Anisur Rahman

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Research Interests

- Synthesis and characterization of advanced semiconducting nanostructured thin films and nanostructures for hydrogen generation, flexible electronics, solar cells, and nano-devices
- Engineering the surface morphology, and crystal compositions and orientation of the one-dimensional nanowires for superior optoelectrochemcial performance
- Investigation of structure-property-performance relation of defect-rich metal-oxide nanomaterial for photo-electrochemcial and electronic applications
- Surface and interface characteristics optimization of nanostructured thin films and nano-devices for enhanced performance

Summary of Qualifications

- 8+ years of research experience for synthesis of metal-oxide thin films and nanostructures for photoelectro-chemical, catalysis, enhanced MRI imaging, magnetic, and solar cells applications
- Interdisciplinary research background of Materials Science, Chemistry, and Physics
- Practical hands-on-operational and data interpretation experience for FIB, TEM, SEM, XRD, XPS, SQUID, and optical microscopes (Raman, UV-Vis, PL, IR)
- Communicated, authored and co-authored many research papers in peer reviewed journals such as Energy & Environ. Sci., ACS Nano, JACS, Angew. Chem. Int. Ed., etc.
- Proven analytical skills with solution orientation to create new technologies
- Had a great experience in collaborative projects, and mentored junior PhD and undergrad students
- Presented and facilitated discussions in conferences and large classrooms

Education

- **Doctor of Philosophy, Ph.D.** May 2011 - April 2016

  Chemistry (Nanotechnology), University of Waterloo, Waterloo, ON

  Dissertation: Defect-rich Titanium (IV) Oxide and Zirconium (IV) Oxide Nanostructures for Ultra-efficient Photocatalyst and High-T_C Dilute Ferromagnetic Semiconductor Applications.

- **Masters of Science, M.Sc.** Sept 2007 - Feb 2010

  Chemistry, Kyung Hee University, Suwon, South Korea

  Dissertation: Synthesis of Hollow Manganese Oxide Nanoparticle through Reductive Dissolution Process for MRI imaging, Drug Delivery, and Catalytic Applications.

- **Bachelor of Science, B.Sc.**, First Class March 2001 - June 2007

  Applied Chemistry & Chemical Technology, University of Dhaka, Dhaka, Bangladesh

Research Experience

Postdoctoral Fellow May 2016 - present

WATLab, Department of Chemistry, University of Waterloo, Waterloo, ON

- Synthesized state-of-the-art size, shape, and stoichiometry controlled hybrid nanomaterials for enhanced bio-seninsing, magentic, and photoelectrochemical applications
- Mentored graduate students and provided technical support for industrial and academic users for XRD, SAXS, SQUID, FESEM, and Spectroscopies (UV-Vis-NIR, FTIR, PL, Raman)

Doctoral Researcher May 2011 - April 2016

Department of Chemistry, University of Waterloo, Waterloo, On

- Synthesized advanced TiO_x, ZrO_x and TaO_x nanostructures for photoelectrochemical hydrogen generation
- Engineered the oxygen vacancy composition defects in single-crystalline and amorphous nanostructures for superior optical and electrochemical performances
- Developed dopant-free defect-induced dilute magnetic semiconductor material with high-T_C and high-saturation magnetization for spin-electronic applications
- Fabricated dye-sensitized and p-n junction solar cells from conducting polymers and SnO_2 nanostructures
- Collaborated with lab mates, and supervised junior PhD and undergraduate students on their projects

Masters Researcher Sept 2007 - March 2011
Department of Chemistry, Kyung Hee University, Suwon, South Korea

- Developed a seed-size-mediated growth process for the synthesis of hybrid Fe_3O_4/MnO nanocrystals, and Fe_3O_4/Mn_3O_4@SiO_2 for superior catalytic performance
- Established a new method for large-scale controlled synthesis of Pt nanodendrites by employing a Au-seed inside a hollow SiO_2 nanosphere and demonstrated their superior oxygen reduction property than Pt black
- Differentially functionalized the internal surface of a hollow silica shell and created a novel nanoreactor framework for size and shape dependent catalysis reactions
- Developed a facile synthesis technique to prepare hollow MnO nanoparticle and demonstrated their greatly improved MRI relaxivities along with their efficient cellular uptake and drug loading capacities

Technical Skills

Extensive Knowledge and Experience on the Nanomaterials Synthesis Techniques

- Wet-Methods: Colloidal, Microemulsion, Hydrothermal, Sol-gel, Polyol, Electrochemical, Spin Coating
- Dry-Methods: Pulsed Laser Deposition, DC and RF Magnetron Sputtering, APCVD and PECVD

Trained and Hands-on Experience on the Nanomaterials Characterization Tools

Microscopy

- Zeiss Libra 200 MC TEM, SEMs with EDX (Zeiss Merlin and UltraPlus, Leo 1530, FEI Quanta ESEM), Zeiss Orion Plus HIM, Asylum BIO-3D AFMs and Olympus LMs

Diffraction

- PANalytical X'pert Pro MRD HR-XRD and MPD Powder XRD, and Anton Paar SAXS

Spectromicroscopy and Spectroscopy

- VGS ESCALab 250 Imaging ESCA, PE LS55 PL, PE Lambda 35 & 1050 UV-Vis, Bruker Senterra-2 Raman, and Bruker Hyperion & Tensor 27 FTIR

Electrical Characterization

- EIS, Four Point Probe, Hall Effect Measurement, Solar Cell Property Measurement (I-V, EQE)

Bulk Characterization

- QD Dynacool PPMS & SQUID-VSM MPMS

Comprehensive Knowledge in Data Presentation and Analysis Softwares

- Windows Suite, Origin Lab, Casa-XPS, Python, LaTeX, MathCad, HTML

Professional Development

Teaching Instructor, University of Waterloo May 2017 - present

- Served as a partial instructor for the CHEM:750 Nanotools course. Lectured 50% of the course materiel and provided ten four-hour hands-on training for XRD and UV-Vis, PL, Raman, and FTIR spectroscopy.

Mentored Projects, University of Waterloo and Kyung Hee University May 2011 - April 2016

- Projects: (1) Structure-property-performance relations of defect-rich one-dimensional nanostructure for PEC applications. (2) Hybrid metal-oxide nanoparticles for enhanced catalytic and MRI applications.
  - Acquired solid problem solving skills through meeting uncertainties in project planning and execution
  - Communicated with P. I. and teams, and maintained strong relationships with collaborators

Professional training/certificates, University of Waterloo May 2011 -April 2017

- Fundamental of University Teaching
- WHIMS, Employee Safety, and Compressed gas, Laser and biosafety Training

Teaching Assistant Sept 2007 - April 2016
University of Waterloo and Kyung Hee University

- *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*

- 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

Publications

1. **Rahman, A.** et al. Defect-Rich Dopant-Free ZrO_2 Nanostructures with Superior Dilute Ferromagnetic Semiconductor Properties. *J. Am. Chem. Soc.* **(2016)**, 138, 11896-11906. **Impact factor: 13.038**
2. **Rahman, A.** et al. Defect-Rich TiO_2 nanowires for super-efficient photoelectrochemical water splitting driven by visible light. *Energy Environ. Sic.* **(2015)**, 8, 3363-3373. **Impact factor: 25.427**
3. 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. 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: 7.145**
5. Srivastava S., Thomas J., **Rahman, A.**, et al. Size-Selected TiO_2 Nanocluster Catalysts for Efficient Photoelectrochemical Water Splitting. *ACS Nano* **2014**, 8(11), 11891-11898. **Impact factor: 13.334**
6. 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: 9.407**
7. 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: 11.709**
8. **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**
9. 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: 11.709**
10. **Rahman, A.** and Leung K. T. A Delaminated Defect-rich ZrO_2 Hierarchical Nanowire Photocathode for Super-efficient Photoelectrochemical Hydrogen Evolution. (submitted)
11. **Rahman, A.** and Leung K. T. A New Way to Make Black TiO_2 for Photoelectrochemical application. (in preparation)
11. **Rahman, A.** and Leung K. T. Ferromagentic and Superparamagnetic Property of Black TiO_2 Nanosheet. (in preparation)
12. **Rahman, A.** and Leung K. T. A Metal Nanoparticle Decorated Hierarchical TiO_2 Nanowires for enhanced Selective Sensing of Ascorbic Acid. (in preparation)

Conference Presentations

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

Awards & Fellowships

1. R. H. F. Manske Prize ($700) | $(GWC)^2$ Annual meeting, University of Waterloo, 2016
2. Best student award ($1000) | Faculty of Science, University of Waterloo, 2015
3. Best student award ($1000) | Faculty of Science, University of Waterloo, 2014
4. Best student abstract award ($70) | $(6)^{th}$Annual Nano Ontario Conference, Ottawa, ON, 2014
5. Science graduate student award ($1000) | Faculty of Science, University of Waterloo, 2014
6. Science graduate experience award ($2,500/year for 4 years) | University of Waterloo, 2011-2015
7. International Doctoral Student Award ($10,000/year for 4 years) | University of Waterloo, 2011-2015
8. President Scholarship ($6,017/term for 3 years) | Kyung Hee University, 2007-2010

Education Community Engagement

1. Judge, Science, Technology, & Math Fair at Mary Johnston Public School.
2. Science & Technology Fair at University of Dhaka
3. Orphanage Kids Education Program in Bangladesh