Syed Z. Islam

Staff Scientist
Chemical Sciences Division
Oak Ridge National Laboratory (ORNL)
Contact information: islamsz@ornl.gov; syedislam32@gmail.com; (336) 676-3470 (cell)
LinkedIn Profile: https://www.linkedin.com/in/syedzislam/

EDUCATION

Ph.D., Chemical Engineering — May 2017
University of Kentucky (UK), Lexington, KY

M.S., Chemical Engineering — July 2012
North Carolina A&T State University, Greensboro, NC

B.Sc., Chemical Engineering — March 2009
Bangladesh University of Engineering and Technology, Dhaka, Bangladesh

PROFESSIONAL APPOINTMENTS

- R&D Associate Staff Member, ORNL — January 2021 - Present
- Postdoctoral Research Associate, ORNL — August 2018- December 2020
- Postdoctoral Research Associate, Rensselaer Polytechnic Institute — August 2017 – July 2018
- Research Assistant, University of Kentucky — August 2012 - May 2017
- Research Assistant, North Carolina A&T State University — August 2010 - July 2012

RESEARCH INTERESTS

Advanced nanostructured materials and novel energy-efficient processes for energy and environmental applications; membrane separation and purification; recovery, separation and recycling of critical materials; desalination; carbon dioxide capture and separation; photocatalysis, solar energy conversion; hydrogen gas production and separation.

SUMMARY OF RECORDS

- Patent/Invention disclosures: 1 U.S. patent, 2 U.S. pending patent applications, 3 invention disclosures
- Technology licensed to industries: 2
- Peer-reviewed journal articles: 15 (first author: 7, co-author: 8)
- Conference and symposium presentations: ~50
- Awarded Grants: 4

AWARDS

1. 2020 ORNL Innovation Award, ORNL, 2020.
2. Best Lightning Talk Award, 7th Annual ORPA Research Symposium, ORNL, 2019.
3. Outstanding Graduate Student Award, UK, 2017.
4. Outstanding Poster Presentation Award, KY NSF EPSCoR Super Collider Symposium, KY, 2017.
5. Dissertation Enhancement Award, UK, 2016.
6. North American Membrane Society Student Stipend Award, 2016.
7. Center of Membrane Sciences 2016 Ph.D. Student Fellow Award, UK, 2016.
8. 1st Place Poster Presentation Award, Chemical and Materials Engineering Symposium, UK, 2015.

9. UK Graduate School Travel Award, 2014-2016.

PROPOSAL AND GRANT ACTIVITIES

1. A novel membrane contactor-based CO_2 separation; Laboratory Directed R&D grant, ORNL, DOE; Role: Principal Investigator; Funding: $870,000, Duration: 2022-2023.
2. A novel solar energy driven photoelectrodialysis desalination approach for brackish water desalination, Laboratory Directed R&D grant, ORNL, DOE, Role: Principal Investigator; Funding: $190,000; Duration: 2021-2022.
3. Process scale up and technical support for field demonstration of separation and recovery of battery grade critical materials from end-of-life lithium ion batteries, Strategic Partnership Project, Momentum Technologies, Role: Contributor, Funding: $955,000; Duration: 2022 – 2023.
4. Material testing capabilities for recovery and separation of heavy and light rare earth elements from electronic wastes, DLA, DOD; Role: Contributor, Funding: $250,000; Duration: 2021-2022.
5. Characterization of a photoelectrode and photoelectrodialysis desalination driven by solar energy, CNMS, ORNL, DOE User Facility, (facilities awarded), Role: Principal Investigator, Duration: 2022-2023.
6. In-situ GISAXS and GIWAXS studies of thickness, aging and plasma doping on processing of titania thin films with oriented 2D hexagonal close packed (HCP) mesostructured, an APS general user proposal for use of X-ray scattering facility from synchrotron source at ANL, Beam time Awarded, Role: Principal investigator, 2016.
7. In-situ GIWAXS study of calcination and plasma doping on processing of titania thin films with oriented 2D hexagonal close packed (HCP) mesostructured, an APS general user proposal for use of X-ray scattering facility from synchrotron source at ANL, Beam time Awarded, Role: Principal investigator, 2016.

EXPERIENCE SUMMARY

- Twelve years of research and development experience in Chemical Engineering, Chemistry, Materials Science and Engineering, and Energy and Environmental Sciences
- Designed and developed synthesis method for well-ordered mesoporous titania thin films by surfactant templated sol-gel process/evaporation induced self-assembly
- Developed different methods to tune the band gap of titania to enhance visible light absorption and photocatalytic activity, prepared nitrogen and hydrogen doped mesoporous TiO_2 films using plasma treatment, and using hydrazine treatment method
- Developed graphene quantum dot sensitized mesoporous titania films for visible light photocatalysis
- Produced hydrogen gas from photoelectrochemical water splitting using titania films.
- Photocatalytic/photoelectrochemical solar fuel production
- Solar energy driven photoelectrodialysis desalination
- The nanostructured materials were comprehensively studied using electrochemical measurements including amperometric profiles, linear sweep voltammetric (LSV) measurements, electrochemical impedance spectroscopy, a Mott−Schottky plot, Nyquist plots.
- Comprehensive material characterization techniques including SEM, XRD, XPS, UV-vis spectroscopy, and ICP
- Membrane contactor-based carbon dioxide capture and separation using green solvent
- Developed advanced novel membrane materials, and energy efficient separation and purification processes for gas and liquid separations

- Developed inorganic and polymer hollow fiber membranes for energy, environmental and separation applications
- Designed, synthesized, characterized and evaluated nanomaterials for energy, environment and separation applications
- Conducted research and development in separation and purification involving rare earth extraction, selective ion transport, and desalination.
- Developed membrane solvent extraction for recovery and recycling of critical materials (rare earth elements from scrap permanent magnets; cobalt, nickel and lithium from end-of-life lithium ion batteries.
- Developed cost-effective and scalable separation and purification systems such as water desalination and water treatment with forward osmosis membrane and capacitive deionization.
- Process scale-up from bench scale to pilot plant scale of membrane solvent extraction process.
- Synthesis and characterization of zeolite membrane on ceramic hollow fibers with for hydrogen separation at high temperature and pressure
- Fabricated, characterized and tested thermal stability of palladium-composite membrane fabricated by surfactant induced electroless plating for hydrogen gas separation and membrane reactor applications.

PATENT/INVENTION DISCLOSURE

1. **Syed Z. Islam**, Ramesh R. Bhave, A novel membrane contactor-based process for CO_2 separation using a green solvent, Invention Disclosure ID#: 202105015, ORNL, December 2021.
2. Ramesh R. Bhave, **Syed Z. Islam**, Recovery and reuse of mineral acids in critical materials recovery and separation, Invention Disclosure ID#: 202105006, ORNL, November 2021.
3. Ramesh Bhave, Priyesh Wagh, **Syed Z. Islam**, A novel efficient process for separation of critical materials from primary and secondary sources, Invention Disclosure, ORNL, December 2021.
4. Ramesh Bhave, Priyesh Wagh, **Syed Z. Islam**, A novel energy efficient membrane-based process for concentration and recovery of lithium containing solutions, *US Provisional Patent* Application Serial No. 63/208,624, June 9, 2021.
5. Ramesh Bhave, **Syed Z. Islam**, Priyesh Wagh, Recovery of critical elements from end-of-life lithium ion batteries with supported membrane solvent extraction, *U.S. Patent* Application No. 16/884,189, May 27, 2020.
6. Ramesh Bhave, **Syed Z. Islam**, Separation of rare earth elements using supported membrane solvent extraction, PCT, *International Patent* Pub. No.: WO 2021/150208A1, July 29, 2021 (*International Patent* Application NO: PCT/US 2020/014363, January 21, 2020).
7. Ramesh Bhave, **Syed Z. Islam**, Separation of rare earth elements using supported membrane solvent extraction, *US Patent* Pub. No.: US 2020/0056264 A1 (*US Patent* Application No. 16/537,759 August 12, 2019) (Notice of allowance received in December 2021).

TECHNOLOGY COMMERCIALIZATION/LICENSING

- Recovery of critical materials from spent lithium ion batteries – licensed to Momentum Technologies, 2020.
- Separation of heavy and light rare earth elements - licensed to Momentum Technologies, 2019.

PEER-REVIEWED PUBLICATIONS (Google Scholar Link)

1. P. Wagh*, **S. Z. Islam***, V. G. Deshmane, P. Gangavarapu, J. Poplawsky, G. Yang, R. Sacci, S. F. Evans, S. Mahajan, M. P. Paranthaman, B. Moyer, S. Harrison, R. Bhave, Fabrication and

characterization of composite membranes for the concentration of lithium containing solutions using forward osmosis, *Advanced Sustainable Systems,* 2020, 2000165, 1-12 (* equal contribution/co-first author).

2. J. Jiang, **S. Islam**, Q. Dong, F. Zhou, S. Li, M. Yu, Deposition of an ultrathin palladium (Pd) coating on SAPO-34 membranes for enhanced H_2/N_2 separation, *International Journal of Hydrogen Energy*, 2020, 45 (58), 33648 - 33656.
3. M. A. Khan, **S. Z. Islam**, S. Nagpure, Y. He, N. Wanninayake, R. L. Palmer, J. Strzalka, D. Y. Kim, B. L. Knutson, S. E. Rankin, Epitaxial formation mechanism of multilayer TiO_2 films with ordered accessible vertical nanopores by evaporation-driven assembly, *Journal of Physical Chemistry C*, 2020, 124, 3, 1958-1972.
4. S. Zhou, E. Guilfoil, Y. He, S. Nagpure, **S. Z. Islam**, M. A. Khan, S. E. Rankin, B. L. Knutson, Impedance analysis of ion transport through supported lipid bilayers on accessible mesoporous silica thin films, *Advanced Materials Interfaces*, 2020, 1901787.
5. V. Deshmane, **S. Z. Islam**, R. Bhave, Selective recovery of rare earth elements from a wide range of e-wastes and process scalability of membrane solvent extraction, *Environmental Science and Technology*, 2020, 54, 550-558.
6. N. Linneen, F. Delnick, **S. Z Islam**, V. G Deshmane, R. Bhave, Application of the macrohomogeneous line model for the characterization of carbon aerogel electrodes in capacitive deionization, *Electrochimica Acta*, 2019, 301, 1-7.
7. S. Nagpure, J. Xu, M. A. Khan, **S. Z. Islam**, Q. Zhang, Y. T. Cheng, S. Rankin, Synthesis of layer-by-layer thick mesoporous titania films with vertically oriented 2D-HCP nanopores and their use in lithium ion batteries as negative electrodes, *Advanced Functional Materials, 2018,* 28 (37), 1801849.
8. **S. Z. Islam**, A. Reed, S. Nagpure, J. Browning, J. Strzalka, D. Y. Kim, S. Rankin, Hydrogen incorporation by plasma treatment gives mesoporous black TiO_2 thin films with visible photoelectrochemical water oxidation activity, *Microporous and Mesoporous Materials,* 2018*,* 261, 35-43.
9. M. A. Khan, W. Wallace, **S. Z. Islam**, S. Nagpure, J. Strzalka, J. Littleton, S. Rankin, B. Knutson, Adsorption and recovery of polyphenolic flavonoids using TiO_2 functionalized mesoporous silica nanoparticles, *ACS Applied Materials and Interfaces,* 2017, *9* (37), 32114–32125.
10. **S. Z. Islam**, S. Nagpure, D. Y. Kim, S. E. Rankin, Synthesis and catalytic applications of non-metal doped mesoporous titania, *Inorganics,* 2017, 5, 15.
11. **S. Z. Islam**, A. D. Reed, N. Wanninayake, D. Y. Kim, S. E. Rankin, Remarkable enhancement of photocatalytic hydrogen production in N_2/Ar plasma treated, mesoporous TiO_2 films, *The Journal of Physical Chemistry C,* 2016, 120(26), 14069–14081.
12. **S. Z. Islam**, A. D. Reed, D. Y. Kim, S. E. Rankin, N_2/Ar plasma induced doping of ordered mesoporous TiO_2 thin films for visible light active photocatalysis, *Microporous and Mesoporous Materials*, 2016, 220, 120-128.
13. **S. Z. Islam**, S. E. Rankin, Hydrazine-based synergistic Ti(III)/N doping of surfactant-templated TiO_2 thin films for enhanced visible light photocatalysis, *Materials Chemistry and Physics,* 2016, 182, 382-393.
14. **S. Z. Islam**, V. G. Deshmane, S. Ilias, Thermal stability study of Pd-composite membrane fabricated by surfactant induced electroless plating (SIEP), *Separation Science and Technology*, 2016, 51(7), 1176-1188.
15. S. Das, S. Nagpure, R. Garlapalli, Q. Wu, **S. Z. Islam,** J. Strzalka, S. E. Rankin, In-Situ GISAXS study of pore orientation effect on thermal transformation mechanism of surfactant templated mesoporous titania thin films, *Physical Chemistry Chemical Physics*, 2016, 18, 2896-2905.

CONFERENCE PRESENTATIONS

Invited Speaker

1. **S. Islam**, Engineered Nanostructured Metal Oxide Thin Films for Energy Applications, CNMS Seminar Series, Oak Ridge National Laboratory, March 2021.
2. R. Bhave, **S. Z. Islam** (co-presenter), Recovery and separation of rare earth elements from e-waste, Webinar, Critical Materials Institute, an Energy Innovation Hub of U.S. DOE, July 2019.
3. **S. Z. Islam**, J. Jiang, Q. Dong, S. Li, M. Yu, Synthesis of modified SAPO-34 membranes on ceramic hollow fibers for high temperature separation of H_2/N_2, Membranes: Materials and Processes, Gordon Research Seminar 2018, New Hampshire, USA.
4. **S. Z. Islam**, A. D. Reed, N. Wanninayake, D. Y. Kim, S. E. Rankin, Synthesis and energy applications of mesoporous titania thin films, Materials and Chemical Engineering Graduate Student Association (MACE) Symposium, 2017, UK, Lexington, KY.

Oral Presentations (Selected)

5. **S. Z. Islam**, V. G. Deshmane, P. Gangavarapu, J. Klaehn, R. R. Bhave, Selective recovery of rare earth elements from e-waste with supported membrane solvent extraction, ACS Spring 2019 National Meeting & Exposition, Fl, USA.
6. **S. Z. Islam**, A. Reed, S. Nagpure, N. Wanninayake, J. F. Browning, D. Y. Kim, S. E. Rankin, Neutron reflectometry investigation of hydrogen in plasma treated hydrogen doped nanoporous TiO_2 thin films for water splitting photocatalysis, 2016 AIChE Annual Meeting, San Francisco, CA, USA.
7. **S. Z. Islam**, N. Wanninayake, A. D. Reed, D. Y. Kim, S. E. Rankin, Synergistic effects of graphene quantum dot sensitization and nitrogen doping of ordered mesoporous TiO_2 thin films for water splitting photocatalysis, SPIE, 2016, San Diego, California, USA.
8. **S. Z. Islam**, N. Wanninayake, A. D. Reed, D. Y. Kim, S. E. Rankin, Graphene quantum dot sensitization and nitrogen doping of ordered mesoporous TiO_2 thin films for visible light driven water splitting, North American Membrane Society Annual Meeting 2016, Bellevue, WA, USA.
9. **S. Islam**, A. Reed, D. Y. Kim, S. Rankin, Synergistic effects of graphene quantum dot sensitization and nitrogen doping of ordered mesoporous TiO_2 thin films for water splitting photocatalysis, 2016 TMS Annual Meeting & Exhibition, Nashville, TX, USA.
10. **S. Z. Islam**, A. D. Reed, D. Y. Kim, S. E. Rankin, N_2/Ar-plasma assisted nitrogen doping of ordered mesoporous TiO_2 thin films for water splitting photocatalysis, 2015 AIChE Annual Meeting, Salt Lake City, UT, USA.
11. **S. Islam**, S. Rankin, Enhancement of visible light absorption of ordered mesoporous titanium (Ti^{3+}) and nitrogen doped titanium dioxide thin films for solar energy conversion, 2014 AIChE Annual Meeting, Atlanta, GA, USA.

MENTORING

- One Post-Master's Research Associate (Sidharth Mahajan), ORNL, January 2020 – June 2020.
- Two students of Science Undergraduate Laboratory Internship (SULI), (Sidharth Mahajan, Eli James Jenkins from University of Tennessee, Knoxville, TN) ORNL, Summer 2019.
- One Post-Master's Research Associate (Pranathi Gangavarapu), ORNL, August 2018 – April 2019.
- Two undergraduate senior students, UK, Spring 2017.
- Two students of Research Experience for Undergraduate (REU), UK, Summer 2016.
- One high school student (Michael Danner), UK, Summer 2015.

PRESS/MEDIA

- Novel Membrane Solvent Extraction technology for LIB recycling placed the second position among the top ten technologies revolutionizing the space of Materials Sciences evaluated by the World Materials Forum, 2020.
- ORNL Review Magazine featured Syed Z. Islam, 2020.
- STEM Magazine featured Syed Z. Islam's research on rare earth recovery, 2020.
- ORNL published a short video on Syed Z. Islam's research on rare earth recovery, 2019.
- Phys.org featured Syed Z. Islam's research on rare earth recovery, 2019.
- ORNL featured Syed Z. Islam's research on rare earth recovery, 2019.
- Eurekalert.org featured Syed Z. Islam's research on rare earth recovery, 2019.
- Newswise.com featured Syed Z. Islam's research on rare earth recovery, 2019.

WORKSHOPS/TRAINING/SHORT PROGRAMS

- Presentation Skills course Fall 2019 – Spring 2020.
- Accent Optimization/Communication course, Fall 2019.
- Postdoc Proposal Writing Workshop (one day), ORNL, April 2019.
- National Alliance for Water Innovation NexGen Research Meeting (one day), ORNL, October 2018.
- 18th National School on Neutron and X-ray Scattering (two weeks), ORNL&ANL, July – August 2016.

PROFESSIONAL SERVICES AND OUTREACH

- Member of 2022 Critical Materials Institute (CMI) Leadership Academy, an energy innovation hub of U.S. Department of Energy.
- Panelist, Career Workshop 2022, National Alliance for Water Innovation, a water innovation hub of U. S. Department of Energy.
- Secretary of the Oak Ridge Postdoc Association (ORPA) 2020.
- Session Chair, Oak Ridge Postdoctoral Association Research Symposium, 2020.
- Reviewer of SBIR/STTR DOE proposals.
- Committee member for reviewing North American Membrane Society Student Award applications, 2020 and 2021.
- Executive member of the ORPA Committee 2019.
- Served as a judge in student poster session, NAMS 2019 Annual Meeting, and undergraduate poster session, AIChE Annual Meeting (2015-2016).
- Review manuscripts for *Membranes, Materials Research Bulletin, Separation Science and Technology, Journal of Sol-Gel Science and Technology, Journal of Saudi Chemical Society, Journal of Nanomaterials, International Journal of Photoenergy, Advanced Powder Technology* and *Thin Solid Films.*

PROFESSIONAL AFFILIATIONS

- American Institute of Chemical Engineers (AIChE)
- North American Membrane Society (NAMS)
- American Chemical Society (ACS)
- International Society for Optics and Photonics (SPIE)
- The Minerals, Metals and Materials Society (TMS)