

Nuwan Harsha Attanayake

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Education

Ph.D. Candidate in Organic Chemistry, University of Kentucky, Lexington, KY, USA (2015-2020)

Expected Graduation: September 2020

Advisor: Prof. Susan A. Odom

B.S. Chemistry, University of Peradeniya, Sri Lanka (2009-2013)

Thesis title: Chemical Modification of Natural Rubber to Develop a Conducting Polymer

Advisor: Prof. H.M.N. Bandara

Research Experience

University of Kentucky, Graduate Research Assistant (August 2015 - present)

- Develop highly soluble, stable electro-active organic compounds for nonaqueous and aqueous redox flow batteries, test long-term stability of organic materials in redox flow batteries and bulk electrolysis cells, evaluate membranes/separators for nonaqueous redox flow batteries to mitigate the active species crossover, study decomposition pathways of organic radical cations
- Develop and test high oxidation potential, stable organic additives (redox shuttles) for Li-ion batteries to prevent the overcharge of high voltage cathodes over 4 V vs. $\text{Li}^{0/+}$.
- Laboratory work includes standard organic synthesis (neutral and charged forms), purification (filtration, extraction, distillation, crystallization, and chromatography), Schlenk line techniques, electroanalytical techniques (cyclic voltammetry, bulk electrolysis, battery testing, electrochemical impedance spectroscopy, spectroelectrochemistry), and spectroscopic analysis (NMR, UV-visible, infrared, GC-MS and DSC, TGA).

Massachusetts Institute of Technology, Visiting Student (September 2017)

Trained to assemble and test redox flow batteries, cyclic voltammetry with ultramicroelectrode, and bulk electrolysis in Brushett research group.

Harvard University, Visiting Student (September 2017)

Tested chemical stability, and solubility of electro-active organic compounds in aqueous electrolytes, to be applied in aqueous redox flow batteries in Aziz research group.

University of Peradeniya, Sri Lanka, Undergraduate Research Assistant (2012 - 2013)

Developed a conjugated back bone on natural rubber in order to obtain a conducting polymer through chemical modification followed by doping with oxidants. Work involved standard organic synthesis, electroanalytical techniques (cyclic voltammetry, impedance spectroscopy, two probe method) and spectroscopic analysis (NMR, infrared).

Fellowships, Honors, and Awards

- Outstanding Poster Presentation, KY NSF EPSCoR-Super Collider Annual Meeting. (2018)
- Outstanding Oral Qualifying Exam Award, Department of Chemistry, University of Kentucky. (2018)
- Chair's Scholarship, Department of Chemistry, University of Kentucky. Provided on the basis of outstanding undergraduate record and the high recommendations on the academic performance, scientific capabilities, and accomplishments. (2015)

Peer-Reviewed Publications

- 8) **Attanayake, N.H.**; Kaur, A.P.; Suduwella, T.M.; Parkin, S.R.; Odom, S.A. "A Stable, Highly Reducing Radical Cation." Submitted to *J. Org. Chem*, jo-2020-017837
- 7) **Attanayake, N.H.**; Liang, Z.; Wang, Y.; Kaur, A.P.; Parkin, S.R.; Mobley, J.K.; Ewoldt, R.H.; Landon, J.; Odom, S.A. "Dual Function Organic Active Materials for Nonaqueous Redox Flow Batteries." Submitted to *Chem*, May 3, 2020.
- 6) Ergun, S.E.; Casselman, M.D.; Kaur, A.P.; **Attanayake, N.H.**; Parkin, S.R.; Odom, S.A. "Improved Synthesis of *N*-Ethyl-3,7-Bis(Trifluoromethyl)Phenothiazine." *New J. Chem.* **2020**, *44*, 11349-11355.
- 5) Wang, Y.; Kaur, A.P.; **Attanayake, N.H.**; Yu, Z.; Suduwella, T.M.; Cheng, L.; Odom, S.A.; Ewoldt, R.H. "Viscous flow properties and hydrodynamic diameter of phenothiazine-based redox-active molecules in different supporting salt environments" *Physics of Fluids*. **2020**, Manuscript ID: POF20-AR-00902.
- 4) Kaur, A.P.; Harris, O.; **Attanayake, N.H.**; Liang, Z.; Parkin, S.R.; Tang M.; Odom, S.A. "Quantifying Environmental Effects on the Solution and Solid-State Stability of Phenothiazine Radical Cations." *Chem. Mater.* **2020**, *32*, 3007-3017.
- 3) **Attanayake, N.H.**; Kowalski, J.; Greco, K.V.; Casselman, M.D.; Milshtein, J.; Chapman, S.; Parkin, S.R.; Brushett, F.R.; Odom, S.A. "Tailoring Two-Electron Donating Phenothiazines To Enable High Concentration Redox Electrolytes for Use in Nonaqueous Redox Flow Batteries." *Chem. Mater.* **2019**, *31*, 4353-4363.
- 2) Kowalski, J.A.; Casselman, M.D.; Kaur, A.P.; Milshtein, J.D.; Elliott, C.F.; Modekrutti, S.; **Attanayake, N.H.**; Zhang, N.; Parkin, S.R.; Risko, C.; Brushett, F.R.; Odom, S.A. "A Stable Two-Electron-Donating Phenothiazine for Application in Nonaqueous Redox Flow Batteries." *J. Mater. Chem. A* **2017**, *5*, 24371-24379.
- 1) Milshtein, J.D.; Kaur, A.P.; Casselman, M.D.; Kowalski, J.A.; Modekrutti, S.; Zhang, P.L.; **Attanayake, N.H.**; Elliott, C.F.; Parkin, S.R.; Risko, C.; Brushett, F.R.; Odom, S.A. "High Current Density, Long Duration Cycling of Soluble Organic Active Species for Non-Aqueous Redox Flow Batteries." *Energy Environ. Sci.* **2016**, *9*, 3531-3543.

Publications in Preparation

- 5) **Attanayake, N.H.**; Suduwella, T.M.; Kaur, A.P.; Yan, Y.; Liang, Z.; Parkin, S.R.; Sanford, S.M.; Odom, S.A. "A Comparative Study of Radical Cation Stability and Coulombic Efficiency for Nonaqueous Redox Flow Battery Applications"
- 4) Suduwella, T.M.; **Attanayake, N.H.**; Kaur, A.P.; Jha, R.K.; Liang, Z.; Odom, S.A. "Capturing the Effects of Structural Modifications on the Solubility of Redox-Active Organic Molecules for Non-Aqueous Redox Flow Battery Applications."
- 3) **Attanayake, N.H.**; Parkin, S.R.; Odom, S.A. "A Highly Soluble, High Potential Polyelectrolyte for Nonaqueous Redox Flow Batteries."
- 2) Liang, Z.; Suduwella, T.M.; **Attanayake, N.H.**; Kaur, A.P.; Landon, J.; Odom, S.A. "A High Energy Density Organic Redox Flow Cell Battery Operated at -40 °C."
- 1) Liang, Z.; **Attanayake, N.H.**; Greco, K.V.; Barton, J.; Baggi, G.; Kaur, A.P.; Eubank, W.L.; Brushett, F.R.; Landon, J.; Odom, S.A. "To Mix or Not to Mix? A Comparison of Separators vs. Membranes in Nonaqueous Redox Flow Batteries."

Patent Applications

2) Odom, S.A.; Kaur, A.P.; Casselman, M.D.; **Attanayake, N.H.**; “Two-Electron Donating Phenothiazines and Use Thereof.” US20180057471A1, March 1, **2018**.

1) Odom, S.A.; Risko, C.; Casselman, M.D.; Elliott, C.F.; **Attanayake, N.H.**; Modekrutti, S. “1,9,10-Substituted Phenothiazine Derivatives with Strained Radical Cations and Use Thereof.” provisional patent application, July 19, **2017**.

Conference Proceedings

1) Odom, S.A.; Kaur, A.P.; Casselman, M.D.; **Attanayake, N.H.**; Anthony, J., Brushett, F.R. “Doubling up: Increasing Charge Storage in Organic Donors and Acceptors for Non-Aqueous Redox Flow Batteries.” *ECS Transactions* **2017**, *77*, 145-151.

Presentations

14) **Attanayake, N.H.**; Liang, Z.; Wang, Y.; Kaur, A.P.; Baggi, G.; Parkin, S.R.; Mobley, J.K.; Ewoldt, R.H.; Landon, J.; Odom, S.A. “Supporting-Salt-Free Nonaqueous Redox Flow Cell Electrolytes Containing Permanently Charged Active Materials” *Super Collider Meeting, KY NSF EPSCoR: 2020*. (poster)

13) **Attanayake, N.H.**; Liang, Z.; Wang, Y.; Kaur, A.P.; Baggi, G.; Parkin, S.R.; Mobley, J.K.; Ewoldt, R.H.; Landon, J.; Odom, S.A. “Dual Function Organic Active Materials for Nonaqueous Redox Flow Batteries.” *Gordon Research Seminar and Gordon Research Conference: 2020*. (poster)

12) **Attanayake, N.H.**; Liang, Z.; Baggi, G.; Kaur, A.P.; Eubanks, W.; Brushett, F.R.; Odom, S.A. Screening “Membranes and Electrolytes for High Performance Nonaqueous Redox Flow Batteries.” *Materials Research Society; University of Kentucky-student chapter: 2019*. (poster)

11) **Attanayake, N.H.** “Design and Synthesis of Redox-Active Molecules for Nonaqueous Redox Flow Batteries.” *JCESR webinar: 2019*. (oral)

10) **Attanayake, N.H.**; Harris, O.; Suduwella, T.M.; Qin, F.; Eubanks, W.; Kaur, A.P.; Tang, M.; Odom, S.A. “Comparative Study on The Chemical and Cycling Stabilities of Redox Active Organic Posolytes with Their Voltages for Nonaqueous Redox Flow Battery Applications.” *American Chemical Society: 2019*; Control ID: 3108171. (oral)

9) **Attanayake, N.H.**; Kaur, A.P.; Kowalski, J.; Casselman, M.D.; Parkin, S.R. Brushett, F.R.; Odom, S.A. “On the Solubility of Charged Organic Species in Nonaqueous Solvents for Redox Flow Battery Applications.” *Materials Research Society: 2018*, Control ID: 3031414. (oral)

8) **Attanayake, N.H.**; Kowalski, J.A.; Kaur, A.P.; Milshtein, J.D.; Casselman, M.D.; Parkin, S.R. Brushett, F.R.; Odom, S.A. “Phenothiazine Posolytes for High Capacity Nonaqueous Redox Flow Batteries.” *Naff symposium, University of Kentucky: 2018*. (poster)

7) **Attanayake, N.H.**; Kowalski, J.A.; Kaur, A.P.; Milshtein, J.D.; Casselman, M.D.; Greco, K.V.; Parkin, S.R. Brushett, F.R.; Odom, S.A. “Towards the Application of Phenothiazine-based Positive Electrolytes for Nonaqueous Redox Flow Batteries.” *Gordon Research Seminar and Gordon Research Conference: 2018*. (poster)

6) **Attanayake, N.H.**; Kowalski, J. A.; Kaur, A. P.; Milshtein, J. D.; Casselman, M. D.; Greco, K.V.; Parkin, S.R.; Brushett, F.R.; Odom, S.A. “Molecular Designing Strategies for High-Capacity Electrolytes in Nonaqueous Redox Flow Batteries.” *Super Collider Meeting, KY NSF EPSCoR: 2018*. (poster)

5) **Attanayake, N.H.** “Stable, High-Capacity Electrolytes for Nonaqueous Redox Flow Batteries.” *Materials Research Society; University of Kentucky-student chapter: 2017*. (oral)

- 4) **Attanayake, N.H.**; Kowalski, J.A.; Milshtein, J.D.; Kaur, A.P.; Casselman, M.D.; Parkin, S.R.; Risko, C.; Brushett, F.R.; Odom, S.A. "A Highly Soluble, Two-Electron Donor for Nonaqueous Redox Flow Batteries." *Materials Research Society*: **2017**, Control ID: 2802517. (poster)
- 3) **Attanayake, N.H.**; Elliott, C.F.; Casselman, M.D.; Risko, C.; Parkin, S.R.; Odom, S.A. "Harnessing Strain to Raise Oxidation Potentials in Organic Electroactive Materials." *Materials Research Society*: **2017**, Control ID: 2802922. (oral)
- 2) **Attanayake, N.H.**; Kowalski, J.A.; Kaur, A.P.; Milshtein, J.D.; Casselman, M.D.; Brushett, F.R.; Odom, S.A. "Stable, High-Capacity Electrolytes for Nonaqueous Redox Flow Batteries." *NSF EPSCoR Site Visit Student Poster Session, KY*: **2017**. (poster)
- 1) **Attanayake, N.H.**; Bandara, H.M.N.; "Chemical Modification of Natural Rubber to Develop a Conducting Polymer." *Undergraduate final year research poster session*, University of Peradeniya, Sri Lanka: **2013**. (poster)

Research Mentoring Experience

Trained and supervised junior graduate students, undergraduates, and high school students in laboratory research activities including organic synthesis, characterization, electrochemical, spectroscopic analysis and maintaining lab equipment. (June 2016 - present)

Professional Memberships

- Electrochemical Society. (president - University of Kentucky Chapter, 2019 - present; member, 2017 - 2019)
- Materials Research Society. (member, 2017 - present)
- American Chemical Society. (member, 2018 - present)

Service / Leadership Responsibilities

- Symposium Assistant at Materials Research Society, Boston, MA. (2018 - fall)
- Laboratory Chemical Hygiene Officer, Odom Group at the University of Kentucky. (2018 - 2019)
- Maintain Glove box (MBraun), Karl-Fisher titrator (Mettler-Toledo), Solvent Purification System (LC technologies), 2016-present
- Maintain potentiostats (BioLogic VSP, CH-instrument), UV-visible spectrophotometer (Agilent), 2017 - 2019

Teaching Experience

University of Kentucky

Organic Chemistry Laboratory I and II, Teaching Assistant. (F2015, S2016)

University of Peradeniya

Elementary Chemistry Laboratory, Teaching Assistant. (April 2013 – September 2014)

Organic Chemistry Laboratory, Teaching Assistant. (October 2013 – February 2014)

Volunteer Experience

- Expanding Your Horizons (EYH) STEM conference for middle school girls, University of Kentucky, April 2018. (helped as a meal server)
- Teachers Training Workshop, Science Education Unit, University of Peradeniya, Sri Lanka, 2014. (demonstrated chemistry lab experiments)

- Chemical Demonstrations for high school students, University of Peradeniya, Sri Lanka, 2014. (set up chemicals and instruments for the chemical demonstration)

References

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