

Dr. Biswajit Ray

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Education

PhD Aug. 2008 – Sept. 2013	Purdue University, West Lafayette, IN, USA School of Electrical and Computer Engineering
MS Aug. 2006 – July 2008	Indian Institute of Science, Bangalore, India Center for Electronic Design and Technology
BTech Aug. 2002 – May 2006	National Institute of Technology, Trichy, India Department of Electrical and Electronics Engineering

Professional Appointment

Jan. 2017 - Present	Assistant Professor, Department of Electrical and Computer Engineering, University of Alabama in Huntsville, Huntsville, AL, USA
Oct. 2013 – Jan. 2017	Senior Device Engineer, SanDisk Corporation, Milpitas, CA, USA

Selected Honors and Awards

2018	New Faculty Award, University of Alabama in Huntsville
2017	Charger Innovation Fund (CIF) Award, University of Alabama in Huntsville
2015	Innovation Award, SanDisk Corporation, USA.
2013	Best student paper award finalist, IEEE Photovoltaic Specialist Conference, Tampa, FL, USA.
2012	Best poster award, IEEE Photovoltaic Specialist Conference, Austin, TX, USA.
2012	Recognized for one of the most notable Applied Physics Letters article published in 2012
2012	Best poster award, Symposium on Nanomaterial for Energy, Indo-US workshop, IN, USA.
2011	Best student paper award finalist, IEEE Photovoltaic Specialist Conference, Seattle, WA, USA.
2011	Graduate Student Mentor Award, Purdue University, West Lafayette, IN, USA.
2009	Technoinventor Award for master's thesis, Indian Semiconductor Association, India.
2006	Ministry of Human Resource Development Scholarship, Government of India
2006	Academic Excellence Award for undergraduate study, NIT Trichy, India
2002	North Eastern Council Scholarship for undergraduate study, Government of India.
2002	First rank (North Eastern India), Indian National Mathematical Olympiad

Publications

Patents

1. **B. Ray**, "Flash memory based radiation sensing", U.S. Patent Application No. 15,717,598, (filing date: September 27, 2017).
2. **B. Ray**, and A. Milenkovic, "A method for true random number generation using read noise of flash memory" Patent Disclosure filed (filing date: August 14, 2017).
3. **B. Ray**, and M. T. Rahman, "Methods for Detection of Recycled Flash Memory", Patent Disclosure filed. (filing date: Oct 27, 2017).
4. **B. Ray**, and L. S. Davies, "Smart Phone Based Application for Continuous Radiation Monitoring", Patent Disclosure filed. (filing date: May 22, 2017).
5. **B. Ray**, M. V. Dunga, G. J. Hemink, and C. Chen, "Erase speed based wordline control", U.S. Patent Application Number 15/194,295 (published on Dec 28, 2017).
6. **B. Ray**, G. J. Hemink, M. V. Dunga, B. Rajamohanan, C. Chen, "Cell current based bit line voltage for Flash memory", U.S. Patent Application Number: 15/181,346 (published on Dec 14 2017).
7. C. Yip, P. Reuswig, N. Yang, G. Shah, A. Dogan, **B. Ray**, M. Dunga, J. Lai, C. Chen, "System solution for first read issue using time dependent read voltages", U.S. Patent # 9711231 (2017).
8. **B. Ray**, M. V. Dunga, C. Chen, "Apparatus and method for preconditioning currents to reduce errors in sensing for non-volatile memory", U.S. Patent # 9704588 (2017).
9. **B. Ray**, M.V. Dunga, C. Chen, "Word line dependent temperature compensation scheme during sensing to counteract cross-temperature effect", U.S. Patent # 9,543,028 (2017).
10. **B. Ray**, A. Dogan, C. Chen, "Temperature dependent sensing scheme to counteract cross-temperature threshold voltage distribution widening", U.S. Patent # 9,530,512 (2016).

Journal Publication

1. S. Sakib, P. Kumari, B. S. Talukder, M. T. Rahman and **B. Ray**, "Early Detection of Recycled Flash Chip using Timing Characteristics", IEEE Transactions on Very Large Scale Integration. (Submitted)
2. P. Poudel, **B. Ray**, and A. Milinkovic, "Microcontroller TRNGs Using Perturbed States of NOR Flash Memory Cells", IEEE Transactions on Computers, 2018. (Submitted)
3. **B. Ray**, and A. Milenkovic, "True Random Number Generation Using Read Noise of Flash Memory Cells", IEEE Transactions on Electron Devices, vol. 65, no. 2, pp. 963-969, 2018.
4. M. Raquibuzzaman, **B. Ray**, T. B. Boykin, and R. S. Gorur, "Polymer-Metal Layered Structures for Improved Energy Storage Density", IEEE Transactions on Dielectrics and Electrical Insulation, 2018. (Accepted)
5. **B. Ray**, A.G. Baradwaj, M.R. Khan, B.W. Boudouris, and M.A. Alam, "Collection-limited theory interprets the extraordinary response of single semiconductor organic solar cells", Proceedings of the National Academy of Sciences, 112 (36), 11193-11198, 2015.
6. **B. Ray**, A.G. Baradwaj, B.W. Boudouris, and M.A. Alam, "Defect Characterization in Organic Semiconductors by Forward Bias Capacitance Analysis", The Journal of Physical Chemistry C 118 (31), 17461-17466, 2014.
7. J.H. Beck, **B. Ray**, R.R. Grote, R.M. Osgood, C.T. Black, M.A. Alam, I. Kymissis, "Nanostructured Electrodes Improve the Fill Factor of Organic Photovoltaics", IEEE Journal of Photovoltaics, 4(4), 1100 - 1106, 2014.

8. R.K. Chavali, J.R. Wilcox, **B. Ray**, J.L. Gray, and M. A. Alam, "Correlated Non-Ideal Effects of Dark and Light I-V Characteristics in a-Si/c-Si Heterojunction Solar Cells", IEEE Journal of Photovoltaics, 4(3), 763 - 771, 2014.
9. M.R. Khan, **B. Ray**, M.A. Alam, "Prospects of layer-split tandem cells for high-efficiency OPV", Solar Energy Materials and Solar Cells, vol. 120, 716-723, 2014.
10. M.A. Alam, **B. Ray**, M.R. Khan, and S. Dongaonkar, "The Essence and Efficiency Limits of Bulk-Heterostructure Organic Solar Cells: A Polymer-to-Panel Perspective", Journal of Materials Research, 28 (4), 2013. (*Invited Feature Article*)
11. **B. Ray**, M.R. Khan, C.T. Black, and M.A. Alam, "Nano-structured Electrode for Organic Solar Cells: Analysis and Design Fundamentals", IEEE Journal of Photovoltaics, 3(1), 318-329, 2013.
12. **B. Ray**, and M.A. Alam, "Achieving Fill Factor Above 80% in Organic Solar Cells by Charged Interface", IEEE Journal of Photovoltaics, 3(1), 310-317, 2013.
13. J.E. Allen, **B. Ray**, M.R. Khan, K.G. Yager, M.A. Alam, C.T. Black, "Self-assembly of single dielectric nanoparticle layers and integration in polymer-based solar cells", Applied Physics Letters, 101(6), 063105, 2012.
14. J. Li, **B. Ray**, M. Alam, and M. Ostling, "On the Threshold of Hierarchical Percolating Systems", Physical Review E, vol. 85, p. 021109, 2012.
15. **B. Ray**, M.S. Lundstrom, and M.A. Alam, "Can morphology tailoring improve the open circuit voltage of organic solar cells?", Applied Physics Letters, vol. 100, pp. 013307-3, 2012.
(*Recognized as one of the most notable APL articles published in 2012*)
16. **B. Ray**, and M.A. Alam, "Random vs regularized OPV: Limits of performance gain of organic bulk heterojunction solar cells by morphology engineering", Solar Energy Materials and Solar Cells, vol. 99, pp. 204-212, 2012.
17. **B. Ray**, P.R. Nair, and M.A. Alam, "Annealing Dependent Performance of Organic Bulk-Heterojunction Solar Cells: A Theoretical Perspective", Solar Energy Materials and Solar Cells, vol.95, pp. 3287-3294, 2011.
18. **B. Ray**, and M.A. Alam, "A compact physical model for morphology induced intrinsic degradation of organic bulk heterojunction solar cell", Applied Physics Letters, vol. 99, pp. 033303-3, 2011.
19. **B. Ray**, and S. Mahapatra, "Modeling of Channel Potential and Subthreshold Slope of Symmetric Double Gate Transistor", IEEE Transactions on Electron Devices, Vol. 56, No. 2, pp. 260-266, 2009.
20. **B. Ray**, and S. Mahapatra, "Modeling and analysis of body potential of cylindrical Gate-All-Around nanowire transistor", IEEE Transactions on Electron Devices, Vol. 55, No. 9, pp. 2409-2416, 2008.

Conference Proceedings

1. P. Kumari, B. S. Talukder, S. Sakib, **B. Ray**, and M. T. Rahman, "Independent Detection of Recycled Flash Memory: Challenges and Solutions", IEEE International Symposium on Hardware Oriented Security and Trust, 2018 (Acceptance rate 20.2%).
2. L. Davies, P. Kumari, N. P. Bhat and **B. Ray**, "Prospect of State-of-the-Art Flash Chips for Dosimetry Application", IEEE Nuclear and Space Radiation Effects Conference (NSREC), 2018. (Accepted)
3. P. Kumari, S. Huang and **B. Ray**, "Accelerated Aging Induced Radiation Hardening of Flash Memory", IEEE Nuclear and Space Radiation Effects Conference (NSREC), 2018. (submitted)

4. **B. Ray**, "Cross Temperature Reliability of NAND Flash Memory: Root cause and Countermeasure", 2018 IEEE International Reliability Physics Symposium (submitted)
5. **B. Ray**, and M.A. Alam, "Role of Charged Defects on Organic Solar Cell Performance: Prospect of Heterojunction-Free Device Design" Proc. of the 39th IEEE Photovoltaic Specialists Conference (PVSC), Tampa, Florida, USA, 2013.
(Nominated for best student paper award in Area 6: Organic Photovoltaic)
6. R.K. Chavali, J.R. Wilcox, **B. Ray**, J.L. Gray, and M. A. Alam, "A Diagnostic Tool for Analyzing the Current-Voltage Characteristics in a-Si/c-Si Heterojunction Solar Cells", Proc. of the 39th IEEE Photovoltaic Specialists Conference (PVSC), Tampa, Florida, USA, 2013.
7. **B. Ray**, and M.A. Alam, "Is A Heterojunction Essential for High-Efficiency Organic Solar Cells?" Device Research Conference, Norte Dame, IN, USA, 2013.
8. **B. Ray**, A.G. Baradwaj, B.W. Boudouris, and M.A. Alam, "Capacitance Collapse in Forward Bias Fingerprints Defects in Organic Semiconductors", MRS Spring Meeting, San Francisco, CA, USA, 2013.
9. **B. Ray**, M.A. Alam , "Achieving Fill Factor Above 80% in Organic Solar Cells by Interface Engineering", Proc. of the 38th IEEE Photovoltaic Specialists Conference (PVSC), Austin, TX, USA, 2012.
(Best poster award in Area 6: Organic Photovoltaic)
10. **B. Ray**, M.A. Alam, "Optimum Morphology and Performance Gains of Organic Solar Cells", Proc. of the 37th IEEE Photovoltaic Specialists Conference (PVSC), Seattle, WA, USA, 2011.
(Nominated for best student paper award in Area 6: Organic Photovoltaic)
11. M.A. Alam, **B. Ray**, M.R. Khan, and S. Dongaonkar, "The Essence and Efficiency Limits of Bulk-Heterostructure Organic Solar Cells", Proc. of MRS Fall Meeting, Boston, MA, USA, 2011.
12. M.A. Alam, **B. Ray**, M.R. Khan, "Untangling the Essence of Bulk Heterostructure Organic Solar Cells: Why Complex Need Not be Complicated", IEEE Semiconductor Device Research Symposium, College Park, MD, USA, 2011.
13. **B. Ray**, P.R. Nair, And M.A. Alam, "Morphology Dependent Short Circuit Current In Bulk Heterojunction Solar Cell", Proc. of the IEEE Photovoltaic Specialists Conference (PVSC), Honolulu, HI, USA, 2010.
14. **B. Ray**, M.R. Khan, and M.A. Alam, "Performance Improvement of Polymer Based Solar Cell by Ordered Nano-morphology", Proc. of the University Government Industry Micro/nano Symposium (UGIM), IEEE, West Lafayette, IN, USA, 2010.
15. **B. Ray**, P.R. Nair, R.E. García and M.A. Alam, "Modeling and Optimization of Polymer based Bulk Heterojunction (BH) Solar cell", Proc. of the IEEE International Electron Devices Meeting (IEDM), Baltimore, MD, USA, 2009.
16. **B. Ray** and S. Mahapatra, "A New Threshold Voltage Model for Omega Gate Cylindrical Nanowire Transistor" Proc. of the IEEE International Conference on VLSI Design, Hyderabad, India, 2008.
17. **B. Ray**, K. Shubhakar, and S. Mahapatra, "Necessity for Quantum Mechanical Simulation for the Future Technology Nodes", Proc. of the IEEE International Workshop on Physics of Semiconductor Devices (IWPSD), Mumbai, India, pp. 880 - 883, 2007.
18. A. Agarwal, **B. Ray**, M. Choudhury, A. Basu and S. Sarkar, "Automatic Extraction of Multiword Expressions in Bengali: An Approach for Miserly Resources Scenario", Proc. of the International Conference on Natural Language Processing (ICON),Hyderabad, India, pp. 165 - 172, Dec. 2004

Book Chapter

1. Alam, M. A., Pimparkar, N. and **Ray, B.** (2010) The Future of Microelectronics is ... Macroelectronics, in Future Trends in Microelectronics: From Nanophotonics to Sensors and Energy (eds S. Luryi, J. Xu and A. Zaslavsky), John Wiley & Sons, Inc., Hoboken, NJ, USA. doi: 10.1002/9780470649343.ch30.

Invited Presentations

1. "Perspective on Solar Energy Harvesting: What are the present Challenges?" **National Institute of Technology, Agartala**, India, October 2014.
2. "Operation and Design of Organic Solar Cells", **Bhabha Atomic Research Centre (BARC)**, India, January 2013.
3. "Defect Characterization in Organic Semiconductors by Forward Bias Capacitance", **Network for Photovoltaic Technology (NPT) Center**, Purdue University, November 2012.
4. "Performance Limits of Nano-Structured Organic Solar Cells", **Tata Institute of Fundamental Research (TIFR)**, Mumbai, India, January 2012.
5. "Morphology-Aware Design of High Performance Nano-Structured Organic Solar Cells", **Indian Institute of Science**, Bangalore, India, December 2011.
6. "Design and Performance Limits of Organic Solar Cells", e-Workshop in **Network for Photovoltaic Technology (NPT) Center**, Purdue University, November 2011.
7. "OPV Operation: Insight from Numerical Simulation", **Energy Frontier Research Center, Columbia University**, April 2011.
8. "Organic Solar Cell: Modeling Optimization and Reliability", **Indian Institute of Technology, Guwahati**, India, January 2011.
9. "Modeling and Optimization of Polymer based Bulk Heterojunction (BH) Solar cell", **Network for Computational Nanotechnology (NCN)**, Purdue University, 2010.
10. "Thin Film Organic Solar Cells", **Northwestern University**, September 2009.

Oral Presentations

1. B. Ray, and M.A. Alam, "Role of Charged Defects on Organic Solar Cell Performance: Prospect of Heterojunction-Free Device Design", **39th IEEE Photovoltaic Specialists Conference (PVSC)**, Tampa, Florida, USA, 2013.
(Nominated for best student paper award in Area 6: Organic Photovoltaic)
2. B. Ray, and M.A. Alam, "Is A Heterojunction Essential for High-Efficiency Organic Solar Cells?" **Device Research Conference**, Norte Dame, IN, USA, 2013.
3. B. Ray, and M.A. Alam, "Optimum Morphology and Performance Gains of Organic Solar Cells", **37th IEEE Photovoltaic Specialists Conference (PVSC)**, Seattle, WA, USA, June 2011.
(Nominated for best student paper award in Area 6: Organic Photovoltaic)
4. B. Ray, P.R. Nair, and M.A. Alam, "Morphology Dependent Short Circuit Current In Bulk Heterojunction Solar Cell", **36th IEEE Photovoltaic Specialists Conference (PVSC)**, Honolulu, HI, USA, June, 2010.

5. B. Ray, P.R. Nair, R.E. García and M.A. Alam, "Modeling and Optimization of Polymer based Bulk Heterojunction (BH) Solar cell", **IEEE International Electron Devices Meeting (IEDM)**, Baltimore, USA, Dec 2009.
6. B. Ray and S. Mahapatra, "A New Threshold Voltage Model for Omega Gate Cylindrical Nanowire Transistor", **IEEE International Conference on VLSI Design**, Hyderabad, India, 2008.
7. B. Ray, A. Pal, S. Das, S. Mahapatra, "A New Spice Simulator for Single Electron Transistor Based Integrated Circuits", **VLSI Design and Test Symposium (VDAT)**, Kolkata, India, 2007.

Poster Presentations

1. B. Ray, A.G. Baradwaj, B.W. Boudouris, and M.A. Alam, "Capacitance Collapse in Forward Bias Fingerprints Defects in Organic Semiconductors", MRS Spring Meeting, San Francisco, CA, USA, 2013.
2. B. Ray, M. A. Alam, "Generation Vs Collection: Which one is the Bottleneck for OPV Devices?", Energy Frontier Research Center, Columbia University, May 2013.
3. B. Ray, M. A. Alam, "Modeling and Simulation of Nano-structured Organic Solar Cell", Symposium on Nanomaterial for Energy, Indo-US workshop, Purdue University, IN, USA, 2012.
(Best poster award in the Symposium)
4. B. Ray, A.G. Baradwaj, B.W. Boudouris, and M.A. Alam, "Forward Bias Impedance Spectroscopy for Organic Solar Cells", Annual Review of Network for Photovoltaic Technology, Purdue University, West Lafayette, IN, USA, 2012.
5. B. Ray, M.A. Alam, "Achieving Fill Factor Above 80% in Organic Solar Cells by Interface Engineering", Proc. of the 38th IEEE Photovoltaic Specialists Conference (PVSC), Austin, TX, USA, 2012.
(Best poster award in Area 6: Organic Photovoltaic)
6. B. Ray, and M.A. Alam, "Modeling and Simulation of Nano-structured Organic Solar Cells: From Process to Performance", Annual Review of Network for Photovoltaic Technology, Purdue University, West Lafayette, IN, USA, 2011.
7. C.A.G. Williamson, B. Ray, M.R. Khan, and M.A. Alam, "Development of Simulation Tool for Organic Solar Cell", Summer Undergraduate Research Fellowships (SURF) Research Symposium, Purdue University, West Lafayette, IN, USA, 2011.
8. B. Ray, M.R. Khan, and M.A. Alam, "Performance Improvement of Polymer Based Solar Cell by Ordered Nano-morphology", Proc. of the University Government Industry Micro/nano Symposium (UGIM), IEEE, West Lafayette, IN, USA, 2010.
9. B. Ray, K. Shubhakar, and S. Mahapatra, "Necessity for Quantum Mechanical Simulation for the Future Technology Nodes", Proc. of the IEEE International Workshop on Physics of Semiconductor Devices (IWPSD), Mumbai, India, pp. 880 - 883, 2007.

Research Grants

1. University of Alabama in Huntsville (#234384- New Faculty Research Award)
 Period: 11/20/17– 11/19/17
 Amount: \$10,000
 Principal Investigator: **Biswajit Ray**
 Title: *Security Primitives Using Flash Memory*

2. University of Alabama in Huntsville (# 602083- Charger Innovation Fund)
Period: 6/26/2017 – 2/26/2018
Amount: \$15,000
Principal Investigator: **Biswajit Ray**
Title: *Smart Phone Based Application for Continuous Radiation Monitoring*

Professional Services

- Manuscript reviewer for the following Journals: Scientific Reports (Nature), NPJ Computational Materials (Nature Partner Journal), IEEE Transactions on Electron Devices, IEEE Electron Device Letters, Advances in Polymer Technology, Applied Physics Letters, Journal of Applied Physics, and Elsevier Microelectronics Journal.
- Served in the publication committee of (i) 26th Photovoltaic Science and Engineering Conference (PVSEC-26), 2016, (ii) 39th IEEE Photovoltaic Specialists Conference (PVSC), Tampa, Florida, USA, 2013; (iii) 38th IEEE Photovoltaic Specialists Conference (PVSC), Austin, TX, USA, 2012 (iv) 37th IEEE Photovoltaic Specialists Conference (PVSC), Seattle, WA, USA, June 2011.

Teaching and Curriculum Development

- EE310: Solid State Fundamentals
 - An undergraduate core course on the physics and operating principles of solid state devices
 - Fall 2017, Enrollment: 40
- EE410/510: Fundamentals of Photovoltaics
 - A new undergraduate (senior)/ graduate level course introducing the fundamental science and technology for solar energy harvesting.
 - Spring 2017, Enrollment: 14
 - Spring 2018, Enrollment: 28
- EE610: Reliability of Electronic Devices
 - A new graduate level course on the operation and degradation/breakdown mechanisms in electronic devices such as logic transistors, memory cells, etc.
 - Fall 2017, Enrollment: 12

Mentoring and Advising

Doctoral student advisees (Current)

- Mr. Sijay Huang (Jan. 2017- Present) (Thesis Topic: Electronic Device Reliability)
- Ms Preeti Kumari (August 2017-Present) (Thesis Topic: Electronic Device Reliability)
- Mr. Sadman Sakib (August 2017-Present) (Thesis Topic: Hardware Security)

Master's student advisees (Current)

- Mr. M D Raquibuzzaman (Jan. 2017- Present, Co-advised with Dr. Gorur)
— Thesis topic: High voltage breakdown in polymer-composite