

Bivas Saha

Postdoctoral Scholar
Department of Materials Science and Engineering
University of California, Berkeley

September 2017

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PROFESSIONAL EXPERIENCE

- 2014 - Present **Postdoctoral Scholar, University of California, Berkeley, CA, USA.**
Department of Materials Science and Engineering &
Center for Energy Efficient Electronic Sciences
- Research Topic: *Sub-threshold Nanoelectronics.*
 - Advisor: Prof. Junqiao Wu
- 2014 – Present **Affiliate, Lawrence Berkeley National Laboratory, Berkeley, CA, USA.**
Division of Materials Science and Molecular Foundry.

EDUCATION

- 2010 - 2014 **Ph. D. Purdue University, West Lafayette, Indiana, USA**
School of Materials Engineering & Birck Nanotechnology Center
- Dissertation Topic: *Thermal and Thermoelectric Properties of Nitride Metal/Semiconductor Superlattices.*
 - Advisor: Prof. Timothy D. Sands
- 2007 - 2010 **M. S. Jawaharlal Nehru Center for Advanced Scientific Research, Bangalore (JNCASR), Karnataka, India**
Chemistry and Physics of Materials Unit
- Dissertation Topic: *Theoretical Modeling of Nanostructured (Hf, Zr)N/(Sc, Y)N Metal/Semiconductor Superlattices for Thermoelectric Energy Conversion.*
 - Advisor: Prof. Umesh Waghmare
- 2004 - 2007 **B. S. Jadavpur University, Kolkata, West Bengal, India**
Department of Physics (Major)

RESEARCH INTERESTS

- ❖ **Solid State Energy Conversion**
 - Thermoelectrics and Plasmonics
 - Nanoscale Heat and Current transport.
 - Metal/Semiconductor Superlattices and Heterostructures.
 - Photodetectors, Terahertz Source and Detectors.

- ❖ **Energy Efficient Electronic and Optoelectronic Sciences**
 - Sub-threshold Nanoelectromechanical (NEM) Relays, MEMS.
 - Engineering Metal/Molecule Heterostructures for MEMS.

- ❖ **First-principles Modeling of Materials and Devices.**

ORIGINAL RESEARCH CONTRIBUTIONS

Graduate School (Purdue University and JNCASR):

- Development of the First Epitaxial, Single Crystalline **TiN/(Al,Sc)N Metal/Semiconductor Superlattice and Heterostructure Metamaterials.**
- Demonstration of the First **p-type ScN** thin-films.
- Development of the First Epitaxial Nitride Metal/Semiconductor **Hyperbolic Metamaterials.**
- Demonstration of one of the First **Phonon Wave-effects in Superlattices.**
- Development of **(Al,Ga,In)N-ScN Alloys as a Novel Class of Rocksalt Semiconductors.**
- First Experimental Demonstration of **Dislocation Pipe Diffusion** (theorized first in 1950's).

Postdoctoral Scholar (UC Berkeley):

- Development of the First **Sub-50 mV Nanoelectromechanical (NEM) Relay Switch Devices** for Low-Power Electronics and Internet-of-Things.
- Development of **Ultra-thin (~2-3 nm) Metallic Oxides on Metal Surfaces with Ion-Beam Synthesis for MEMS.**

TEACHING EXPERIENCES

Purdue University, School of Materials Engineering.

- Fall 2013: Materials Properties Laboratory (MSE-235)
 - Student Evaluation: 4.8/5 for MSE-235-002, and 4.2/5 for MSE-235-003.

- Fall 2011: Structure and Properties of Materials (MSE-230)
 - Student Evaluation: 4.5/5 for MSE-230-003, and 4.4/5 for MSE-230-008.

AWARDS, HONORS, FELLOWSHIPS

Purdue University

- College of Engineering (CoE) **Outstanding Graduate Student Research Award** in Materials Engineering for 2014.
- Research Assistantship award (2010-2014).

Materials Research Society (MRS)

- Fall 2013 award for “**among the very best**” presentation in the symposium-T.

Best Poster Award:

- SIGMA XI Graduate Student Research Awards Competition; Purdue University.
- Symposium on Nanomaterial for Energy, Purdue University, April 2012.
- Winter School on Chemistry and Physics of Material. JNCASR, Bangalore, 2009.

International Travel Grant

- Networks for Computational Nanotechnology (NCN) Summer School Travel Award. Purdue University, 2010. (\$1800.00).
- Institute of Complex Adaptive Matter Travel Grant for Materials Research Society Spring Meeting, San Francisco, California, USA, April 5-9, 2010 (\$2000.00).

J. N. Center for Advanced Scientific Research

- M.S. Student fellowship award from JNCASR, 2007-2010.

PROFESSIONAL SERVICES

Journal Reviewer

- Journal of Applied Physics
- Journal of Physics D: Applied Physics
- RSC Advances
- Journal of Material Science
- Science of Advanced Materials
- Energy Conversion and Management
- Measurement (Elsevier)
- Phys. Stat. Solidi: Rapid Research Letters
- Physical Status Solidi A: Applications and Basic Research,
- Chemistry of Materials
- Advanced Energy Materials
- Superlattices and Microstructures,
- IEEE Transactions of Nanotechnology.
- Journal of Computational Electronics
- Materials.

Member

- Materials Research Society (MRS) of USA, 2010-Cont.
- American Physical Society (APS), 2014-Cont.
- Research Awareness Sub-committee: Nanotechnology Students Advisory Council (NSAC), Purdue University, 2013-2014.
- Activities Committee: Nanodays, Birck Nanotechnology Center, 2012.

Ambassador:

- Discovery Park, Purdue University, 2012-2013.

- Birck Nanotechnology Center, Purdue University. 2011-2012.

Chair:

- Poster Organizing Committee: Symposium on Nanomaterial for Energy, Purdue University, April, 2012.

Reviewer:

- Center of Energy Efficient Electronics and Sciences (E³S) Research Experience for Undergraduates (REU) Program 2015.

STUDENT MENTORSHIP

Undergraduate Students

- Jane Edgington (RPI-2016)
- Liam Dougherty (Community College, TTEREU-2016).
- Andrew Cook (Univ. of Maryland, 2015)
- Jonathan Comparan (Purdue LSM, 2013-2014).

Graduate Students

- Nelson Yaw Dzade (African University of Science and Technology, 2009-2010)
- Jagaran Acharya (Tribhuvan University, 2008-2009)

ON-LINE PRESENTATIONS

- MRS OnDemand: “Pseudomorphic Stabilization of Cubic Al_xSc_{1-x}N with High Al Concentration and Large Critical Thickness on (001) MgO Substrates with TiN as Seed Layer.”
<http://www.prolibraries.com/mrs/?select=session&sessionID=2909>

PATENTS

1. TiN based metamaterials. **US Patent**, PCT/US2013/64057, G. V. Naik, **B. Saha**, T. D. Sands, V. M. Shalaev and A. Boltasseva.

GRANTS

1. Project Title: “Novel materials for hot-electron-based solar-energy harvesting devices: Titanium nitride-based metal/semiconductor heterostructures and superlattices with plasmonic properties”. PI: Magnus Garbrecht (Linköping University), **Co-PI: Bivas Saha (UC Berkeley)**, Participating Researchers: Lars Hultman ((Linköping University) and Tim Sands (Virginia Tech). **The Swedish Research Council Research Project Grant, Natural and Engineering Sciences (Under review from April 4th, 2017).**
2. Project Title: “Exploration of functional nitride-based metal/semiconductor superlattices for applications as thermoelectric and plasmonic materials”. **Co-PIs: Bivas Saha (UC Berkeley)** and Magnus Garbrecht (Linköping University). **The Swedish Foundation for International Cooperation in Research and Higher Education (STINT) Research Initiation Grant, \$12,500. Awarded, March 2017.**

JOURNAL PUBLICATIONS

(13 published first-author (with 11-as corresponding author), **3 submitted** (first and corresponding author), **3 under preparation** (first-author))

1. B. Osoba, **B. Saha**, S. Almeida, J. Patil, L. Brandt, M. Roots, E. Acosta, J. Wu and T. J. K. Liu, “Variability Study of Low Voltage MEM Relay Operation” (*in-review, 2017*).
2. **B. Saha**, B. Osoba, T. J .K. Liu, and J. Wu, “Nanoelectromechanical Relay Switch Operations at 40 mV enabled by Self-assembled Molecular Coating” (*in-review, 2017*)
3. **B. Saha**, J. Anders, Y. R. Koh, J. Bahk, M. M. Gonzalez, A. Shakouri and T. D. Sands, “Large Thermoelectric Power-factor in Epitaxial *n*- and *p*-type Scandium Nitride (ScN)” (*in-review 2017*).
4. K. Dong, H. S. Choe, X. Wang, H. Liu, **B. Saha**, C. Koh, Y. Deng, K. B. Tom, S. Lou, L. Wang, C. P. Grigoropoulos, Z. You, J. Yao and J. Wu, “A 0.2-Volt Microelectromechanical Switch Enabled by Phase Transition”, (*in-review, 2017*).
5. M. Garbrecht, L. Hultman, M. H. Fawey, T. D. Sands, and **B. Saha**, “Tailoring of plasmon resonances in TiN/(Al,Sc)N superlattices by interlayer thickness variation”, (*in-review 2017*)
6. **B. Saha**, A. Shakouri and T. D. Sands, “Metal/Semiconductor Superlattices: Development of an Elusive Heterostructure”. (*Invited review at Appl. Phys. Rev. 2017*).

7. M. Garbrecht, L. Hultman, T. D. Sands, and **B. Saha**. “Void-mediated coherency-strain relaxation and impediment of cubic-to-hexagonal transformation in epitaxial metastable metal/semiconductor TiN/Al_{0.72}Sc_{0.28}N multilayers” *Phys. Rev. Materials* **1**, 033402, (2017).
8. **B. Saha**, M. Garbrecht, J. Anders, Y. R. Koh, L. Hultman, M. M. Gonzalez, A. Shakouri and T. D. Sands, “Compensation of Native Donor Doping in ScN: Carrier Concentration Control and *p*-type ScN”, *Appl. Phys. Lett.* **110**, 252104 (2017).
9. M. Garbrecht, **B. Saha**, J. L. Schroeder, L. Hultman, and T. D. Sands, “Dislocation Pipe Diffusion in Nitride Superlattices Directly Observed in Lattice Resolved Microscopy.” *Sci. Rep.* **7**, 46092 (2017).
10. **B. Saha**, A. Peschot, B. Osoba, and T. J. K. Liu and J. Wu, “Reducing Adhesion Energy of Mirco Relay Contacts Through Surface Engineering” *APL Materials*, **5**, 036103, (2017).
11. **B. Saha**, Y. R. Koh, J. P. Feser, S. Sadasivam, A. Shakouri, T. S. Fisher, and T. D. Sands, “Phonon Wave-effects in the thermal transport of epitaxial TiN/(Al,Sc)N metal/dielectric superlattices.” *J. Appl. Phys.* **121**, 015109 (2017).
12. **B. Saha**, S. Saber, E. Stach, E. P. Kvam, and T. D. Sands “Understanding the Rocksalt-to-Wurtzite Phase Transformation Through Microstructural Analysis of (Al,Sc)N Epitaxial Thin Films. *Appl. Phys. Lett.* **109**, 172102 (2016).
13. B. Osoba, **B. Saha**, L. Dougherty, J. Edgington, C. Qian, F. Niroui, J. H. Lang, V. Bulovic, J. Wu and T. J. K. Liu, “Sub-50 mV NEM Relay Operation Enabled by Self-Assembled Molecular Coating”. *IEEE International Electron Devices Meeting (IEDM) Technical Digest*, pp 655-658, (2016).
14. M. Garbrecht, J. L. Schroeder, L. Hultman, J. Birch, **B. Saha** and T. D. Sands, "Microstructural evolution and thermal stability of Zr_xHf_{1-x}N/ScN (x= 0, 0.5, 1) metal/semiconductor superlattices", *J. Mater. Sci.*, **51**, 8250 (2016).
15. Y. Chen, S. Zhang, W. Gao, F. Ke, J. Yan, **B. Saha**, C. Ko, J. Suh, B. Chen, J. W. Ager III, W. Walukiewicz, R. Jeanloz, J. Wu, "Pressure-induced structural transition and phase diagram of CdxZn1-xO alloys", *Appl. Phys. Lett.* **108**, 152105 (2016)
16. **B. Saha**, Y. R. Koh, J. Comparan, S. Sadasivam, J. L. Schroeder, M. Garbrecht, A. Mohammed, J. Birch, T. S. Fisher, A. Shakouri, T. D. Sands, “Cross-plane thermal transport in (Ti,W)N/(Al,Sc)N metal/semiconductor superlattice.” *Phys. Rev. B*, **93**, 045311 (2016).
17. J. L. Schroeder, **B. Saha**, M. Garbrecht, N. Schell, T. D. Sands, and J. Birch, “Thermal stability of epitaxial TiN/(Al,Sc)N metal/semiconductor superlattices for refractory applications.” *J. Mater. Sci.* **50** (8), 3200-3206 (2015).

18. **B. Saha**, S. K. Lawrence, J. L. Schroeder, J. Birch, D. F. Bahr, and T. D. Sands, “Enhanced Hardness in Epitaxial TiAlScN Alloy Thin Films and Rocksalt TiN/(Al,Sc)N Superlattices.” *Appl. Phys. Lett.* **105**, 151904 (2014).
19. **B. Saha**, G. V. Naik, S. Saber, E. Stach, V. M. Shalaev, A. Boltasseva, and T. D. Sands, “TiN/(Al,Sc)N metal/dielectric superlattices and multilayers as hyperbolic metamaterial in the visible spectral range.” *Phys. Rev. B*, **90**, 125420, (2014). (*Editor’s Suggestion*)
20. **B. Saha**, S. Saber, G. V. Naik, A. Boltasseva, E. Stach, E. P. Kvam, and T. D. Sands, “Development of epitaxial $\text{Al}_x\text{Sc}_{1-x}\text{N}$ for artificially structured metal/semiconductor superlattice metamaterials.” *Phys. Stat. Sol. B*, **252**, 251 (2015). (*Editor’s Choice and Cover Article, Purdue MSE News*)
21. G. V. Naik, **B. Saha**, J. Liu, S. M. Saber, E. Stach, J. M. K. Irudayaraj, T. D. Sands, V. M. Shalaev and A. Boltasseva, “Epitaxial superlattices with titanium nitride as a plasmonic component for optical hyperbolic metamaterials.” *Proc. Natl. Acad. Sci.* **111**, 7546 (2014). (*Chosen for Issue Highlight, Purdue News*)
22. **B. Saha**, G. Naik, V. Drachev, A. Boltasseva, E. E. Marinero, and T. D. Sands, “Electrical and optical properties of ScN and Mn-doped ScN deposited by dc-magnetron sputtering.” *J. Appl. Phys.*, **114**, 063519 (2013).
23. P. V. Burmistrova, J. Maassen, T. Favaloro, **B. Saha**, S. Salamat, Y. R. Koh, M. S. Lundstrom, A. Shakouri, and T. D. Sands, “High mobility and high thermoelectric power factor in epitaxial ScN films deposited by reactive magnetron sputtering onto MgO(001) substrate.” *J. Appl. Phys.* **113**, 153704 (2013).
24. **B. Saha**, T. D. Sands and U. V. Waghmare, “Electronic structure, vibrational spectra and thermal properties of HfN/ScN metal/semiconductor superlattices: A first-principles Study.” *J. Phys.: Cond. Matt.*, **24** 415303, (2012).
25. **B. Saha**, T. D. Sands and U. V. Waghmare, “Electronic structure, vibrational spectrum, and thermal properties of yttrium nitride (YN): A first-principles study.” *J. Appl. Phys.* **109**, 083717 (2011).
26. **B. Saha**, T. D. Sands and U. V. Waghmare, “First-principles analysis of thermoelectric ZrN/ScN metal/semiconductor superlattices”, *J. Appl. Phys.* **109**, 073720 (2011).
27. **B. Saha**, J. Acharya, T. D. Sands and U. V. Waghmare, “Electronic structures, phonons and thermal properties of ScN, ZrN and HfN: A first-principles Study”, *J. Appl. Phys.* **107**, 033715 (2010).

CONFERENCE PUBLICATIONS

1. M. Garbrecht, J. L. Schroeder, L. Hultman, J. Birch, T. D. Sands and **B. Saha**, "Microstructural evolution and thermal stability of nitride-based metal/semiconductor superlattices for thermoelectric and hard-coating applications." **European Microscopy Congress 2016: Proceedings**, pp.237-238.
2. J. Suh, **B. Saha**, J. Wu. "Novel device functionalities enabled by substitutional doping against native propensity in 2D semiconductors" **Energy Efficient Electronic Systems (E3S)**, **2015 Fourth Berkeley Symposium**, September 6-11, 2015.
3. M. Garbrecht, J. L. Schroeder, **B. Saha**, T. D. Sands, J. Birch. "Combined HR(S)/TEM and EDX Characterization of Nanostructured Metal/Semiconductor Superlattices." **Microscopy Conference Gottingen**, September 6-11, 2015.
4. G. V. Naik, **B. Saha**, T. D. Sands, A. Boltasseva, "A Titanium Nitride Based Metamaterial for Applications in the Visible Spectral Range." **4th International Topical Meeting on Nanophotonics and Metamaterials (NANOMETA 2013)**, Seefeld, Austria, January 2-6, 2013.
5. G. V. Naik, **B. Saha**, J. Liu, S. M. Saber, E. Stach, J. Irudayaraj, T. D. Sands, V. M. Shalaev, and A. Boltasseva, "A Titanium Nitride based Metamaterial for Applications in the Visible," **Lasers and Electro-Optics (CLEO) and Quantum Electronics and Laser Science Conference (QELS), 2013 Conference on. IEEE, 2013.**

INVITED TALKS

1. Metal/Semiconductor Superlattices: Promise for a New Paradigm in Solid-State Energy Conversion, Department of Metallurgical Engineering and Materials Science, **Indian Institute of Technology, Bombay**, India July 12th 2017.
2. Sub-50 mV Nano-electromechanical Relay Switch, Department of Electrical Engineering, **Indian Institute of Technology, Bombay**, India July 12th 2017. (Host: Prof. S. Lodha)
3. Metal/Semiconductor Superlattices: Promise for a New Paradigm in Solid-State Energy Conversion, Department of Condensed Matter Physics and Materials Science, **Tata Institute of Fundamental Research**, India July 11th 2017. (Host: Prof. P. Raychaudhuri)
4. Sub-50 mV Nano-electromechanical Relay Switch, **Center for Nano and Soft Matter**, Bangalore, India, July 7th 2017 (Host: Prof. G U Kulkarni).
5. Metal/Semiconductor Superlattices: Promise for a New Paradigm in Solid-State Energy Conversion, International Center for Materials Science and New Chemistry Unit, **Jawaharlal Nehru Center for Advanced Scientific Research**, Bangalore, India July 6th 2017.

6. Metal/Semiconductor Superlattices: Promise for a New Paradigm in Solid-State Energy Conversion, Department of Materials Engineering, **Indian Institute of Science**, Bangalore, India July 3rd 2017.
7. Sub-thermionic Nano-electromechanical Relay Switches for Low Power Electronics and Internet of Things, **Micron Technology, Inc.** Boise, ID, June 5th, 2017.
8. Metal/Semiconductor Superlattices: Promise for a New Paradigm in Solid-State Energy Conversion, **Micron Technology, Inc.** Boise, ID, June 5th, 2017.
9. Metal/Semiconductor Superlattices: Promise for a New Paradigm in Solid-State Energy Conversion, Materials Department, **UC Santa Barbara**, February 21st, 2016.
10. Materials Engineering of MEMS Relay Contact Surfaces, **NSF STC Energy Efficient Electronics Sciences Seminar, UC Berkeley**, October 27, 2016.
11. Metal/Semiconductor Superlattices at Last- **Materials Research Society (MRS) Spring Meeting 2015**, San Francisco, CA. (Co-Authored with Prof. T. Sands)
12. **Invited Talk:** Thermal and Thermoelectric Properties of Nitride Metal/Semiconductor Superlattices- **California Institute of Technology**, July 2014. (Host: Prof. Austin Minnich).

PRESENTATIONS (ORAL and POSTER)

(Presented by B. Saha, ~25 other presentations where B. Saha is a co-author are not listed here)

1. **Oral: B. Saha**, B. Osoba, T. J. K. Liu and J. Wu, Sub-50 mV Nanoelectromechanical Relay Switches. **NSF STC Energy Efficient Electronics Sciences Annual Review Meeting, Massachusetts Institute of Technology (MIT)**, Boston, MA, September 7th, 2017.
2. **Poster: B. Saha**, B. Osoba, T. J. K. Liu and J. Wu, Materials Engineering of Micro-relay Contact Surfaces for milli-Volt Switches. **NSF STC Energy Efficient Electronics Sciences Annual Review Meeting, Massachusetts Institute of Technology (MIT)**, Boston, MA, September 7th, 2017.
3. **Poster: B. Saha**, “Metal/Semiconductor Superlattices: Development of an Elusive Heterostructure”, **42nd Electronic Materials Symposium**, Menlo Park, California, May 5th 2017.
4. **Oral: B. Saha**, M. Garbrecht, and T. D. Sands, Defects in Epitaxial Metal/Semiconductor Superlattices, **Materials Research Society (MRS) Fall Meeting**, Boston, MA November 30, 2016.
5. **Oral: B. Saha**, A. Peschot, B. Osoba, T. J. K. Liu, and J. Wu, Engineering Adhesion Properties of Micro Relay Contacts Through Surface Engineering, **Materials Research Society (MRS) Fall Meeting**, Boston, MA December 1, 2016.

6. **Poster: B. Saha**, Yee Rui Koh, A. Shakouri and T. D. Sands, Phonon wave-effects in the thermal transport of epitaxial TiN/(Al,Sc)N metal/semiconductor superlattices, **Materials Research Society (MRS) Fall Meeting**, Boston, MA, November 29, 2016.
7. **Poster: B. Saha**, B. Osoba, T. J. K. Liu, and J. Wu, Contact Surface Material Engineering Toward millivolt Relays, **IEEE S³S conference**, San Francisco, CA October, 2016.
8. **Oral and Poster: B. Saha, B. Osoba**, L. Dougherty, J. Edgington, C. Qian, F. Niroui, J. H. Lang, V. Bulovic, T. J. K. Liu and J. Wu, Sub-50 mV NEM Relay enabled by Self-assembled Molecular Coating. **NSF STC Energy Efficient Electronics Sciences Annual Review Meeting, UC Berkeley**, CA, September 2016.
9. **Poster: B. Saha**, B. Osoba, T. J. K. Liu and J. Wu, Reduction of Adhesion Energy on Micro Relay Contacts Through Surface Engineering, **NSF STC Energy Efficient Electronics Sciences External Review Meeting, UC Berkeley**, CA, January, 2016.
10. **Poster: B. Saha**, B. Osoba, T. J. K. Liu and J. Wu, Advanced Materials Engineering for NEM Relays, **NSF STC Energy Efficient Electronics Sciences Annual Review Meeting, Massachusetts Institute of Technology (MIT)**, Boston, MA, September 12th, 2015.
11. **Poster: B. Saha** and J. Wu, Disorder and Defects in Epitaxial Materials, **Singapore-Berkeley Research Initiative for Sustainable Energy (SinBeRISE) Workshop**, National University of Singapore (NTU), CREATE Towers, Singapore, July 28th, 2015.
12. **Poster: B. Saha**, “Metal/Semiconductor Superlattices at Last”, **Purdue University Prospective Future Faculty Workshop**, West Lafayette, IN, March 2, 2015.
13. **Oral: B. Saha**, Yee Rui Koh, A. Shakouri and T. D. Sands, Effect of Period Thickness on the Cross-plane Thermal Transport of (Ti,W)N/(Al,Sc)N Metal/Dielectric Superlattices, **International Thermoelectric Society, Nashville**, TN, July 6-10, 2014.
14. **Oral: B. Saha**, Yee Rui Koh, A. Shakouri and T. D. Sands, Heat Conduction through (Ti,W)N/(Al,Sc)N Metal/Semiconductor Superlattices, **Electronic Materials Conference, University of California, Santa Barbara**, CA, June, 2014.
15. **Oral: B. Saha**, Yee Rui Koh, A. Shakouri and T. D. Sands, Thermal transport in TiN/(Al,Sc)N metal/dielectric superlattices. **Materials Research Society Spring Meeting**, San Francisco, CA, USA, April 21-25 2014.
16. **Oral: B. Saha**, E. Marinero and T. D. Sands, Electronic and optical properties of ScN and (Sc,Mn)N thin films deposited by dc-magnetron sputtering, **American Physical Society (APS) March Meeting**, Denver, CO, March 3-7, 2014.
17. **Poster: B. Saha**, S. Saber, E. Kvam, E. Stach, and T. D. Sands, Pseudomorphic stabilization of cubic Al_xSc_{1-x}N with high Al concentration and large critical thickness on (001) MgO substrates with TiN as a seed layer, **Materials Research Society (MRS) Fall**

Meeting, Boston, MA, USA, December 2-6, 2013. (*Awarded “one of the very best” research presentation in the Fall MRS meeting, and Nominated for the Best Poster Award*).

18. **Oral: B. Saha**, G. V Naik, A. Boltasseva and T. D. Sands, TiN/(Al,Sc)N metal/dielectric superlattices as hyperbolic metamaterials in the visible range. **Electronic Materials Conference, University of Notre Dame**, IN, June 26-28, 2013.
19. **Poster: B. Saha**, T. D. Sands, TiN/(Al,Sc)N metal/dielectric superlattices as hyperbolic metamaterials in the visible range. **School of Materials Engineering External Advisory Board Meeting, Purdue University**, IN, April 25-26, 2013.
20. **Oral: B. Saha**, G. V Naik, A. Boltasseva and T. D. Sands, TiN/(Al,Sc)N metal/dielectric superlattices as hyperbolic metamaterials in the visible range. **Materials Research Society Spring Meeting, San Francisco**, CA April 1-5, 2013.
21. **Poster: B. Saha**, and T. D. Sands, TiN/(Al,Sc)N metal/dielectric superlattices as hyperbolic metamaterials in the visible range. **SIGMA XI Graduate Student Research Awards Competition; Purdue University**, IN, February 13, 2013. (*Best Poster Award*)
22. **Poster: B. Saha**, E. Marinero and T. D. Sands, Growth, characterization and optoelectronic properties of MN-doped ScN. **Brick Nanotechnology Center Annual Review Meeting, Purdue University**, IN, October 10, 2012.
23. **Oral: B. Saha**, E. Marinero and T. D. Sands, Growth, characterization and optoelectronic properties of MN-doped ScN. **Electronic Materials Society. Penn. State Convention Center**, Pennsylvania, June 20-22, 2012.
24. **Oral: B. Saha**, and T. D. Sands, Growth, characterization and optoelectronic properties of MN-doped ScN. **Materials Science and Engineering Annual Day 2012, Purdue University**, IN, May 2012.
25. **Poster: B. Saha**, and T. D. Sands, Growth, characterization and optoelectronic properties of Mn-doped ScN. **Symposium on Nanomaterial for Energy, Burton. D. Morgan Center for Entrepreneurship, Purdue University**, IN, April 2012. (*Best Poster Award*).
26. **Poster: B. Saha**, and T. D. Sands, Growth, characterization and optoelectronic properties of MN-doped ScN. **The Society of Sigma Xi, Graduate Student & Post-doctoral Researcher Poster Competition**, Stewart Center, Purdue University, IN, February 2012.
27. **Poster: B. Saha**, and T. D. Sands, Nanostructured thermoelectric for automotive waste heat recovery, **Materials Science and Engineering Annual Day 2011**, Purdue University, IN, May 2011.

28. **Poster: B. Saha**, T. D. Sands, and U. V. Waghmare, Nanostructured (Hf,Zr)N/(Sc,Y)N metal/semiconductor superlattices for thermoelectric energy conversion: **Materials Research Society Spring Meeting 2010**, San Francisco, California, April 5-9, 2010. (*Nominated for the Best Poster Award*).
29. **Oral: B. Saha**, and U. V. Waghmare Ordering tendency of nitrogen in N doped MgO for spintronic Applications: **Joint INDO-EU meeting on Advanced Materials**, HRI, Allahabad, India, January 2010.
30. **Oral: B. Saha**, T. D. Sands, and U. V. Waghmare, Nitride metal/semiconductor superlattices and alloys for thermoelectric and thermionic applications: **Joint INDO-EU meeting on Advanced Materials**, HRI, Allahabad, India, January 2010.
31. **Oral: B. Saha**, T. D. Sands, and U. V. Waghmare, Nitride metal/semiconductor superlattices and alloys for thermoelectric and thermionic applications. **Annual Faculty Meeting, JNCASR**, India, November 2009.
32. **Oral: B. Saha**, T. D. Sands, and U. V. Waghmare, Metal/semiconductor superlattices for solid-state energy conversion. **TSU In-house symposium**. JNCASR, India August 2009.
33. **Poster: B. Saha**, T. D. Sands, and U. V. Waghmare, Nitride metal/semiconductor superlattices and alloys for thermoelectric and thermionic applications. **Winter School on Chemistry and Physics of Materials**, JNCASR, November 30 –December 6, 2009. (*Best Poster Award*)
34. **Poster: B. Saha**, T. D. Sands, and U. V. Waghmare, Strain, electronic structure, phonons and thermal Properties of ZrN/ScN and HfN/ScN metal/semiconductor superlattices. **Indo-US joint conference on advanced materials Research**. JNCASR 2009.
35. **Poster: B. Saha**, T. D. Sands, and U. V. Waghmare, Strain, electronic structure, phonons and thermal Properties of ZrN/ScN and HfN/ScN metal/semiconductor superlattices. **CPMU In-house symposium**. JNCASR 2009.
36. **Poster: B. Saha**, T. D. Sands, and U. V. Waghmare, Strain, electronic structure, phonons and thermal Properties of ZrN/ScN and HfN/ScN metal/semiconductor superlattices. **Frontiers and Directions in Condensed Matter Physics. Indian Institute of Science, Bangalore 2009**.