various MS and PhD students

Intel Corporation: 1999-2010

- **Technology Development Manager**, Thermal and Fluids Core-Competency : A Team of 9 Ph.D. Engineers: 2006-2010
 - Research and development of advanced cooling technologies for Intel CPU
 - Development of new metrologies and modeling techniques for electronics thermal management
 - Development of thermal technology roadmap for electronics thermal management
 - Research and development of physics-based electronic package manufacturing
 - Research and development of advanced nano-materials
- **Sr. Technologist: 2003-2005**
 - Led various technology development projects: microchannels, thermal interface materials, Heat pipes, nanofluids, nanoscale thermoelectric
- **Sr. Thermal Engineer: 1999-2003**
 - Led various technology development projects: microchannels, thermal interface materials, heat pipes, nanofluids

Awards and honors

- **Fellow** of American Society of Mechanical Engineers (Elected 2009)
- Senior Member of IEEE (Elected 2005)
- Outstanding Young Engineer of the Year Award, Components and Packaging Society of IEEE, 2006
- Best Paper Award for “Predicted Efficiency of Nanofluid-Based Direct Absorption Solar Receiver,” Proceedings of ES 2007, Energy Sustainability 2007, Long Beach, California, June 27-30 by H. Tyagi, P. Phelan and R.S. Prasher
- **Intel Achievement Award** (highest award for technical achievement in Intel)
- IEEE society award for very significant contribution to the CPMT Phoenix Chapter

Other professional activities:

Publications:

- **More than 85 Archival Journal publications** in top science and engineering journals (Nature Nanotechnology, Science, Physical Review Letters, Journal of Heat Transfer and etc.)
- **4 book chapters** on thermal interface materials, nanofluids and electronics cooling

Patents:

More than 30 US patents on microchannels, heat pipes, thermoelectric, thermal interface materials, nanofluids, carbon nanotubes

Associate Editor:

- *IEEE Transactions on Components and Packaging Technology* (2005-present)
- *Nanoscale and Microscale Thermophysical Engineering* (2008-present)
- *ASME Journal of Thermal Science Engineering and Applications* (2010 – 2013)
- *Annual Reviews of Environment and Resources* (2013-2018)

Tutorial:

Taught a 4 hour tutorial on Micro/Nanotechnology in Electronics Thermal Management (with Prof. Ken Goodson of Stanford University) in the ASME InterPACK, and IOTHERM

Dissertation Committee Member of Students at Various Universities

- **Ph.D. committee: Stanford:** Xuejiao Hu (2005), Matt Panzer (2010); **U. of California Berkley:** Tao Tong (2007); **ASU:** Prajesh Bhattacharya (2005), Himanshu Tyagi (2008), Lucia Lai, Sabarish Vinod and Todd Otanicar (on going);
- **M.S committee: ASU:** Sridhar Nara (2005)

Panelist and Reviewer for Multiple Research Agencies:

NSF, Air Force Office of Scientific Research (AFOSR), American Chemical Society, US Department of Energy, National Research Council of Canada, World Bank

Reviewer for Various Archival Journals and Magazines:

Science, Nature Materials, Nature Energy, Scientific Reports, ACS Nano, Physical Review Letters, Physical Review B, J. Applied Physics, Physical Review E, ASME J. of Heat Transfer, Physics Letters A, ASME J. of Electronics Packaging, AIAA J. of Thermophysics and Heat Transfer, J. of Enhanced Heat Transfer, IEEE Transaction of Components and Packaging Technology, International J. of Thermal Sciences, International J. of Heat and Mass Transfer, Nano Today, Materials Today, Nano Letters

Invited Seminars and Lectures: Multiple invited seminars and lectures on Thermal Energy Transport and Conversion at places such as MIT, Ecole Centrale Paris Lawrence Berkeley National Laboratory, *Japan/U.S. Joint Seminar on Nanoscale Transport Phenomena - Science and Engineering*

Mentor for Semiconductor Research Corporation (SRC) (1999-present):

- Provide both technical and strategic guidance to universities for future research needs and current research
- Thesis committee member of Ph.D. students at Stanford University

iNEMI (International Electronics Manufacturing Initiative): Co-Chair of the 2009 iNEMI Thermal Roadmap Technology Working Groups (TWGs) & **Co-Chair** of 2007 Thermal Technology Integration Group

Education

01/96-05/99 **Arizona State University** Tempe, AZ

- Ph.D. in Mechanical Engineering, (Adviser: Dr. Pat Phelan)
- Minor: Electrical Engineering

07/91-05/95 **Indian Institute of Technology (IIT)** New Delhi, India

- BS in Mechanical Engineering

Ph.D. Dissertation: Size and Interfacial Effects on the Thermophysical Properties of Thin Solid Films

- Thermal analysis of solid state devices
- Proposed a universal dimensionless parameter for the prediction of size effects on the thermodynamic properties of solids
- Developed two analytical models to predict the thermal boundary resistance at the interface of thin films used in solid state devices and their substrates
- Developed an analytical model to describe the size effects on the specific heat of semiconductor thin films and microstructures due to their reduced dimension

Refereed Journal Publications:

- 1) Yu., P., Jain, A., and **Prasher, R.S.**, 2019, “Enhanced Thermochemical Heat Capacity of Liquids: Molecular to Macroscale Modeling,” *Nano and Microscale Thermophysical Engineering*,
- 2) Shin, S., Elzouka, M., **Prasher, R.S.**, and Chen, R., 2019, “Far-Field Coherent Thermal Emission From Plasmonic Resonance in Individual Anisotropic Nanoribbons,” *Nature Communications*, Vol. 10, 1377
- 3) Wang, H., Kaur, S., Elzouka, M., and Prasher, R.S., 2019, “A Nano Photonic Infrared Radiative Heater,” *Applied Thermal Engineering*, Vol. 153, 221
- 4) Wang, H., Haechler, I., Kaur, S. and **Prasher, R.S.**, 2018, “Spectrally Selective Solar Absorber Stable up to 900 °C for 120 hrs Under Ambient Condition,” *Solar Energy*, Vol 174, 305

- 5) **Prasher, R.S.**, 2018, “Acoustic Mismatch Model for Thermal Contact Conductance of Van Der Waals Contacts Under Static Force,” *Nano and Microscale Thermophysical Engineering*, Vol. 22, 1
- 6) Freedman, J., Wang, H., and **Prasher, R.S.**, 2018, “Analysis of Nanofluid-Based Parabolic Trough Collectors for Solar Thermal Applications,” *Journal of Solar Energy Engineering*, Vol. 140, 051008
- 7) Chalise, D., Shah, K., **Prasher, R.**, and Jain, A., 2018 Conjugate Heat Transfer Analysis of Thermal Management of a Li-Ion Battery Pack,” *J. of Electrochemical Energy Conversion and Storage*, Vol. 15, 011008
- 8) Lee, S., et al., 2016, “Low-Temperature Melting of Silver Nanoparticles in Subcooled and Saturated Water,” *J. of Heat Transfer*, Vol. 138, 052301
- 9) Vishwakarma, V., et al., 2015, “Heat transfer enhancement in a lithium-ion cell through improved material-level thermal transport,” *J. of Power Sources*, Vol. 30, 123
- 10) Lee, S., et al., 2015, “The effective latent heat of aqueous nanofluids,” *Materials Research Express*, Vol. 2, 065004
- 11) Shi, L., et al., 2015, “Evaluating broader impacts of nanoscale thermal transport research,” *Nanoscale & Microscale Thermophysical Engineering*, Vol. 19, 127
- 12) Kaur, S., Rarvikar, N., Helm, B.A.Helms, **Prasher, R.S.**, and Ogletree, D.F., 2014, “Enhanced thermal transport at covalently functionalized carbon nanotube array interfaces,” *Nature Communications*, Vol. 5, 3082
- 13) Henery, A., and **Prasher, R.S.**, 2014, “The prospect of high temperature solid state energy conversion to reduce the cost of concentrated solar power,” *Energy and Environmental Science*, Vol. 7, 1819
- 14) Yang, J. et al., 2014, “Phonon transport through point contacts between graphitic nanomaterials,” *Phys. Rev. Lett.*, Vol. 112, 205901
- 15) Lee, S. et al., 2014, “Experimental investigation of the latent heat of vaporization in aqueous nanofluids,” *App. Phys. Lett.*, Vol. 104, 151908
- 16) Gunawan, A., 2014, “The amplifying effect of natural convection on power generation thermogalvanic cells,” *Int. J. of Heat and Mass Transfer*, Vol. 78, 423
- 17) Taylor, R. et al., 2013, “Small particle big impacts: A review of the diverse application of nanofluids,” *Journal of Applied Physics*, Vol. 113, 11301
- 18) Gunawan, A., 2013, “Liquid thermoelectrics: Review of recent and limited new data of thermogalvaic cell experiments,” *Nanoscale and Microscale Thermophysical Engineering*, Vol. 17, 304
- 19) Miner, M.J. et al., 2013, “Optimized expanding microchannel geometry for flow boiling,” *J. of Heat Transfer*, Vol. 135, 042901
- 20) Taylor, R. et al., 2012, “Socioeconomic impacts of heat transfer research,” *International Communications in Heat and Mass Transfer*, 39, 1467
- 21) Odom, B.A., et al., 2012 “Heat Sink Effect on System Pressure and Mass Flow Rate in a Pumped Refrigerant Loop,” *Journal of Thermal Science Engineering and Applications*, Vol. 4, 31009
- 22) Odom, B.A., et al., 2012, “Microchannel Two-Phase Flow Oscillation Control With an Adjustable Inlet Orifice,” *Journal of Heat Transfer*, Vol. 134, 122901
- 23) Yang, J., Yang, Y., Waltermire, S.W., Wu, X., Zhang, H., Gutu, T., Jiang, Y., Chen, Y., Zinn, A., **Prasher, R.**, Xu, T. and Li, D., 2012, “Enhanced and Switchable Nanoscale Thermal Conduction due to van der Waals Interfaces,” *Nature Nanotechnology*, Vol. 7, 91
- 24) Gur, I., Sawyer, K., and **Prasher, R.S.**, 2011, “Searching for a Better Thermal Battery,” *Science*, 335, 1454
- 25) Taylor, R.E., et al., 2011, “Nanofluid Optical Property Characterization Towards Efficient Direct Absorption Solar Collectors,” *Nanoscale Research Letters*, 6, 225
- 26) Taylor, R.E. et al., 2011, “Applicability of Nanofluids in High Flux Solar Collectors,” *J. Renewable and Sustainable Energy*, 3, 023104
- 27) Otanicar, T., Phelan, P.E., **Prasher, R.S.**, Rosengarten, G., and Taylor, R.A., 2010, “Nanofluid-based direct absorption solar collector,” *Journal of Renewable and Sustainable Energy*, 2, 033102

- 28) Otanicar, T., Chowdhury, E.T., Phelan, P.E., and **Prasher, R.S.**, 2010, "Parametric analysis of a coupled photovoltaic/thermal concentrating solar collector for electricity generation," *J. Applied of Physics*, 108, 114907
- 29) **Prasher, R.S.**, 2010, "Graphene Spreads the Heat," *Science*, Vol. 28, 185
- 30) Zhang, T., Peles, Y., Went, J.T., Tong, T., Chang, J-Y, **Prasher, R.S.**, and Jensen, M., 2010 "Analysis and Active Control of Pressure-drop Flow Instabilities in Boiling Microchannel System." *Int. J. of Heat and Mass Transfer*, 53, 2347
- 31) Phelan, P.E., Gupta, Y., Tyagi, H., Prasher, R.S., Catano, J., Michna, G., Zhou, R., Wen, J., Jensen, M., and Peles, Y. 2010, "Energy Efficiency of Refrigeration Systems for High-Heat-Flux Microelectronics," *J. of Thermal Science and Engineering Applications*, Vol. 2, 031004
- 32) Lai, W.Y., Phelan, P.E., and Prasher, R.S., 2010, "Pressure-drop Viscosity Measurements for γ -Al₂O₃ in Water and PG-Water Mixtures," to appear in *J. of Nanoscience and Nanotechnology*
- 33) Taylor, R., Phelan, P.E., Otanicar, T., Adrian, R., **Prasher, R.S.**, 2009, "Vapor Generation in a Nanoparticle Liquid suspension Using a Focused Continuous Laser," *Appl. Phys. Lett.*, Vol. 95, 161907.
- 34) Chowdhury, I, **Prasher, R.S.**, Lofgreen, K., Chrysler, G., Narasimhan, S., Mahajan, R., Koester, D., Alley, R., and Venkatasubramanian, R., 2009, "Site-specific and On-demand Thermoelectric Cooling of Electronic Devices," *Nature Nanotechnology*, Vol.4, 235
- 35) Zhang, T., Tong, T., Chang, J, Peles, Y., **Prasher, R.S.**, Jensen, M., Wen, J., and Phelan, P.E., 2009, "Ledinegg instability in microchannels" *Int. J. of Heat and Mass Transfer*, 52, 5661
- 36) Sarangi, R.K., Bhattacharya, A., and **Prasher, R.S.** 2009, "Numerical Modelling of Boiling Heat Transfer In Microchannels, *Applied Thermal Engineering*, 29, 300
- 37) **Prasher, R.S.**, Hu, X.J., Chalopin, Y., Mingo, N., Lofgreen, S. Volz, Cleri, F., and Koblinski, P., 2009, " Turning Carbon Nanotubes From Exceptional Heat Conductors Into Insulators," *Phys. Rev. Lett.*, Vol. 102, 105901
- 38) **Prasher, R.S.**, 2009, "Acoustic Mismatch Model for Thermal Contact Resistance of van der Waals Contacts," *Applied Physics Letters*, Vol.94, 041905
- 39) Lai, W.Y., Vinod, S., Phelan, P.E., and Prasher, R.S., 2009, "Convective Heat Transfer for Water-based Alumina Nanofluids in a Single 1.02 mm Tube," *J. Heat Transfer*, 131, 112401
- 40) Tyagi, H., Phelan, P.E., and **Prasher, R.S.**, 2008, "Predicted Efficiency of a Low-Temperature Nanofluid- Based Direct Absorption Solar Collector, to appear in *Journal of Solar Energy Engineering*
- 41) Tyagi, H., Phelan, P.E., **Prasher, R.S.**, Peck, R., Lee, T., Pacheco, J.R, and Arentzen, P., 2008, "Increased Hot-Plate Ignition Probability for Nanoparticle-Laden Diesel Fuel," *Nano Letters*, Vol. 8, 1410
- 42) **Prasher, R.S.**, 2008 "Thermal Boundary Resistance and Thermal Conductivity of Multiwalled Carbon Nanotube," *Physical Review B*, 77, 75424
- 43) Garimella, S.V. et al., 2008, "Thermal Challenges in Next-Generation Electronic Systems," *IEEE Transactions on Components and Packaging Technology*, Vol. 31, No. 4, pp. 801-815
- 44) Chang, J-Y., **Prasher, R.S.**, Prstic, S., Cheng, P., and Ma, H.B, 2008, "Evaporative Thermal Performance of Vapor Chambers Under Non-uniform Heating Conditions," *J. Heat Transfer*, 130, 121501
- 45) Moore, A.L., Saha, S., **Prasher, R.S.**, and Shi, L., 2008, "Phonon Backscattering and Thermal Conductivity Suppression in Sawtooth Nanowires," *Applied physics Letters*, 93, 083112
- 46) Koblinski, P., **Prasher, R.S.**, and Eapen, J., 2008, "Thermal Conductivity of Nanofluids: Is the Controversy Over?" *J. of Nano Particle Research*, In press
- 47) Evans, W., **Prasher, R.S.**, Fish, J., Meakin, P., Phelan, P.E., and Koblinski, P., 2008 "Effect of Aggregation and Interfacial Thermal Resistance On the Thermal Conductivity of Nanocomposites and Colloidal Nanofluids," *International Journal of Heat and Mass Transfer*, 51, 1431
- 48) **Prasher, R.S.**, Tong, T. , Majumdar, A., 2008 "Approximate Analytical Models for Phonon Specific Heat and Ballistic Thermal Conductance of Nanowires," *Nano Letters*, 8, 99

- 49) **Prasher, R.S.**, 2007, "Thermal Radiation in Dense Nano and Micro Particulate Media," *J. Applied Phys*, 102, 74316
- 50) Hu, J.X., **Prasher, R.S.**, Lofgreen, K., 2007, "Ultra-low Thermal Conductivity of Nanoparticle Packed Bed," *Appl. Phys. Lett.*, 91, 203113
- 51) **Prasher, R.S.**, Tong, T., and Majumdar, A., 2007 "An acoustic and Dimensional Mismatch Model for Thermal Boundary Conductance Between a Vertical Mesoscopic Nanowire/nanotube and a Bulk Substrate," *J. Appl. Phys.*, 102, 104312
- 52) **Prasher, R.S.**, Tong, T., and Majumdar, A., 2007, "Diffraction-limited Phonon Thermal Conductance of Nanoconstrictions," *Appl. Phys. Lett.*, 91, 143119
- 53) **Prasher, R.S.**, 2007, "Thermal Conductance of Single-Walled Carbon Nanotube Embedded in an Elastic Half-Space," *Applied Physics Letters*, 90, 143110
- 54) **Prasher, R.S.**, Dirner, J., Chau, D., Chang, J-Y, Myers, A., Prstic, P., and Dongming, H., 2007 "Nusselt Number and Friction Factor of Staggered Arrays of Low Aspect Ratio Micro-Pin-Fins Under Cross Flow for Water as Fluid," *J. of Heat Transfer*, Vol. 129, pp. 141 - 153
- 55) **Prasher, R.S.**, 2006, "Far Field Thermal Radiation Through Nanoholes and Apertures," *Nano Letters*, Vol. 6, No. 9, 2135 - 2139
- 56) **Prasher, R.S.**, "Transverse Thermal Conductivity of Porous Materials Made From Aligned Nano and Micro Cylindrical Pores," *J. Applied Physics*, Vol. 100, 064302
- 57) **Prasher, R.S.**, 2006 "Thermal Conductivity of Composites of Aligned Nanoscale and Microscale Wires and Pores," *J. Applied Physics*, Vol. 100, 034307
- 58) **Prasher, R.S.**, 2006, "Ultra Low Thermal Conductivity of Packed Bed of Crystalline Nanoparticles: A Theoretical Study," *Physical Review B*, 74, 165413
- 59) **Prasher, R.S.**, "Thermal Conductivity of Tubular and Core-Shell Nanowires," *Applied Physics Letters*, Vol. 89, 063121, 89, 063121
- 60) **Prasher, R.S.**, 2006, "Thermal Transport Due to Phonons in Random Nano-particulate Media in The Multiple and Dependent (Correlated) Elastic Scattering Regime," *J. of Heat Transfer*, 128, 627
- 61) **Prasher, R.S.**, 2006, "Thermal Interface Materials: Historical Perspective, Status and Future Directions," *Proceedings of the IEEE (Invited)*, Vol. 94, No. 8, 1571-1586'
- 62) **Prasher, R.S.**, Bhattacharya, P., and Phelan, P.E., 2006, "Brownian-Motion-Based Convective-Conductive Model for the Effective Thermal Conductivity of Nanofluids," *Journal of Heat Transfer*, Vol. 128, pp. 588 - 595
- 63) Bhattacharya, P., Nara, S., Vijayan, P., Tang, T., Phelan, P.E., **Prasher, R.S.**, Song, D.W., and Wang, J., 2006 "Characterization of Temperature Oscillation Technique to Measure the Thermal Conductivity of Fluids," *International Journal of Heat and Mass Transfer*, Vol. 49, pp. 2950 – 2956
- 64) Krishnamurthy, S., Bhattacharya, P., Phelan, P.E., and **Prasher, R.S.**, "Enhanced Mass Diffusion in Nanofluids," *Nano Letters* , 6, 419
- 65) **Prasher, R.S.**, Evans, W., Meakin, P., Fish, J., Phelan, P., and Koblinski, P., 2006 "Effect of Aggregation on Thermal Conduction in Colloidal Nanofluids," *Applied Physics Letters*, 89 , 143119
- 66) **Prasher, R.S.**, 2005, "Modification of Planck Blackbody Emissive Power and Intensity in Particulate Media Due to Multiple and Dependent Scattering," *J. of Heat Transfer* Vol. 127, pp. 903-910
- 67) **Prasher, R.S.**, 2005, "Planck Blackbody Emissive Power in Particulate Media," *Applied Physics Letters*, Vol. 86, 071914
- 68) **Prasher, R.S.**, 2005, "Modeling of Thermal Boundary Resistance of Nanocomposites," *International J. of Heat and Mass Transfer*, 48, 4942
- 69) **Prasher, R.S.**, and Phelan, P.E., "Microscopic and Macroscopic Thermal Resistance of Pressed Mechanical Contacts," *J. Applied Physics*, Vol. 100, 063538
- 70) **Prasher, R.S.**, 2005, "Predicting the Thermal Resistance of Nano-sized Constrictions," *Nano Letters* , 5, 2155
- 71) **Prasher, R.S.**, 2005, "Thermal Transport Due to Transverse Phonons in Nano and Micro Particulate Media," *J. of Applied Physics* Vol. 97, 0643313

- 72) Ganpathy, D, Singh, K., Phelan, P.E., and **Prasher, R.S.**, 2005 “An Effective Unit Cell Approach to Compute the Thermal Conductivity of Composites with Cylindrical Particles,” *Journal of Heat Transfer*, Vol. 127, 553-559
- 73) **Prasher, R.S.**, 2005, “Rheology Based Modeling and Design of Particle Laden Thermal Interface Materials,” *IEEE transactions on components and packaging technology* , Vol.. 28, pp. 230-237
- 74) **Prasher, R.S.**, Song, D., Wang, J., and Phelan, P., “Measurement of Nanofluid Viscosity and Its Implications for Thermal Applications, *Applied Physics Letters*, Vol. 89, 133108
- 75) **Prasher, R.S.**, Phelan, P.E., and Bhattacharya, P., 2006 “Effect of Aggregation Kinetics on Thermal Conductivity of Nanoscale Colloidal Solutions (Nanofluids),” *Nano Letters*, Vol. 6, 1529-1534
- 76) Torresola, J., Chiu, C-P., Chrysler G., Grannes, C., Mahajan, R., **Prasher, R.S.**, and Watwe, A., 2005 “Density Factor Approach to Representing Impact of Die Power Maps on Thermal Management,” *IEEE Transactions on Advanced Packaging*, Vol. 28, pp. 659-664
- 77) **Prasher, R.S.**, Bhattacharya, P., and Phelan, P.E., 2005, “Thermal Conductivity of Nanoscale Colloidal Solutions (Nanofluids),” *Physical Review Letters*, Vol. 94, NO. 2, 25901; also in *Virtual Journal of Nanoscale Science and Technology*, Vol. 11, No. 4, Jan 2005
- 78) **Prasher, R.S.**, 2004, “Thermal Transport Cross Section and Phase Function of Longitudinal Phonons for Scattering by Nano and Micro Particles,” *J. of Applied Physics*, Vol. 96, No. 9, pp. 5202-5211
- 79) **Prasher, R.S.**, 2004, “Mie Scattering Theory for Phonon Transport in Particulate Media,” *J. of Heat Transfer*, Vol. 1126, No. 5, p. 793-804
- 80) Bhattacharya, P., Yadav, A., Saha, S., Phelan, P.E., and **Prasher, R.S.**, 2004 “Brownian Dynamics Simulation to Determine Effective Conductivity of a Nanofluid,” *Journal of Applied Physics*, Vol. 95, No. 11, pp.6492-6494, also in *Virtual Journal of Nanoscience and Technology*, June 7, 2004, Vol. 9, No. 22
- 81) **Prasher, R.S.**, and Matayabus, J.C., 2004, “Thermal Contact Resistance of Cured Gel Polymeric Thermal Interface Materials,” *IEEE transactions on components and packaging technology*, Vol. 27, No. 4, pp. 702-709
- 82) **Prasher R.S.**, 2003, “Phonon Transport in Anisotropic Scattering Particulate Media,” *J. of Heat Transfer*, vol. 125, No. 6
- 83) **Prasher R.S.**, 2003, “Generalized Equation of Phonon Radiative Transport,” *Applied Physics Letters*, Vol. 83, No. 1, pp. 48-51
- 84) **Prasher R.S.**, Koning, P., Shipley, J., Prstic, S., and Wang, J.L., 2003 “Thermal Resistance of Particle Laden Polymeric Thermal Interface Materials,” *J. of Heat Transfer*, Vol. 125, No. 6
- 85) **Prasher, R.S.**, Koning, P., Shipley, J.C., and Devpura, A, 2003, “Dependence of Thermal Conductivity and Mechanical Rigidity of Particle-Laden Polymeric Thermal Interface Material on Particle Volume Fraction,” *Journal of Electronics Packaging*, vol. 125, No. 3
- 86) **Prasher, R.S.**, 2003, “A Simplified Conduction Based Modeling Scheme for Design Sensitivity Study of Thermal Solution Utilizing Heat Pipe and Vapor Chamber Technology,” *Journal of Electronics Packaging*, Vol. 125, No. 3
- 87) **Prasher, R.S.**, and Phelan, P.E., 2001, “A Scattering Mediated Acoustic Mismatch Model for the Prediction of Thermal Boundary Resistance,” *ASME J. of Heat Transfer*, Vol. 123, No.1
- 88) De Bellis, L., Phelan, P.E., **Prasher, R.S.**, 2000 " Variations of the Acoustic and Diffuse Mismatch Models in Predicting Thermal Boundary Resistance", *Journal of Thermophysics and Heat Transfer*, Vol.14, No.2, April-June2000
- 89) **Prasher, R.S.**, and Phelan, P.E., 1999, “Nondimensional Size Effects on the Thermodynamic Properties of Solids”, *Int. J. of Heat and Mass Transfer*, Vol. 42, pp. 1991-2001
- 90) De Bellis, L., Phelan, P.E., **Prasher, R.S.**, 1999"Thermal Boundary Resistance at a Plane Boundary Using the SMAMM and Various Scattering Mechanisms" *Thermal Science & Engineering*, Vol. 7 No.6 , pp. 53-60
- 91) **Prasher, R.S.**, and Phelan, P.E., 1998, “Size Effects on the Thermodynamic Properties of Thin Solid Films,” *ASME J. of Heat Transfer*, Vol. 120, No. 4, pp. 1078-1081

- 92) **Prasher, R.S.**, and Phelan, P.E., 1997, "Review of Thermal Boundary Resistance of High-Temperature Superconductors," *J. of Superconductivity*, Vol. 10, No. 5, pp. 473-484
- 93) Jiang, L., Koo, J.-M., Zhou, P., Mikkelsen, J., Yao, S., Huber, D., Zhang, L., Maveety, G., **Prasher, R.S.**, Santiago, J.G., Kenny, T.W., and Goodson, K., 2002, "Closed-loop Electroosmotic Microchannel Cooling System for VLSI circuits" *IEEE Transactions on Components and Packaging Technology*, Vol. 25, No. 3, pp. 347-355
- 94) Sauciuc, I., Chrysler, G., Mahajan, R., and **Prasher, R.S.**, 2002, "Spreading in Electronics: Phase Change Systems or Solid Metals?," *IEEE Transactions on Components and Packaging Technology*, Vol. 25, No. 4
- 95) Devpura, A., Phelan, P.E., and **Prasher, R.S.**, 2001, "Size Effects on the Thermal Conductivity of Polymers Laden with Highly Conductive Filler Particles," *J. of microscale Thermophysical Engineering* Vol. 5, No. 3
- 96) **Prasher, R.S.**, 2001 "Surface Chemistry and Characteristics Based Model for the Contact Resistance of Polymeric Interstitial Thermal Interface Materials," *ASME J. of Heat Transfer*, Vol. 123, No. 5

Book chapters:

- 1) R. Prasher, & C-P Chiu, "Thermal Interface Materials," *Materials for Advanced Packaging*, Springer (D. Lu & C.P. Wong eds.)
- 2) A. Bar-Cohen, A. Watwe, R.S. Prasher, "Heat Transfer in Electronic Equipment," *Hand book of heat transfer*, Wiley (A. Bejan, and A.D. Kraus eds.)
- 3) P. Phelan, P. Bhattacharya, R. Prasher, "Nanofluids for Heat Transfer Applications," *Ann. Rev. of Heat Tran.*, Vol. 14 (2005)
- 4) P. Phelan et al., "Light Induced Energy Conversion in Liquid Nanoparticle suspension," *Advances in numerical heat transfer*, Vol. 1V (2013)

Magazine articles:

- 1) Mahajan, R., Chiu, C-P., and Prasher, R.S., 2005 "Thermal Interface Materials: a Brief Review of Design Characteristics and Materials," *Electronics Cooling*, Vol. 10, No. 1
- 2) Sauciuc, I., Prasher, R.S., Chang, J-Y., Mahajan, R., and Migliaccio, 2005 "Bearing Life: A Future Package Cooling Challenge," *Advanced Packaging*, July, 2005

Archival peer reviewed conference publications:

- 1) Gunawan, A., and Prasher, R. et al., 2013 "Electrode Separation and Operating Orientation: Mechanisms for Maximizing Performance of Cu/Cu²⁺Aqueous Thermogalvanic Cells," *ASME 2013 International Mechanical Engineering Congress and Exposition*, San Diego, California, USA, November 15–21
- 2) Taylor R., and Prasher, R. et al., 2012, "Critical Review of the Novel Applications and Uses of Nanofluids," *ASME 2012 Third International Conference on Micro/Nanoscale Heat and Mass Transfer*, Atlanta, Georgia, USA, March 3–6
- 3) Taylor R., and Prasher, R.S. et al., 2011, "Nanofluid Extinction Coefficients for Photothermal Energy Conversion," *ASME/JSME 2011 8th Thermal Engineering Joint Conference*, Honolulu, Hawaii, USA, March 13–17
- 4) Chowdhury, I. and Prasher, R.S. et. al., 2011 "Enhanced Efficiency in Coupled Photovoltaic/thermal Concentrating Solar Collectors," *ASME 2010 4th International Conference on Energy Sustainability*, Phoenix, AZ
- 5) Otanicar, T., and Prasher, R.S. et al. 2009, "Impact of Size and Scattering Mode on the Optimal Solar Absorbing Nanofluid," *ASME 2009 3rd International Conference on Energy Sustainability collocated with the Heat Transfer and InterPACK09 Conferences*, San Francisco, California, USA, July 19–23
- 6) Taylor, R., et al., and Prasher et al., 2009, "Experimental Results for Light-Induced Boiling in Water-Based Graphite Nanoparticle Suspensions," *ASME 2009 Heat Transfer Summer Conference collocated with the InterPACK09 and 3rd Energy Sustainability Conferences*, Paper No. HT2009-88176, pp. 155-163

- 7) Lai et al. and Prasher, R.S. et al., 2008, "Convective heat transfer for water-based alumina nanofluids in a single 1.02-mm tube" Proc. Of 11th Intersociety Conference on Thermal and Thermomechanical Phenomena in Electronic Systems, May 28 - 31
- 8) Phelan, P.E., and Prasher, R.S. et al., 2008, "Optimization of Refrigeration Systems for High-Heat Flux Microelectronics," Proc. Of Int. Mech. Eng. Congress and Exposition, Boston Massachusetts
- 9) Lee, T-W, Tyagi, H., Sonenschein, D., Phelan, P.E., Prasher, R., and Peck, R., 2008 "Ignition and Combustion Characteristics of Liquid Fuel Droplets Containing Metal Nanoparticles," Proc. of 2008 Summer Heat Transfer Conference, Aug 10 -14, Jacksonville, Florida
- 10) R. Prasher and J-Y Chang, 2008, "Cooling of Microelectronics Chips Using Microchannels and Micro-Pin Fin Heat Exchangers," Proc. of Sixth Int. ASME Conference on Nanochannels, Microchannels and Minichannels, June 23-25, Darmstadt, Germany
- 11) T. Tong, J-Y. Chang, S. Devasenathipathy, J. Dirner, S. Prstic and R. Prasher, 2007 "Performances of Silicon Micro-Flow-Passage Cold Plates From Single-Phase to Two-Phase With Water and HFE – 7100 As Working Fluids," ASME Int. Mechanical Engineering Congress and Expo, Nov. 11 – 15, Seattle, Washington
- 12) T. Tong, R. Prasher, and A. Majumdar, 2007, " Heat Capacity and Thermal Conductance Calculations For Non-Metallic Crystalline Nanowires Based on Elastic Dispersion Relations," ASME Int. Mechanical Engineering Congress and Expo, Nov. 11 – 15, Seattle, Washington
- 13) H. Tyagi, P. Phelan, and R.S. Prasher, 2007, Predicted Efficiency of Nanofluid-Based Direct Absorption Solar Receiver," Proceedings of ES 2007, Energy Sustainability 2007, Long Beach, California, June 27-30 (awarded the best paper)
- 14) W.Y. Lai, B. Ducelescu, P.E. Phelan, and R.S. Prasher, 2006, "Convective Heat Transfer With Nanofluids in A Single 1.02 mm Tube, Proc. Int. Mech. Eng. Cong. and Expo, Chicago, Illinois, Nov. 5 - 10
- 15) J-Y. Chang, C-U. Kim, N. Michael, B. Pathangey, P. Gwin and R. Prasher, 2006, "New Electrochemical Cell Designs and Test Methods For Corrosion Testing of The Components in Integrated Circuit Cooling Systems," Proc. Int. Mech. Eng. Cong. and Expo, Chicago, Illinois, Nov. 5 - 10
- 16) Prasher, R.S., 2006, "Thermal Radiative Transport in Dense Absorbing and Scattering Nano and Micro Particulate Media," Proc. Int. Mech. Eng. Cong. and Expo, Chicago, Illinois
- 17) Saha, S., Shi, L. and Prasher, R.S., 2006 "Monte Carlo Simulation of Phonon Backscattering in a Nanowire," Proc. Int. Mech. Eng. Cong. and Expo, Chicago, Illinois
- 18) Prasher, R.S., Tong, T., and Majumdar, A., 2006, "Thermal Resistance of Nano Constrictions," Proc. Int. Mech. Eng. Cong. and Expo, Chicago, Illinois
- 19) Tong, T., Devasenathipathy, S., Chang, J-Y., Dirner, J., Prstic, S. and Prasher, R.S., 2006, "Performance of Two-Phase Microchannel at Sub Atmospheric Pressures," Proc. Int. Mech. Eng. Cong. and Expo, Chicago, Illinois
- 20) Prasher, R.S., and Phelan, P.E., 2005, "Optical and Radiative Properties of Nanofluids Based Multiple and Dependent Scattering Theories," Proc. Int. Mech. Eng. Cong. and Expo, Orlando, Florida
- 21) Sarangi, R.K., Bhattacharya, A., Prasher, R.S., and Narasimhan, S., 2005, "Numerical Modeling of Boiling Heat Transfer In Microchannels," Proc. of ASME Int. Mech. Eng. Congress and Expo, Orlando, Florida, Nov. 5-11
- 22) Nara, S., Bhattacharya, P., Vijayan, P., Lai, W., Rosenthal, W., Phelan, P.E., and Prasher, R.S. "Experimental determination of the effect of varying the base fluid on static thermal conductivity of nanofluids," Paper No. IMECE2005-81494, *ASME International Mechanical Engineering Congress & Exposition*, Orlando, Florida, November (2005).
- 23) Sarangi, R.K., Bhattacharya, A., Prasher, R.S., and Narasimhan, S., 2005, "Numerical Modeling of Boiling Heat Transfer In Microchannels," Proc. of ASME Int. Mech. Eng. Congress and Expo, Orlando, Florida, Nov. 5-11

- 24) Prasher, R.S., and Song, D.W., 2005, "Microscopic Effective Medium Model for Thermal Conductivity of Two Dimensional Nano-Porous and Micro-Porous Media," Proc. of ASME Heat Transfer Conference, San Francisco, 2005, July 17- 22
- 25) Prasher, R.S. et al., 2005, Effect of Localized Hotspot on the Performance of Two-phase Microchannel Heat Exchanger, Proc. of ASME InterPACK, San Francisco, 2005, July 17- 22
- 26) Chang, J-Y, Prasher, R.S. et al., 2005, Convective Performance of Package Based Single Phase Microchannel Heat Exchanger, Proc. of ASME InterPACK, San Francisco, 2005, July 17- 22
- 27) Sauciu, I. , Prasher, R.S. et al., 2005, Thermal Performance and Key Challenges for Future CPU Cooling Technologies, Proc. of ASME InterPACK, San Francisco, 2005, July 17- 22
- 28) Hu, X., Prasher R.S., and Goodson, K.E., "Thermal Conductance Phenomena in Advanced Thermal Interface Materials for Electronics Cooling," Proc. of ASME Heat Transfer Conference, San Francisco, 2005, July 17- 22
- 29) Chang, J-Y., Vadakkan, U., Prasher, R.S., and Prstic, S., 2005, "Thermal Performance of Vapor Chambers Under Hotspot Heating Conditions," Proc. Of ASME InterPACK, San Francisco, 2005, July 17- 22
- 30) Prasher, R.S., 2004, "Scattering of Phonons by Nano and Micro Particles," Proc. Of International Mech. Eng. Cong. And Expo, Anaheim, CA, Nov. 13-19
- 31) Kramer, T.A., Flynn, R.D., Fogg, D.W., Wang, E.N., Hidrovo, C.H., Goodson, K., Prasher, R.S., Chau, D.S., and Narasimhan, S., "Microchannel Experimental Structure for Measuring Temperature Fields During Convective Boiling, Proc. of International Mech. Eng. Cong. And Expo, Anaheim, CA, 2004, Nov. 13 -19
- 32) Wei, Joshi, Patterson, Prasher 2004, "Numerical Study of Conjugate Heat Transfer in Stacked Microchannels," ITherm, Las Vegas, 2004
- 33) Bhattacharya, P., Phelan, P.E., and Prasher, R.S., 2004 Determining the Effective Viscosity of a Nanofluid Using Brownian Dynamics Simulation," The First Symposium on Micro and Nano Technology (ISMNT-1), Hawaii
- 34) Cho, E.S., Koo, Jae-Mo, Jiang, L., Prasher, R.S., Kim, M.S., Santiago, J.G., Kenny, T.W., and Goodson, K.E., 2003 "Experimental Study of Two Phase Heat Transfer in Microchannel Heat Sinks with Hotspots," Semitherm, San Jose, 2003.
- 35) Koo, J-M., Im, S., Prasher, R.S. et al., 2002, "VLSI Hotspot Cooling Using Two Phase Microchannel Convection," Int. Mech. Eng. Cong. And Expo., New Orleans, Nov. 17-22
- 36) Jiang, L., Koo, J-M., Bari, A., Wang, E., Prasher, R.S. et al., 2002, "Cross-linked Microchannels for VLSI Hotspot Cooling," Int. Mech. Eng. Cong. And Expo., New Orleans, Nov. 17-2
- 37) Jiang, L., Mikkelsen, J., Koo, J-M, Zhang, L., Huber, S., Yao, S., Bari, A., Zhou, P., Santiago, J., Kenny, T., Goodson, K.E., Maveety, J., and Prasher, R.S., 2002, "Transient and Sub-Atmospheric Performance of a Closed-Loop Electrosmotic Microchannel Cooling System," Thermes, 2002, Ed. Y. Joshi and S. Garimella, Santa Fe, New Mexico, USA
- 38) Prasher, R.S., Shipley, J., Koning, P., Prstic, S., and Wang, J.L., 2002, "Rheological and Thermal study of Micro Particle laden Polymeric Thermal interface Materials: Experimental (Part 1)," Proc. Int. Mech. Eng. Cong. And Expo., New Orleans, Nov. 17-22
- 39) Prasher, R.S., Shipley, J., Koning, P., Prstic, S., and Wang, J.L., 2002, "Rheological and Thermal study of Micro Particle laden Polymeric Thermal interface Materials: Modeling (Part 2)," Proc. of Int. Mech. Eng. Cong. And Expo., New Orleans, Nov. 17-22
- 40) Beth, R.A., Taya, M., Koning, P, and Prasher, R.S., 2001 "Prediction of conductivity of composite thermal interface material using resistive network model" Proc. of Interpack, Hawaii
- 41) Prasher, R.S., Alger, O., and Phelan P.E., 2001 "A Unified Macroscopic and Microscopic Approach to Contact Conduction Heat Transfer, Proc. of *National Heat Transfer Conference*, 2001
- 42) Watwe, A., and Prasher, R.S., 2001, "Spreadsheet Tool For Quick-Turn 3D Numerical Modeling of Package Thermal Performance With Non-Uniform Die Heating," accepted for *International Mechanical Engineering Congress and Exposition*, New York

- 43) Devpura, Prasher, R.S., and Phelan, P.E., 2001, "Using Amorphous Material Properties in Scattering-Mediated Acoustic Mismatch Model for Predicting Thermal Boundary Resistance," proc. of *International Mechanical Engineering Congress and Exposition*, New York,
- 44) Devpura, A., Phelan, P.E., and Prasher, R.S., 2000, "Percolation Theory Applied to Study the Effect of Shape and Size of the Filler Particles in Thermal Interface Materials," proceedings of *the International Mechanical Engineering Congress and Exposition*, Orlando, Florida
- 45) Devpura, Amit, Phelan, P.E., and Prasher, R.S., 2000 "Percolation Theory Applied to the Analysis of Thermal Interface Materials in Flip-Chip Technology" Proceeding s of *ITherm, 2000, Las Vegas*.
- 46) Prasher, R.S., Simmons, C, and Solbrekken, G., 2000 "Thermal Contact Resistance of Phase Change and Grease Type Polymeric Materials," proceedings of the *International Mechanical Engineering Congress and Exposition*, Orlando, Florida
- 47) De Bellis, L., Prasher, R.S., and Phelan, P.E., 1998, "Predicting Thermal Boundary Resistance Using Monte Carlo Simulation," Proc. of International Mechanical Engineering Congress and Exposition, Heat Transfer Division, HTD-Vol. 361-4, pp. 221-228, 1998
- 48) Prasher, R.S., and Phelan, P.E., 1998, "Size Effects on the Thermodynamic Properties of Thin Films," *AIAA/ASME Joint Thermophysics and Heat Transfer Conference*, HTD-Vol. 357-3
- 49) Prasher, R.S., and Phelan, P.E., 1997, "Size Effects on the thermodynamic properties of thin films" *Thermophysical Phenomena in Microscale Sensors Devices and Structures*," Baltimore, Maryland, August 9

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