Dhritiman Bhattacharya

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Doctoral candidate with primary research focus on design, simulation, fabrication and characterization of nanomagnetic memory and computing devices based on electric field induced manipulation of fixed magnetic skyrmions and shape anisotropic planar nanomagnets.

Education

- PhD Candidate, Mechanical and Nuclear Engineering, Virginia Commonwealth University, Richmond, VA. Expected Graduation: Fall 2019.
- Bachelor of Science, Electrical and Electronic Engineering, BUET, Dhaka, Bangladesh. Graduation Year: 2013.

Professional Experience

- **Graduate Research Assistant,** Mechanical and Nuclear Engineering, VCU, Fall 2016 to present.

❖ ***Modeling and Simulation of nanomagnetic devices***

- Strain and acoustic wave induced incoherent magnetization dynamics of nanomagnets.
- VCMA and spin current induced reversal of fixed magnetic skyrmions for magnetic memory/neuromorphic applications.

- ***Simulation and analysis***: Micromagnetic Simulation tools MuMax3 & OOMMF, MATLAB, COMSOL etc.

❖ ***Fabrication and Characterization of nanomagnetic devices***

- ***Local strain induced clocking of shape anisotropic nanomagnets (Ongoing, with UParis-Sud)***
  - Fabrication of elliptical nanomagnets on piezoelectric thin films.
  - Studying the switching characteristics while subjected to voltage generated strain.

- ***Experimental realization of fixed magnetic skyrmion reversal using VCMA (Ongoing, with UCLA)***
  - Patterning films to create nanodots to nucleate fixed skyrmions.
  - Studying the behavior of magnetic skyrmions under electric field in continuous films and nanodots.

- ***Thin film deposition and Lithography:*** E-beam evaporation, DC/RF sputtering, Photolithography, Electron beam lithography, Plasma and Reactive Ion Etching, Wedge Bonding.

- ***Characterization tools:*** Scanning Electron Microscopy (SEM), Atomic and Magnetic Force Microscopy (AFM/MFM), Vibrating Sample Magnetometer (VSM), Physical Property Measurement System (PPMS).

- **Graduate Teaching Assistant**, Mechanical and Nuclear Engineering, VCU, Fall 2014- Summer 2016.
  - ***Courses***: Mechanical Systems design, Process and system dynamics, Dynamics and Kinematics.
- **Reviewer**: IOP Nanotechnology, IEEE Magnetic Letters, Journal of Physics Condensed Matter.
- **Affiliations**: American Physical Society (Group of Magnetism), IEEE Magnetics Society.

Awards

- Finalist, Outstanding Research Assistant, College of Engineering, VCU, 2018 & 2019.
- Outstanding Reviewer, Journal of Physics: Condensed Matter, 2018.
- IEEE Magnetics Society Travel Grant, International Conference on Magnetism, San Francisco, 2018.
- American Physical Society GMAG Travel Grant, March Meeting, Los Angeles, 2018.
- Primary, Junior, Secondary and Higher Secondary Scholarship, Education Board, Bangladesh, 1999-2012.

Patent

1. Switching Skyrmions with VCMA/electric field for memory, computing, and information processing, J. Atulasimha, **D. Bhattacharya**, M. Al-Rashid, PCT/US2017/020148.

Publication

Journal

1. Voltage controlled core reversal of fixed magnetic skyrmions without a magnetic field, **D. Bhattacharya**, M. Al-Rashid, and J. Atulasimha, *Sci. Rep.*, vol. 6, p. 31272 (2016).
2. Incoherent magnetization dynamics in strain mediated switching of magnetostrictive nanomagnets, **D. Bhattacharya**, M. Al-Rashid, N. D'Souza, S. Bandyopadhyay, and J. Atulasimha, *Nanotechnology*, 28(1), 015202 (2016).
3. Energy efficient and fast reversal of a fixed skyrmion two-terminal memory with spin current assisted by voltage controlled magnetic anisotropy, **D. Bhattacharya**, M. Al-Rashid, and J. Atulasimha, *Nanotechnology*, 28, 425201 (2017).
4. Skyrmion mediated voltage controlled switching of ferromagnets for reliable and energy efficient 2-terminal memory, **D Bhattacharya**, J Atulasimha, *ACS Applied Materials and Interfaces, 10 (20), pp 17455–17462 (2018).*
5. Voltage Induced Strain Control of Magnetization: Computing and Other Applications, **D. Bhattacharya**, J. Atulasimha and S. Bandyopadhyay, *Multifunctional Materials, 2019*
6. Experimental creation and annihilation of nonvolatile magnetic skyrmions using voltage control of magnetic anisotropy without an external magnetic field, **D. Bhattacharya**, S. A. Razavi, H. Wu, K.L. Wang, J. Atulasimha, Under Review.
7. Effect of Nanomagnet Geometry on Reliability, Energy Dissipation, and Clock Speed in Strain-Clocked DC-NML, M. Al-Rashid, **D. Bhattacharya**, S. Bandyopadhyay, and J. Atulasimha, *IEEE Trans. of Electron Devices*, vol. 62, no. 9, pp. 2978– 2986 (2015).

8. Acoustic-wave-induced magnetization switching of magnetostrictive nanomagnets from single-domain to nonvolatile vortex states, V. Sampath, N. D'Souza, **D. Bhattacharya**, G. M. Atkinson, S. Bandyopadhyay and J. Atulasimha, *Nano Letters* 16 (9), 5681-5687, (2016).
9. Polarized Neutron Reflectometry Study of Depth Dependent Magnetization Variation in Co Thin Film on a PMN-PT Substrate, M. Al-Rashid, **D. Bhattacharya**, A. Grutter, B Kirby and J. Atulasimha *Journal of Applied Physics 124, 113903 (2018).*
10. Resonate and Fire Neuron with Fixed Magnetic Skyrmions, Md. Ali Azam, **D. Bhattacharya,** D Querlioz and J. Atulasimha, *Accepted: Journal of Applied Physics 124, 152122 (2018).*
11. Energy-efficient switching of nanomagnets for computing: Straintronics and other methodologies, N. D'Souza, A. Biswas, H. Ahmad, M. Fashami, M. Al-Rashid, V. Sampath, **D. Bhattacharya**, A Abeed, J. Atulasimha and S. Bandyopadhyay, *Nanotechnology 29, 44 (2018).*

Research Highlighted in: phys.org, VCU NEWS [1], [2], Wireless Design Magazine

Conference (Selected)

1. **Invited Talk:** Energy efficient switching of fixed magnetic skyrmions with an electric field for nanomagnetic computing devices, **D. Bhattacharya**, MM Al-Rashid, J Atulasimha, *SPIE Optics+Photonics, San Diego, CA, 2017.*

2. An energy efficient memory device based on fixed magnetic skyrmions switched with an electric field, **D. Bhattacharya**, MM Al-Rashid, J Atulasimha, *Device Research Conference (DRC), 74th Annual, 1-2,Newark, DE, 2016.*

3. Voltage controlled reversal of fixed magnetic skyrmions, **D. Bhattacharya**, MM Al-Rashid, J Atulasimha, *61st Annual Conference on Magnetism and Magnetic Materials, New Orleans, LA, 2016.*

4. Strain induced and spin torque induced switching of nanomagnets: Coherent or incoherent?, M Al-Rashid, **D. Bhattacharya**, S Bandyopadhyay, J Atulasimha, *IEEE Nanotechnology Materials and Devices Conference (NMDC), Anchorage, AK 2015.*

5. Incoherent stress-mediated magnetization reversal in shape anisotropic multiferroic nanomagnets, **D. Bhattacharya**, MM Al-Rashid, V Sampath, N D'Souza, S Bandyopadhyay, J Atulasimha, *APS March Meeting, Baltimore, MD, 2016.*

6. Switching fixed skyrmions with electrical field in the presence of thermal noise, **D. Bhattacharya**, MM Al-Rashid, J Atulasimha, *APS March Meeting, New Orleans, LA 2017.*

7. Robust Pathway for Voltage Controlled Switching of Ferromagnets Via an Intermediate Skyrmion State, **D. Bhattacharya**, J Atulasimha, *APS March Meeting, Los Angeles, CA, 2018.*

8. Fixed Magnetic Skyrmion Based Resonate and Fire Neurons, MA Azam, **D. Bhattacharya**, D Querlioz, J Atulasimha, *APS March Meeting, Los Angeles, CA, 2018.*