

Dr. Biswajit Ray

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University of Alabama in Huntsville, Huntsville, AL 35899, USA.

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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

- (2020) Outstanding Faculty Research Award, College of Engineering, The University of Alabama in Huntsville
- (2020) Outstanding Junior Faculty Award, College of Engineering, The University of Alabama in Huntsville
- (2019) Elevated to IEEE Senior Member
- (2019) NSF EPSCoR Research Fellow (RII Track-4), 2019.
- (2019) Joseph Dowdle Outstanding ECE Faculty Award, The University of Alabama in Huntsville
- (2017) New Faculty Award, The University of Alabama in Huntsville
- (2017) Charger Innovation Fund (CIF) Award, The University of Alabama in Huntsville
- (2014) 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) 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

From UAH:

1. **B. Ray**, Levi Davies, “Flash memory based radiation sensing”, U.S. Patent # 10,509,132 (2019)
2. **B. Ray**, “Methods to Convert Flash Memory into One-Time Programmable Memory” (UAH Docket No.: UAH-P-19002; filing date: 3/15/2019)
3. **B. Ray**, “Methods for analog sanitization of flash memory system” (UAH Docket No.: UAH-P-19003; filing date: 2/15/2019)
4. **B. Ray** and Preeti Kumari, “Methods for Radiation Hardening of NAND Flash Memory”, Patent Disclosure filed. (filing date: Feb 2, 2018)
5. **B. Ray**, “True Random Number Generator using Solar Cell” (UAH Docket No.: UAH-P-18019; filed on May 14, 2018)
6. **B. Ray**, “Long distance Traffic Monitoring using Solar-Powered Road Marker” (UAH Docket No.: UAH-P-18018; filing date: April 22, 2018)
7. **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).
8. **B. Ray**, and M. T. Rahman, “Methods for Detection of Recycled Flash Memory”, Patent Disclosure filed. (filing date: Oct 27, 2017)
9. **B. Ray**, and L.S. Davies, “Smart Phone Based Application for Continuous Radiation Monitoring”, Patent Disclosure filed. (filing date: May 22, 2017).

Prior to UAH:

10. M. V. Dunga, A. Khandelwal, C. Chen, and B. Ray, “System and method for string-based erase verify to create partial good blocks”, U.S. Patent # 10535411 (2020).
11. M. V. Dunga, C. Chen, B. Ray, "Post write erase conditioning", U.S. Patent # 10269439 (2020)
12. H. Naik, B. Ray, M. V. Dunga, C. Chen, "Memory write verification using temperature compensation", U.S. Patent # 10304559 (2019).
13. B. Ray, M. V. Dunga, G. J. Hemink, and C. Chen, “Erase speed based wordline control”, U.S. Patent # 10304551 (2019).
14. H. Naik, M. V. Dunga, C. Chen, B. Ray, "System and method for programming a memory device with multiple writes without an intervening erase", U.S. Patent # 9972396 (2018).
15. B. Ray, M. V. Dunga, and C. Chen, "Erase for partially programmed blocks in non-volatile memory", U.S. Patent # 10074440 (2018).
16. B. Ray, G. J. Hemink, M. V. Dunga, B. Rajamohanam, C. Chen, “Cell current based bit line voltage for Flash memory”, U.S. Patent # 10008273 (2018).
17. Chris Yip, Philip Reusswig, Nian Niles Yang, Grishma Shah, Abuzer Azo Dogan, Biswajit Ray, Mohan Dunga, Joanna Lai, Changyuan Chen, "System solution for first read issue using time dependent read voltages", U.S. Patent # 9711231 (2017).
18. 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).
19. B. Ray, M.V. Dunga, C. Chen, “Word line dependent temperature compensation scheme during sensing to counteract cross-temperature effect”, U.S. Patent # 9543028 (2017).
20. B. Ray, A. Dogan, C. Chen, “Temperature dependent sensing scheme to counteract cross-temperature threshold voltage distribution widening”, U.S. Patent # 9530512 (2016).

Journal Publication

From UAH:

1. P. Kumari, S. Huang, M. Wasiolek, K. Hattar, and B. Ray, "Layer Dependent Bit Error Variation in 3-D NAND Flash Under Ionizing Radiation", IEEE Transactions on Nuclear Science, 2020.
(Journal Impact Factor = 1.8; Citation = 0)
Author Contribution: Ms P. Kumari performed the research and wrote the paper. Mr Huang helped her to analyse data. Dr. Wasiolek and Dr. Hattar helped her to collect data and edited the paper. Dr Ray led the research effort by designing the research, analyzing the data and editing the paper)
2. M. Hasan and B. Ray, "Reliability of NAND Flash Memory as a Weight Storage Device of Artificial Neural Network", IEEE Transactions on Device and Materials Reliability, 2020.
(Journal Impact Factor = 1.8; Citation = 0)
Author Contribution: Mr M. Hasan performed the research and wrote the paper. Dr Ray led the research effort by designing the research, analyzing the data and editing the paper)
3. S. Sakib, A. Milenkovic, and **B. Ray**, "Flash Watermark: An Anti-Counterfeiting Technique for NAND Flash Memories", IEEE Transaction on Electron Devices, vol. 67, no. 10, pp. 4172–4177, 2020.
(Journal Impact Factor = 2.7; Citation = 0)
Author Contribution: Mr Sakib (Advisor: Dr Ray) performed the research and wrote the paper. Dr. Milinkovic helped him to analyze data and editing the paper. Dr Ray led the research effort by designing the research, analyzing the data and editing the paper)
4. S. Sakib, A. Milenkovic, M. T. Rahman, and **B. Ray**, "An Aging-Resistant NAND Flash Memory Physical Unclonable Function", IEEE Transaction on Electron Devices, vol. 27, no. 3, pp. 937–943, Mar. 2020.
(Journal Impact Factor = 2.7; Citation = 0)
Author Contribution: Mr Sakib (Advisor: Dr Ray), performed the research and wrote the paper. Dr. Milinkovic and Dr Rahman helped him to analyze data and editing the paper. Dr Ray led the research effort by designing the research, analyzing the data and editing the paper)
5. S. Huang, T. B. Boykin, R. S. Gorur and **B. Ray**, "Electrical Tree Formation in Polymer-Filler Composites", IEEE Transactions on Dielectrics and Electrical Insulation, vol. 26, no. 6, pp. 1853-1858, Dec. 2019.
(Journal Impact Factor =1.8; Citation = 0)
Author Contribution: Mr. Huang (Advisor: Dr. Ray) performed the research and wrote the paper. Dr Boykin and Dr Gorur helped in editing the paper. Dr Ray led the research effort by designing the research, analyzing the data and editing the paper)
6. B. Talukder, B. Ray, D. Forte, and M. T. Rahman "PreLatPUF: Exploiting DRAM Latency Variations for Generating Robust Device Signatures", IEEE Access, vol. 7, no. 1, pp. 81106-81120, 2019.
(Journal Impact Factor =4.1; Citation = 2)
Author Contribution: Mr. Talukder (Advisor: Dr. Rahman) performed the research and wrote the paper. Dr Ray, Dr Forte and Dr Rahman helped in editing the paper)
7. P. Poudel, **B. Ray**, and A. Milinkovic, "Microcontroller TRNGs Using Perturbed States of NOR Flash Memory Cells", IEEE Transaction on Computer, vol. 68, no. 2, pp. 307–313, 2019.
(Journal Impact Factor = 3; Citation = 0)
Author Contribution: P. Poudel (Advisor: Dr Milinkovic), performed the research and wrote the paper. Dr Ray and Dr. Milinkovic helped to analyze data and editing the paper.)

8. S. Sakib, P. Kumari, B.M.S.B. Talukder, M.T. Rahman, **B. Ray**, “Non-Invasive Detection Method for Recycled Flash Memory Using Timing Characteristics”, *Cryptography*, vol. 2, no. 3, pp. 17, Aug. 2018.
(Journal Impact Factor = NA; Citation = 1
Author Contribution: This is a newly initiated research direction on counterfeit memory detection led by Dr. Ray. Mr Sakib and Ms Kumari (Advisor: Dr Ray), performed the research and wrote the paper. Dr Rahman and Mr Talukder (Advisor: Dr Rahman) helped in editing the paper.)
(This work was highlighted in IEEE Spectrum, phys.org, The Resister, etc.)
9. 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*, vol. 15, no. 6, pp. 2375-2379, 2018.
(Journal Impact Factor =1.8; Citation = 0
Author Contribution: M. Raquibuzzaman (Dr. Ray’s PhD student co-advised by Dr Gorur) performed the research, analyzed data and edited the paper. B. Ray designed the research, analyzed the data, and wrote the paper. T.B. Boykin and R. S. Gorur helped to design the research and edited the paper)
10. **B. Ray**, and A. Milenkovic, “True Random Number Generation Using Read Noise of Flash Memory Cells”, *IEEE Transaction on Electron Devices*, vol. 65, no. 2, pp. 963-969, 2018.
(Journal Impact Factor = 2.7; Citation = 10
Author Contribution: This is a newly initiated research direction on hardware security led by Dr. Ray. B. Ray designed the research, performed the research, analyzed the data, contributed the formulation of algorithm and wrote the paper. A. Milenkovic helped to analyze data and editing the paper.)

Prior to UAH:

11. **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.
12. **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.
13. 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.
14. 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.
15. 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.
16. 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)*
17. **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.
18. **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.
19. 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.

20. J. Li, **B. Ray**, M. Alam, and M. Ostling, “On the Threshold of Hierarchical Percolating Systems”, Physical Review E, vol. 85, p. 021109, 2012.
21. **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)
22. **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.
23. **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.
24. **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.
25. **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.
26. **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

From UAH:

1. P. Poudel, B. Ray, and A. Milinkovic, “Flashmark: Watermarking of NOR Flash Memories for Counterfeit Detection”, IEEE Design and Automation Conference, 2020. (Acceptance rate 23%).
2. M. Hasan and **B. Ray**, “Data Recovery from “Scrubbed” NAND Flash Storage: Need for Analog Sanitization” 29th USENIX Security Symposium, Boston, MA, Aug. 2020. (Acceptance rate 16%)
3. S. Sakib, and **B. Ray**, “Temperature Compensation Technique for NAND Flash Memory Based Physical Unclonable Function” 2020 Government Microcircuit Applications & Critical Technology Conference (Gomactech), San Diego, CA, Mar. 2020. (Accepted)
4. M. Hasan, M. Raquibuzzaman, and **B. Ray**, “Radiation Tolerance of 3-D NAND Flash Based Neuromorphic Computing System” Proc. of the 2020 IEEE International Reliability Physics Symposium, Dallas, TX, Mar 2020. (Accepted)
5. B. Bahar Talukder, V. Menon, B. Ray, T. Neal, M. Rahman “Towards the Avoidance of Counterfeit Memory: Identifying the DRAM Origin”, in Proc. of IEEE International Symposium on Hardware Oriented Security and Trust, 2020 (accepted).
(Acceptance rate 20%)
Author Contribution: Mr. Talukder (Advisor: Dr Rahman) performed the research and wrote the paper. Dr. Ray, Dr. Menon and Dr. Rahman helped Mr. Talukder to analyze data and editing the paper.)
6. S. Chattopadhyay, P. Kumari, B. Ray, R. S. Chakraborty, “Machine Learning Assisted Accurate Estimation of Usage Duration and Manufacturer for Recycled and Counterfeit Flash Memory Detection”, Proc. of the 2019 IEEE 28th Asian Test Symposium, Kolkata, India, pp. 49-54.

(Citation = 0

Author Contribution: This is a collaborative research between UAH and IIT Kharagpur, India. Mr. Chattopadhyay (IIT) and P. Kumari (UAH) performed the research; while Dr Ray and Dr Chakraborty wrote the paper.)

7. P. Kumari, F. Irom, and **B. Ray**, “Word Line Dependent Bit Error in 3-D NAND Flash Under Ionizing Radiation”, 2019 IEEE Nuclear and Space Radiation Effects Conference, San Antonio, Texas (**accepted**).

(Citation = 0

Author Contribution: Ms. Kumari (Advisor: Dr Ray) performed the research and wrote the paper. Dr. Ray, and Dr. Irom helped Ms. Kumari to analyze data and editing the paper.)

8. M. Raquibuzzaman, S. Dongaonkar, and **B. Ray**, “Can Bad Solar Cells Make a PV Module More Efficient?” Proc. of the 46th IEEE Photovoltaic Specialists Conference, Chicago, IL, 2019.

(Citation = 0

Author Contribution: Mr. Raquibuzzaman (Advisor: Dr Ray) performed the research and wrote the paper. Dr Ray, and Dr Dongaonkar helped him to analyze data and editing the paper.)

9. M. Hasan and **B. Ray**, “Tolerance of Deep Neural Network Against the Bit Error Rate of NAND Flash Memory”, Proc. of the 2019 IEEE International Reliability Physics Symposium, Monterey, CA, 2019.

(Citation = 0

Author Contribution: This is a newly initiated research direction on neuromorphic computing led by Dr. Ray, who designed the research. M. Hasan, performed the research and wrote the paper. Dr Ray helped to analyze data and editing the paper.)

10. B. Talukder, **B. Ray**, T. Morris, and M. T. Rahman, “Exploiting DRAM Latency Variations for Generating True Random Numbers”, Proc. of 2019 IEEE International Conference on Consumer Electronics (ICCE). (accepted)

(Citation = 0

Author Contribution: Mr. Talukder (Dr Rahman’s PhD student) performed the research and wrote the paper. Dr Ray and Dr Rahman helped to analyze data and editing the paper.)

11. P. Kumari and **B. Ray**, “Wireless Passive Radiation Dosimeter Using Flash Memory,” in Proc. of 6th IEEE International Conference on Wireless for Space and Extreme Environments (WiSEE), Huntsville, AL, USA, 2018, pp. 239–245.

(Citation = 0

Author Contribution: This is a newly initiated research direction on radiation sensing led by Dr Ray. P. Kumari, performed the research and wrote the paper. Dr Ray helped to analyze data and editing the paper.)

12. S. Ritter, T. Pigg, C. Brown, **B. Ray**, “True Random Number Generator using Solar Output Characteristics”, Proc. of IEEE International Conference on Wireless for Space and Extreme Environments, Huntsville, AL, USA, Dec. 2018.

(Citation = 0

Author Contribution: S. Ritter, T. Pigg, C. Brown, performed the research as a part of their ECE senior design project. Dr Ray helped to analyze data and wrote the paper.)

13. P. Kumari, L. Davies, N. P. Bhat, E. X. Zhang, M. W. McCurdy, D. M. Fleetwood and **B. Ray**, "State-of-the-Art Flash Chips for Dosimetry Application", in Proc. of IEEE Radiation Effects Data Workshop, Kona, HI, USA, 2018. (Acceptance rate 60%).

(Citation = 0

Author Contribution: S. Ritter, T. Pigg, C. Brown, performed the research. Dr Ray helped to analyze data and wrote the paper.)

14. L. Davies, R. Thornton, P. Hudson, and **B. Ray**, "Automatic Detection and Characterization of Partial Shading in PV System," in Proc. of *2018 IEEE 7th World Conference on Photovoltaic Energy Conversion (WCPEC) (A Joint Conference of 45th IEEE PVSC, 28th PVSEC, 34th EU PVSEC)*, 2018, pp. 1185–1187.

(Citation = 0

Author Contribution: L. Davies, R. Thornton, P. Hudson, performed the research as a part of their senior design project. Dr Ray helped to analyze data and wrote the paper.)

15. P. Kumari, B. S. Talukder, S. Sakib, **B. Ray**, and M. T. Rahman, "Independent Detection of Recycled Flash Memory: Challenges and Solutions", in Proc. of IEEE International Symposium on Hardware Oriented Security and Trust, 2018, pp. 89-95.

(Acceptance rate 20.2%

Citation = 1

Author Contribution: Mr Sakib and Ms Kumari (both Dr Ray's PhD student), performed the research and wrote the paper. Dr Rahman, Mr Talukder and Dr Ray helped analyzing the data and editing the paper.)

Prior to UAH:

16. **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)

17. 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.

18. **B. Ray**, and M.A. Alam, "Is A Heterojunction Essential for High-Efficiency Organic Solar Cells?" Device Research Conference, Norte Dame, IN, USA, 2013.

19. **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.

20. **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)

21. **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)

22. 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.

23. 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.

24. **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.

25. **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.
26. **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.
27. **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.
28. **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.
29. 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

After joining UAH:

1. "Wireless, Passive and Real-time Radiation Dosimeter for Enhanced Situational Awareness", Kansas State University, Manhattan KS, Oct. 2019.
2. "Hack-proof Non-volatile Memory Systems" Air Force Research Laboratory, Albuquerque, NM, 2019.
3. "Word Line Dependent Bit Error in 3-D NAND Flash Under Ionizing Radiation", 2019 IEEE Nuclear and Space Radiation Effects Conference, San Antonio, Texas, July 2019.
4. "Low cost radiation dosimeter using flash memory chip", NASA MSFC, Huntsville, AL, 2019.
5. "Hack-proof Non-volatile Memory System", IEEE EDS Student Chapter, Indian Institute of Technology, Roorkee, India, May 2019.
6. "Hack-proof Non-volatile Memory System", Cypress Semiconductor, San Jose, CA, April 2019.
7. "Hack-proof Non-volatile Memory System", Western Digital Corporation, Milpitas, CA, April 2019.
8. "Detection of Recycled Flash Memory", 2018 Southeast Symposium on Contemporary Engineering Topics (SSCET), Aug. 2018.

9. "Wireless Passive Radiation Dosimeter Using Flash Memory," 6th IEEE International Conference on Wireless for Space and Extreme Environments (WiSEE), Huntsville, AL, USA, 2018.

Prior to UAH:

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

Oral Student Paper 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. National Science Foundation (Award # 2007403)
Period: 10/01/2020 - 09/30/2023
Amount: \$496,925
Role: Principal Investigator
Title: "*CNS Core: Small: Ensuring Privacy by Runtime Analog Sanitization of Solid-State Storage Devices*"
2. National Science Foundation (Award # 1929099)
Period: 12/15/2019-11/30/2021
Amount: \$233,345
Role: Principal Investigator (sole PI)
Title: "*RII Track-4: Real-Time Radiation Dosimetry Using Flash Memory*"
3. National Science Foundation (Award # 1935676)
Period: 01/01/2020-12/31/2022
Amount: \$799,950
Role: Co-Principal Investigator (My portion of fund: \$120,000)
Title: "*SitS NSF-UKRI: Real-time and Continuous Monitoring of Phosphates in the Soil with Graphene-Based Printed Sensor Arrays*"
4. Department of Energy, Office of Nuclear Energy (Contract DE-AC07-051D14517)
Period: 5/14/2019-5-13/2020
Amount: \$50,000
Role: Principal Investigator (sole PI)
Title: "*In-situ investigation of irradiation damage on non-volatile memory*"
5. University of Alabama in Huntsville (# 602083- Charger Innovation Fund)
Period: 6/26/2018 – 1/31/2019
Amount: \$15,000
Role: Principal Investigator (sole PI)
Title: *True Random Number Generator for Internet of Things Applications*
6. University of Alabama in Huntsville (# 602083- Charger Innovation Fund)
Period: 6/26/2017 – 2/26/2018
Amount: \$15,000
Role: Principal Investigator (sole PI)
Title: *Smart Phone Based Application for Continuous Radiation Monitoring*
7. University of Alabama in Huntsville (#234384- New Faculty Research Award)
Period: 11/20/17– 11/19/17
Amount: \$10,000
Role: Principal Investigator (sole PI)
Title: *Security Primitives Using Flash Memory*

Teaching and Curriculum Development

- EE310: Solid State Fundamentals (Undergraduate course)
 - Enrollment: 42 (F' 17); 52(F' 18); 57 (F' 19)
 - SIE Score (overall): 4.1/5.0 (F' 17); 4.5/5.0 (F' 18); 4.7/5.0 (F' 19)
- EE417/510: Fundamentals of Photovoltaics (**New Undergraduate/ Graduate Course**)
 - Enrollment: 14(S'17); 28(S'18); 21(S'19)
 - SIE Score (overall): 4.8/5 (S'17); 4.9/5.0 (S'18); 4.9(S'19)
- EE622: Hardware Reliability (**New Graduate Course**)
 - Enrollment: 12 (F' 17); 4(F' 18); 7 (F' 19)
 - SIE Score (overall): 4.7/5.0 (F' 17); 4.9/5.0 (F' 18); 4.8/5.0 (F' 19)

Mentoring and Advising

Doctoral student advisees

1. Mr. Sijay Huang (Jan. 2017- Present) -Thesis Topic: Reliability of thick dielectrics
2. Ms Preeti Kumari (August 2017-Present) -Thesis Topic: Radiation effects on non-volatile memory
3. Mr. Sadman Sakib (August 2017-Present) - Thesis Topic: Hardware Security using non-volatile memory
4. Mr. M D Raquibuzzaman (Aug. 2018- Present) -Thesis Topic: Reliability of Neuromorphic Computing System
5. Mr Umeshwarnath Surendranathan (Jan. 2020- Present) -Thesis Topic: Radiation Tolerant Non-volatile Memory System

Master's student advisees

1. Mr Mehedi Hasan (Aug. 2018- Present): Application of non-volatile memory for machine learning applications.
2. Ms. Matchima Buddhanoy (Jan 2020-present): Extreme Temperature effects on non-volatile memory

Undergraduate student advisees (senior design projects)

Fall 2019:

- Team-6: Dylan Wallace, Andrew Lopez, Teven Buchanon (Car Roof PV Design)

Spring 2019:

- Team-5: Juan Gonzalez, Sajjwal Chaulagain (PV Power Meter)

- Team-4: Elizabeth Bekken, Dana Overton (Arduino based PV I-V tracker)

Spring 2018:

- Team-3: Levi Davies, Ryan Thornton, Paul Hudson (Shade detection on PV module)
- Team-2: Stephen Ritter, Connor Brown, Tyler Pigg (Solar Power Monitor)

Fall 2017:

- Team-1: Aaron Mashburn, Bryan Fernandez, and Minh Nguyen (Radiation Hardening Through Error Analysis in Flash Memory)
- Mr. Levi Davies (Aug. 2017 - Present) (Honors Thesis Topic: Smart Phone based Radiation Monitoring)

Professional Services

1. Technical Program Committee Member for the following conferences:
 - IEEE SoutheastCon, Huntsville, AL, 2019.
 - IEEE International Conference on Wireless for Space and Extreme Environments (WiSEE), Huntsville, AL, USA, Dec. 2018.
 - 26th Photovoltaic Science and Engineering Conference (PVSEC-26), 2016
2. Manuscript reviewer for the following Journals:
 - IEEE Transactions on Circuits and Systems
 - IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems
 - IEEE Transactions on Electron Devices,
 - IEEE Electron Device Letters
 - Applied Physics Letters
 - Journal of Applied Physics
 - Scientific Reports (Nature)
3. Volunteered a lecture for UAH FYE (Freshman-Year Experience) presentations, (2020, 2018).
4. Performed as Volunteer in UAH Discovery Day, College of Engineering Visit (2019, 2018, 2017).