Shailesh Dangwal

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Profile

Postdoctoral research associate at UT Battelle, LLC (Oak Ridge National Laboratory). Have demonstrated expertise in materials recycling including critical battery materials and rare earth elements, membrane-based gas and liquid separations, hollow fiber membrane module fabrication, material characterization, CO_2 capture, bio-separation, and process intensification using membrane reactors. Currently working on the separation and recovery of critical materials from end-of-life e-waste.

Professional Experience

Postdoctoral Research Associate| Oak Ridge National Lab, Tennessee, US *2022-Present*

- Leading a DoE funded project for the separation and recovery of critical battery materials from end-of-life Li-ion batteries and recycling them to make new batteries.
- Leading a Critical Material Institute (CMI) funded project for the separation and recovery of rare earth elements from end-of-life EV magnets.
- Leading the development of a membrane assisted separation system for the recovery of 2-3 butanediol from fermentation broth for sustainable aviation fuel (SAF).
- Developed a continuous membrane contactor-based system for capturing CO_2 from flue gas using green solvent.

Postdoctoral Associate| University of Buffalo, Buffalo, New York, US *2021-2022*

- Lead the development of a novel sorption material for capturing CO_2 from air on amine functionalized “advanced hierarchical nanoporous structures”.
- Worked on designing highly efficient membrane reactor system to produce methanol and dimethyl carbonate using water conduction membrane.

Research Associate| Oklahoma State University, Stillwater, Oklahoma, US *2021-2021*

- Performed literature review for new projects dealing with membrane-based separation for gases and water purification.
- Assisted PI in writing and revising manuscripts.

Senior Engineer| Project Management, Orient Cement Limited, Hyderabad, India *2013-2015*

- Developed project schedule with McKinsey & Company for 6000 tons per day greenfield cement plant on primavera software.
- Implemented the pioneering control tower in the system to monitor the project progress at micro level.

Engineer| Production Department, Orient Cement Limited, Hyderabad, India *2012-2013*

- Managed operations including heat and mass balance for three kilns (combined capacity of 10,000 tons per day).
- Reduced power consumption by 0.8 KW/unit production by decreasing false air in the system by detecting and fixing the leakage points in the plant.

Education

PhD Chemical Engineering, Oklahoma State University, Stillwater, US *2017-2020*

Thesis Title: Microporous Inorganic Membrane Reactor for High Temperature Alkane Dehydrogenation and Product Separation

- Developed zeolite and silica-based membrane reactor for alkane (ethane, propane, and isobutane) dehydrogenation reactions.
- Developed novel ZIF-8 membrane for the propylene/propane gas separation and modified ZIF-8 membranes with atomic layer deposition (ALD) technique for curing pinholes and defects.

MS Chemical Engineering, Oklahoma State University, Stillwater, US *2016-2017*

Thesis Title: High-Temperature Ethane Dehydrogenation Reaction in microporous Zeolite Membrane Reactor

- Investigated and optimized the effect of operating conditions on ethane dehydrogenation reaction performance in a membrane reactor.
- Developed 1D plug flow model for ethane dehydrogenation reaction in a membrane reactor using MATLAB.

Bachelor of Technology, Chemical Engineering, Indian Institute of Technology, Guwahati *2008-2012*

Thesis Title: Study of Kinetics of CO Methanation Using Monte Carlo Simulations

- Studied CO methanation system using Monte Carlo simulation.
- Compared reaction performance results obtained from simulation to experimental results.

Internships

Indian Oil Corporation *May 2011- Jul 2011*

- Worked on a project dealing with reduction of heat losses due to improper heat exchange in the heat exchangers installed in the crude distillation unit, which consumes the most significant amount of energy.

National Thermal Power Corporation *May 2010 - Jul 2010*

- Completed robust vocational training at National Thermal Power Corporation (NTPC) Badarpur, a coal-based power plant, covering all the aspects of a power plant.

Teaching Assistant

School of Chemical Engineering (CHE), Oklahoma State University, Stillwater, US

- Served as teaching assistant for Thermodynamics (Fall 2018), Chemical Process Control (Spring 2019, Spring 2020), Fluid mechanics (Summer 2020), and Transport Phenomena (Fall 2018, Fall 2019).

Technical Skills

- Gas chromatography, X-ray diffraction, Scanning electron microscopy, FT-IR, X-ray photoelectron spectroscopy, Energy dispersive X-ray spectroscopy, UV-vis, Thermogravimetric analyzer, Brunauer–Emmett–Teller (BET), Inductively Coupled Plasma Optical Emission spectroscopy (ICP-OES), and High-Performance Liquid Chromatography (HPLC).
- MATLAB, C, C++, Python, Microsoft Office, PRIMAVERA, Microsoft Project, Origin, Fluent, Gambit and AutoCAD.

Patents

- Islam, S., **Dangwal, S.**, Nair, S., et al., (2024). Membrane pervaporation for the production of sustainable aviation fuel precursors. US Patent Application No. 81955052.
- Bhave, R., **Dangwal, S.**, Islam, S., (2024). A novel membrane contactor based liquid-liquid extraction process for biofuel separation and recovery from fermentation broth for sustainable aviation fuel. US Patent Application No. 81948035.

Publications

- **Dangwal, S.**, Liu, R., and Kim, S. (2017). High-temperature ethane dehydrogenation in microporous zeolite membrane reactor: Effect of operating conditions. *Chem. Eng. J.*, 328, 862-872.
- **Dangwal, S.**, Ronte, A., Lin H., Liu R., Zhu, J., Lee J., Fahlenkemp H., and Kim, S. (2021). ZIF-8 membranes supported on silicalite-seeded substrates for propylene/propane separation. *J. Membr. Sci.* 626, 119165.
- **Dangwal, S.**, Liu, R., and Kim, S. (2018). Effect of pressure on ethane dehydrogenation reaction in MFI zeolite membrane reactor. *Energy Fuels* 32, 4628-4637.
- **Dangwal, S.**, Liu, R., and Kim, S. (2019). Zeolite membrane reactor for high-temperature isobutane dehydrogenation reaction: Experimental and modelling studies. *Chem. Eng. Process.,* 142, 107583.
- **Dangwal, S.**, Ronte, A., Mahmodi, G., Zarrintaj, P., Lee, J., Mohammad R., Fahlenkamp, H., and Kim, S. (2021) Propane Dehydrogenation Reaction in High Pressure Zeolite Membrane Reactor. *Energy Fuels.*
- **Dangwal, S.**, Liu, R., Bastatas, L., Echeverria, E., Chengqian, H., Mao, J., Mcllroy, D., and Kim, S. (2019). ZnO microfiltration membranes for desalination by a vacuum flow-through evaporation method. *Membranes* 9(12), 156.
- Islam, S., **Dangwal, S.**, Bhave, R. (2023). Membrane Solvent Extraction to Recover Rare Earth Elements. *Chemical Engineering Progress*, 31-35.
- Ronte, A**., Dangwal, S.**, Liu, R., and Kim, S. Modification of ZIF-8 membranes by atomic layer deposition for high propylene/propane selectivity. *MICROPOR MESOPOR MAT.*, 112173.
- Lin., H., **Dangwal, S.,** Liu, R., Kim, S., Mehra, N., Li., Y., and Zhu, J. (2018). Reduced wrinkling in GO membranes by grafting basal-plane groups for improved gas and liquid separations. *J. Membr. Sci.* 563, 336-344.
- Liu, R., **Dangwal, S.**, Shaik, I., Aichele, C., and Kim, S. (2018). Hydrophilicity-controlled MFI-type zeolite-coated mesh for oil/water separation. *Sep. Purif. Technol.*, 195, 163-169.
- Ronte, A**.,** Wagle, P., Mahmodi, G., Chevula, M., **Dangwal, S.**, Saeb, M., Lee J., and Kim, S. (2023). High-Flux ZIF-8 Membranes on ZnO-Coated Supports for Propane/Propylene Separation. *Energy Fuels*.
- Mahmodi, G., **Dangwal, S.**, Zarrintaj, P., Zhu, M., Mao, Y., Mcilroy, D., Saeb, M., Vatanpour, V., Ramsey, J., and Kim, S. (2020). NaA zeolite coated meshes with tunable hydrophilicity for oil-water separation. *Sep. Purif. Technol.* 240, 116630.
- Mahmodi, G., Ronte A., **Dangwal, S.**, Wagle, P., Vatanpour, V., Mcilroy, D., Ramsey, J., and Kim, S. (2021). Improving antifouling property of alumina microfiltration membranes by using atomic layer deposition technique for produced water treatment. *Desalination,* 523, 115400.
- Lin, H., Liu, R., **Dangwal, S.**, Kim, S., Mehra, N., Li., Y., and Zhu, J. (2018). Permselective H_2/CO_2 separation and desalination of hybrid GO/rGO membranes with controlled pre-crosslinking. *ACS Appl. Mater. Interfaces* 10, 28166-28175.
- Liu, R., Young, S., **Dangwal, S.**, Shaik, I., Echeverria, E., Mcilroy, D., Aichele, C., and Kim, S. (2018). Boron-substituted MFI-type zeolite coated-mesh for oil-water separation. *Colloids Surf. A* 550, 108-114.
- Mahmodi, G., Bafti, R., Boroujeni, N., Pradhan, S., **Dangwal, S.**, Sengupta, B., Vatanpour, V., Sorci, M., Fathizadeh, M., Bikkina, P., Belfort, G., Yu, M., Kim, S., (2023). Improving cellulose acetate mixed matrix membranes by incorporating hydrophilic MIL-101 (Cr)-NH2 nanoparticles for treating dye/salt solution. *Chem. Eng. J.* 477, 146736.
- Mahmodi, G., Zarrintaj, P., Taghizadeh, A., Taghizadeh, M., Manouchehri, S., **Dangwal, S.**, Ronte, A., Ganjali, M., Ramsey, J., Kim, S., Saeb, M., (2020). From microporous to mesoporous mineral frameworks: An alliance between zeolite and chitosan. *Carbohydr. Res.* 489, 107930.

- **Dangwal, S.**, Coin, Z., et al., (2024). Effect of Viscosity of a Deep Eutectic Solvent on CO_2 Capture Performance in an Energy-Efficient Membrane Contactor–Based Process. ACS Omega *(under review).*
- Islam, S., Wagh, P., **Dangwal, S.**, et al., (2024). Separation and Recovery of High Purity Dysprosium from Scrap Permanent Magnets using a Novel Membrane Solvent Extraction. Separation and Purification Technology *(Under review).*
- Liu, J., Kubic, W., ….. **Dangwal, S.,** Islam, S., Bhave, R., (2024). Techno-Economic Analysis and Life Cycle Assessment for the Separation of 2,3-Butanediol from Fermentation Broth Using Liquid-Liquid Extraction. Industrial & Engineering Chemistry Research (*Under review*)
- **Dangwal, S.**, Trusty, B., Coin, Z., et al., (2024). Separation of 2-3 butane-diol from fermentation broth using a continuous and scalable membrane assisted liquid-liquid extraction (MALLE) system. *(in preparation).*

Notable Conference Presentations

- **Shailesh Dangwal**, Zachary Coin, Blake Trusty, Syed Islam, Ramesh Bhave, 2,3-Butanediol Separations from Fermentation Broth using Membrane Assisted Liquid-Liquid Extraction (MALLE) , NAMS Annual Meeting, Santa Fe, 2024.
- Ramesh Bhave, Syed Z. Islam, **Shailesh Dangwal**, Zachary Coin, A novel energy efficient membrane separation process for the recovery and recycling of critical materials, Scientist-to-scientist webinar on magnet recycling organized by U.S. DOE and Natural Resources Canada (NRCan), October 20, 2023.
- Syed Z. Islam, Ramesh Bhave, Priyesh Wagh, **Shailesh Dangwal**, Zachary Coin, John Klaehn, Membrane Separation Process for Recovery of Critical Materials, 11th Annual Japan – U.S. Bilateral Meeting on Rare Metals, December 12, 2023.
- Syed Islam, Zachary Coin, Gernot Rother, Jacek Jakowski, Vera Bocharova, Robert Sacci, Md Arifuzzaman, Ilia N Ivanov, Jingsong Huang, Thomas Knight, **Shailesh Dangwal**, Ramesh Bhave, Tomonori Saito, David Sholl, Effect of Viscosity of Deep Eutectic Solvent on CO_2 Capture Performance in an Energy Efficient Membrane Contactor Based Process, AIChE Annual Meeting, Orlando, 2023.
- **Shailesh Dangwal**, Syed Islam, Priyesh Wagh, John Klaehn, Ramesh Bhave, A Novel Membrane Solvent Extraction Process Enabling Highly Efficient Separation and Recovery of Critical Materials from End-of-Life Lithium-Ion Batteries , NAMS Annual Meeting, Tuscaloosa, 2023.
- Kaleb Friedman, **Shailesh Dangwal**, Miao Yu, Entrapment of Small Amines in Mesoporous Silica Via Polymeric Coating for the Direct Air Capture of CO2, AIChE Annual Meeting, Phoenix, 2022.
- **Shailesh Dangwal**, Ronte Anil, S.-J. Kim, Zeolitic imidazolate framework membranes on silicalite-seeded substrates for propylene/propane separation, AIChE Annual Meeting San Francisco, 2020.
- **Shailesh Dangwal**, Anil Ronte, S.-J. Kim, Process Intensification of Propane Dehydrogenation Using Microporous Silica Membranes, AIChE Annual Meeting, Orlando, 2019.
- Ghader Mahmodi, **Shailesh Dangwal**, Seokjhin Kim, Produced Water Purification By a Vacuum Flow-through Evaporation, AIChE Annual Meeting, Orlando, 2019.
- **Shailesh Dangwal**, Ruochen Liu, Savannah Kirk, S.-J. Kim, Effect of pressure on ethane dehydrogenation reaction in MFI zeolite membrane reactor, AIChE Annual Meeting, Pittsburgh, 2018.
- **Shailesh Dangwal**, Ruochen Liu, Lyndon D Bastatas, Elene Echeverria, Chengqian Huang, Yu Mao, David N McIlroy, S.-J. Kim, Ceramic Membranes for Desalination By a Vacuum Flow-through Evaporation, AIChE Annual Meeting, Pittsburgh, 2018.
- Ruochen Liu, **Shailesh Dangwal**, S.-J. Kim, Hydrophilicity controlled MFI-type zeolite coated mesh for oil/water separation, NAMS Annual Meeting, Lexington , KY, 2018.
- **Shailesh Dangwal**, Ruochen Liu, S.-J. Kim, Experimental and Simulation Studies of High-Temperature Ethane Dehydrogenation in Microporous Zeolite Membrane Reactor, AIChE Annual Meeting, Minneasota, 2017.
- **Shailesh Dangwal**, Ruochen Liu, S.-J. Kim, Zeolite membrane reactor for high-temperature isobutane dehydrogenation reaction: Experimental and modelling studies, AIChE Annual Meeting, Minneasota, 2017.
- **Shailesh Dangwal**, Ruochen Liu, S.-J. Kim, High temperature ethane dehydrogenation in microporous zeolite membrane reactor, AIChE Annual Meeting, San Francisco, 2016.

Achievements and Extra Curricular Activities

- **R&D 100 award** finalist for year 2024.
- Developed a course on rare earth elements (REEs) supply chain for **Critical Materials Innovation (CMI)** 2024 meeting in Golden, CO as a part of CMI leadership academy.
- Served as a **co-chair** for the oral session "Mixed matrix and composite membranes for gas separation" at NAMS Annual Meeting, Santa Fe, 2024.
- Served as a **judge** for poster session in NAMS Annual Meeting, Santa Fe, 2024.
- Served as a **judge** for poster session in NAMS Annual Meeting, Tuscaloosa, 2023.
- Successfully completed **NSF I-Corp** site program and national program as entrepreneurial lead in spring 2018 and summer 2020, respectively.
- Successfully co-wrote the **NSF I Corp proposal** which got funded in summer 2020.
- Successfully wrote the **NSF SBIR pitch** which got accepted in Nov 2020 for funding of $225,000.
- **Reviewer** for journals like Journal of Membrane Science, Chemical Engineering Science, Energy and Fuels, Journal of Industrial and Engineering Chemistry, and ACS Applied Biomaterial etc.
- Received **Dennis Hussey Scholarship** for the year 2018-19 at Oklahoma State University.
- Received **Robberson Summer Dissertation Fellowship** for the 2018-2019 academic year.
- Received **Creativity, Innovation and Entrepreneurship (CIE) Scholarship** 2019 from Watson Graduate School of Management.
- Was among top 1% students who successfully cleared **Indian Institute of Technology-Joint Entrance Examination** (IIT-JEE) 2008 with All India Rank 2830.
- Served as **Liaison** in Chemical Engineering Graduate Student Association at Oklahoma State University (2016-17).