

Anisur Rahman, Ph.D.

iM3NY / Senior Scientist, Cell Development Team
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Education

- **University of Waterloo** 2016
Ph.D. Chemistry (Nanotechnology)
Dissertation: Defect-rich Titanium (IV) Oxide and Zirconium (IV) Oxide Nanostructures for Ultra-efficient Photocatalyst and High- T_C Dilute Ferromagnetic Semiconductor Applications.
- **Kyung Hee University, Suwon, South Korea** 2010
M.Sc. Chemistry
Dissertation: Synthesis of Hollow Manganese Oxide Nanoparticle through Reductive Dissolution Process for MRI imaging, Drug Delivery, and Catalytic Applications.
- **University of Dhaka, Dhaka, Bangladesh** 2007
B.Sc. Applied Chemistry & Chemical Technology

Work & Research Experience

Senior Scientist, iM3NY April 2022 - present
Cell Development Team

- Leading the cell development team for strategic improvement of battery cycle life based on root cause of battery performance degradation
- Collaborating with engineers operating the automatic production line to optimize the quality by DOE design

Postdoctoral Associate, University of Maryland March 2021 - March 2022
Department of Materials Science & Engineering

- Designed and optimized tape casting conditions to synthesize thin garnet electrolyte for high-energy density battery
- Investigated and optimized the PVDF-HFP polymer separator mechanical strength, thickness and porosity for improved cycleability of thin Garnet-NMC622 system

This project was a collaborative project with a battery company, Ion Storage System

Postdoctoral Associate, Massachusetts Institute of Technology Dec 2018 - Feb 2021
Department of Materials Science & Engineering

- Coordinated and collaborated with Ford Motor Company for all-solid-state battery degradation mechanism research
- Developed a thin-film approach to characterize the all-solid-state battery interfaces with non-destructive synchrotron-based X-ray techniques (XANES, EXAFS, XPS, XRD)
- Revealed the interfacial degradation mechanism of LATP-LCO and LATP-NMC622 interfaces in different sintering environments (CO_2 , dry- and wet-air, N_2 and O_2)
- Identified a thin layer of inorganic oxide coating that minimize the interfacial reaction at the Li-LATP interface

This project was a collaborative project with Ford Motor Company

Graduate Student & Postdoctoral Fellow, University of Waterloo May 2011 - Nov 2018
Department of Chemistry

- Synthesized advanced metal-oxide thin-film nanomaterials using pulsed laser deposition and physical vapor deposition techniques and study their structure-property-performance relationships in solar-to-hydrogen conversion reactions
- Engineered the oxygen vacancy composition defects in single-crystalline and amorphous nanostructures for superior optical and electrochemical performances
- Performed collaborative R&D work with dye-sensitized and p-n junction polymer solar cells teams research

Resulted in nine publications in Energy Environ. Sci. (first author), ACS Nano, Adv. Energy Mater. (first author), Nanoscale, Adv. Electron. Mater., and ACS App. Mater. Interfaces.

- Explored the wet synthesis of a wide range of metal-oxide nanostructures using a novel nanoscale etching process
- Evaluated the efficacy of functionalized nanoreactor in size-selective catalysis, MRI imaging and targeted drug-delivery applications

Resulted in four publications in J. Mater. Chem. (first author), Chem. Mater., Angew. Chem. Int. Ed.

Fellowships

NSERC Postdoctoral Fellowship

2019 - 2020

Role: Postdoctoral Fellow

Value: \$90,000

Honors & Awards

R. H. F. Manske Prize , University of Waterloo, (\$700)	2016
Best Student Award , Faculty of Science, University of Waterloo, (\$1000)	2015
Best Student Award , Faculty of Science, University of Waterloo, (\$1000)	2014
Best Student Abstract Award , (6) th Annual Nano Ontario Conference, \$70	2014
Science Graduate Student Award , Faculty of Science, University of Waterloo, (\$1000)	2014
Science Graduate Experience Award , University of Waterloo, (\$2500/year)	2011-2015
International Doctoral Student Award , University of Waterloo, (\$10,000/year)	2011-2015
President Scholarship , Kyung Hee University, (\$12,000/year)	2007-2010

Publications

1. Guan, X.; Srivastava, S.; Thomas, J.; **Rahman, A.**; et. al. Defect-rich Dopant-free ZrO₂ Nanoclusters and their Size-dependent Ferromagnetism. *Acs App. Mater. & Interfaces* **2020**, 12, 43, 48998-49005. **Impact factor: 8.758**
2. Thomas, J., **Rahman, A.** et al. Highly Conducting Hybrid Silver-Nanowire-Embedded Poly (3, 4-ethylenedioxythiophene): Poly (styrenesulfonate) for High-Efficiency Planar Silicon/Organic Heterojunction Solar Cells *ACS Nano* **2018**, 12,9, 9795-9503. **Impact factor: 13.903**
3. **Rahman, A.** et al. A Delaminated Defect-rich ZrO₂ Hierarchical Nanowire Photocathode for Super-efficient Photoelectrochemical Hydrogen Evolution. *Adv. Energy Mater.* **2018**, 8, 1701234. **Impact factor: 24.884**
4. Srivastava S., Thomas J. P., Heinig N., Abd-Ellah M., **Rahman, A.** et al. Efficient photoelectrochemical water splitting on ultrasmall defect-rich TaOx nanoclusters enhanced by size-selected Pt nanocluster promoters. *Nanoscale* **2017**, Advanced Article. **Impact factor: 6.970**
5. **Rahman, A.** et al. Defect-Rich Dopant-Free ZrO₂ Nanostructures with Superior Dilute Ferromagnetic Semiconductor Properties. *J. Am. Chem. Soc.* **2016**, 138, 11896-11906. **Impact factor: 14.695**
6. **Rahman, A.** et al. Defect-Rich decorated TiO₂ nanowires for super-efficient photoelectrochemical water splitting driven by visible light. *Energy Environ. Sci.* **2015**, 8, 3363-3373. **Impact factor: 33.250**
7. Abd-ellah, M., Bazargan S., Thomas J., **Rahman, A.** et al. Hierarchical Tin Oxide Nanostructures for Dye-Sensitized Solar Cell Application. *Adv. Electronic. Mater.* **2015**, 1, 15000032. **Impact factor:4.193**
8. Thomas J., Zhao, L., Abd-ellah M., McGillivray D., Kang, J., **Rahman, A.**, et al. Reversible Structural Transformation and Enhanced Performance of PEDOT:PSS-Based Hybrid Solar Cells Driven by Light Intensity. *ACS Appl. Mater. Interfaces*, **2015**, 7(14), 7466-7470. **Impact factor: 8.456**
9. Srivastava S., Thomas J., **Rahman, A.**, et al. Size-Selected TiO₂ Nanocluster Catalysts for Efficient Photoelectrochemical Water Splitting. *ACS Nano* **2014**, 8(11), 11891-11898. **Impact factor: 13.903**
10. Lee K., **Rahman, A.**, et al. Seed Size-Dependent Formation of Fe₃O₄/MnO Hybrid Nanocrystals: Selective, Magnetically Recyclable Catalyst Systems. *Chem. Mater.* **2012**, 24(4), 682-687. **Impact factor: 10.159**
11. Yeo K., Choi S., **Rahman, A.**, et al. Surfactant-Free Platinum-on-Gold Nanodendrites with Enhanced Catalytic Performance for Oxygen Reduction. *Angew. Chem. Int. Ed.* **2011**, 60, 745-748. **Impact factor: 12.257**
12. **Rahman, A.**, et al. Hollow silica nanosphere having functionalized interior surface with thin manganese oxide layer: nanoreactor framework for size-selective Lewis acid catalysis. *J. Mater. Chem.* **2010**, 20, 10615-10621. **Impact factor: 6.626**
13. Jongmin S. **Rahman, A.**, et al. Hollow Manganese Oxide Nanoparticles as Multifunctional Agents for Magnetic Resonance Imaging and Drug Delivery *Angew. Chem. Int. Ed.* **2009**, 48, 321-324. **Impact factor: 12.257**
14. **Rahman, A.**, Leung K. T, et al. Singly charged oxygen vacancy induced ferromagnetism in oxygen-deficient dopant-free Ti₃O₅ and Ti₂O₃ nanowalls and nanobricks. (submitted)
15. **Rahman, A.**, Yildiz, B, et. al. Secondary Phases at the Interface of Li_{1.4}Al_{0.6}Ti_{1.6}(PO₄)₃ Solid Electrolyte and LiCoO₂ Cathode - Dependence on Environment, and Effects on Charge Transfer. (under review)

Teaching & Mentorship

University of Waterloo, Waterloo, ON

Lecturer

May 2017 - August 2017

- CHEM:750 Nanotools - Lectured 50% of the course material and provided ten four-hour hands-on training on XRD and UV-Vis, PL, Raman, and FTIR instruments for sample measurement and data interpretation

Mentored Projects

2016 - 2018

- Mentored two undergraduate and three graduate students for synthesis and applying thin-film nanomaterials for energy conversion reactions
- Acquired solid problem-solving skills through meeting uncertainties in project planning and execution
- Edited both personal and research essays, and gave individual feedback and group Q&A sessions

Professional certificate - Fundamental of University Teaching

2014 - 2015

- Practiced effective & interactive classroom presentation methodologies with a general audience
 - Developed lesson plans that are interactive & to meet specific learning outcomes
 - Identified & executed strategies that foster active learning; conceived the ability & to give & receive effective feedback
- Completed workshops: Flipped Classroom, Effective Questioning Strategies, Teaching with Confidence, Teaching Methods, One Minute Paper and Think-Pair-Share Strategies, Effective Lesson Plans, Assessing and Improving Teaching*

Teaching Assistant

2011 - 2015

- Courses: CHEM 254: Introductory Chemical Thermodynamics, CHEM 140L: Introductory Scientific Calculation Laboratory, CHEM 358: Statistical Thermodynamics, CHEM 209: Introductory Spectroscopy and Structure, MNS 102: Techniques for Materials & Nanosciences, CHEM 134: Physical Chemistry Laboratory
- Lead two one-hour discussion sections and held an hour-long office hour per week, and occasionally taught the main class
- Presented complex concepts in a clear, concise manner for up to 100 students during weekly tutorials using PowerPoint slides and interactive activities
- Assessed students approaches to problem-solving through evaluating assignments and providing constructive, written feedback to enhance student learning and future performance
- Designed creative visualizations and animations using a variety of technologies to facilitate understanding

Skills & Interests

Material Synthesis: pulsed laser deposition, physical vapor deposition, atomic layer deposition, wet-chemistry routes (hydrothermal, sol-gel, colloidal, polyol, & electrochemical deposition)

Hands-on Experience XRD, SEM, TEM, XPS, XANES, EXAFS, SQUID, SAXS, Spectroscopies, EIS, CV, CCD

Personal: new technology, teaching innovations, hiking, travel, canoeing

Service & Outreach

Member, BDKW Welfare Foundation
Waterloo, ON

2012-present

Judge, Science, Technology & Math Fair,
Mary Johnston Public School, Waterloo, ON

2014

Ad Hoc Reviewer

Journal of Physical Chemistry C, Advanced Energy Materials, Advanced Materials

2016 - present

Conference Presentations

1. 237th ECS Meeting, April 10-14, 2020, Montreal, Canada
2. (GWC)² Annual General Meeting, April 29, 2016, University of Waterloo, ON
3. Materials Research Society Meeting (MRS), March 28-April 1, 2016, Phoenix, AZ
4. **Invited Talk:** 6th Annual Nano Ontario Conference, Nov 5-6, 2015, Ottawa, ON
5. (GWC)² Annual General Meeting, May 8, 2015, University of Guelph, Guelph, ON
6. Materials Research Society Meeting (MRS), April 6-10, 2015, San Francisco, CA
7. Korean Chemical Society Meeting, 2008, October 16-17, ICC, Jeju, South Korea