COMPLEX SYSTEMS, ENVIRONMENT, INFRASTRUCTURE & MATERIALS FRONTIERS

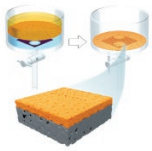
Devin Shaffer, Ph.D., P.E.

Ph.D. – Yale University

Assistant Professor, Civil and Environmental Engineering

Dr. Shaffer is a researcher and a professional engineer with a focus on membrane separations for water purification and resource recovery. He investigates new membrane materials with tailored separation properties for applications in membrane distillation to treat high-salinity brines, desalination to purify drinking water, and membrane reactors to capture and recover contaminants. He employs novel fabrication techniques like layer-by-layer assembly and novel characterization techniques like neutron radiography and electrochemical impedance spectroscopy to gain insight into the structure-property relationships that influence membrane performance. In addition to conducting research on membrane materials and processes, Dr. Shaffer also engages with regional partners to promote resilient communities and ecosystems by studying water supply and water quality in interrelated engineered and natural water systems.

COVALENT ORGANIC FRAMEWORK (COF) MEMBRANES FOR LIQUID SEPARATIONS



Dr. Shaffer's research group fabricates composite membranes from two-dimensional covalent organic framework (COF) materials with tunable separation properties. The COF membranes have potential applications for liquid separations, including drinking water treatment and organic solvent filtration.

STRUCTURE-PROPERTY RELATIONSHIPS FOR POLYMER FILMS BY MOLECULAR LAYER DEPOSITION

Dr. Shaffer uses solution-based molecular layer deposition (MLD) to identify structure-property relationships for polymer films fabricated from monomers with different characteristics. For this research, solution-based MLD is a facile technique to achieve monomer-level control in thin polymer film fabrication.

QUANTIFYING POTENTIAL WATER SAVINGS FROM CONSERVATION IN HOUSTON THROUGH MODELING

Dr. Shaffer is working with the City of Houston Public Works Department to construct a land use-based model of water demand for a mixed land use area in northwest Houston. The model will be used to quantify potential water savings from conservation best management practices, including incentives and efficiency measures. This research is sponsored by the Harris-Galveston Subsidence District's Water Conservation Grant Program.

WETTABILITY ALTERATION AND IMMISCIBLE FLUID DISPLACEMENT IN POROUS MEDIA

Dr. Shaffer and his group are investigating the influence of fluid chemistry on wettability alteration in carbonate porous media and the resulting impacts on immiscible fluid displacement. This research, sponsored by the American Chemical Society, has implications for the properties and transport of petroleum in rock reservoirs and for waterflooding for oil recovery.

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Publications

1. Shaffer D.L., Feldman, K.E., Chan, E.P., Stafford, G.R., and Stafford, C.M. Characterizing salt permeability in polyamide desalination membranes using electrochemical impedance spectroscopy. Journal of Membrane Science, 2019, 583, 248-257.

2. Shaffer D.L., LaManna J.M., Jacobson D.L., Hussey D.S., Elimelech M., and Chan E.P. Studying water and solute transport through desalination membranes via neutron radiography. Journal of Membrane Science, 2018, 548, 667-675.

3. Shaffer D.L., Tousley M.E., Elimelech M. Influence of polyamide membrane surface chemistry on gypsum scaling behavior. Journal of Membrane Science, 2017, 525, 249-256.

4. Tousley M.E., Shaffer D.L., Lee J.H., Osuji C.O., Elimelech M. Effect of Final Monomer Deposition Steps on Molecular Layer-by-Layer Polyamide Surface Properties. Langmuir, 2016, 32 (42), 10815-10823.

5. Shaffer D.L., Jaramillo H., Romero-Vargas Castrillón S., Lu X., and Elimelech M. Post-fabrication modification of forward osmosis membranes with a poly(ethylene glycol) block copolymer for improved organic fouling resistance. Journal of Membrane Science, 2015, 490, 209-219.

6. Shaffer D.L., Werber J.R., Jaramillo H., Lin S., and Elimelech M. Forward osmosis: Where are we now? Desalination, 2015, 356,271-284.