Warsinger Lab Research Opportunities

The Warsinger Water Lab is recruiting motivated undergraduate students interested in conducting research in the topics of water and energy. We are looking to hire 3-4 undergraduate researchers for the 2021-2022 academic year (and beyond). Applicants with a passion for research or a career in water, energy, or sustainability are strongly preferred.

Projects

Reverse osmosis integrated with renewables: Reverse osmosis (RO) is the most common way to filter pure water out of salty or otherwise contaminated solutions. To make RO more sustainable, we have projects combining it with renewables including solar power, wind power, and wave power, the latter of which we combine with Purdue's Marine Energy Collegiate Competition. We also work on new configurations to make RO more energy efficient, and capable of treating saltier/more hazardous waters.

Membrane Distillation for Rapid Cooling: Rapid cooling is especially important for vehicles using batteries or hydrogen fuel cells, that lack large incoming air streams to dump heat. Inspired by a desalination technology called membrane distillation, we are making water-permeable heat exchangers that use water vapor evaporation and conduction to dissipate record levels of heat. We are prototyping, testing, and modeling this system. The approach will have synergies and potential future projects with other thermal desalination technologies.

MemDry DOE Project: The Warsinger Lab recently received 2 million dollars from the department of energy to study the application of heat pumps and membrane dehumidification technologies for industrial drying and manufacturing applications. The student who joins this project will get help develop and test new membranes and will also get hands-on experience with modeling and building heat pump systems.

Magnetocaloric Cooling for Space Applications: A new series of projects are underway focusing on the application of novel high-entropy alloys and exploiting their exotic characteristics for next-generation space flight hardware. Namely, exploring superparamagnetic properties for hydrogen liquefaction in Lunar in-situ resource utilization (ISRU). This encompasses material and system design, thermodynamic analysis, and hardware assembly.

Acoustic Air Cleaning: Acoustic air cleaning involves the use of acoustic forces such as acoustic standing waves and acoustic streaming patterns to manipulate the transport of aerosols in a flowing stream. The project will start in the spring semester. Students with knowledge in fluid mechanics, and a preliminary understanding about the aerosol transport, and acoustics would be preferred. Students will mostly be involved in designing experiments to understand the transport of aerosols in internal flows under the influence of acoustic forces.

Ocean Thermal Energy Conversion: The oceans display unique temperature gradients, called thermoclines. Ocean thermal energy conversion (OTEC) is a form of renewable energy that harnesses the energy in the ocean thermocline. We are making the first global estimate of the fundamental thermodynamic energy available in the ocean waters using machine learning models of the thermocline. Students with strong programming skills especially in python are preferred. Students with any machine learning experience and/or experience with computing clusters are also ideal. Students will be in charge of the machine learning/coding side of the project and will work with Andrew Fix (Thermodynamics), with potential assistance from Dr. Bilionis' lab (ML). A highly motivated and independent student is needed to take ownership of the programming portion of the project.

3D-Printed Morphing Membranes: We are making the first membranes that can morph shape with external stimuli, such as stretching, heating, or humidity exposure. This morphing can enable on/off and size-selectivity of these membranes. This will enable new applications in cell sorting, humidity control, microfluidics, and other applications. The designs are inspired by Kirigami, a Japanese paper-cutting art. Team members will be involved with 3D printing and testing of small membrane structures.

What Experience will you gain?

- Hands on research experience and potential co-authorship in high impact journals
- Application of engineering fundamentals to important societal problems
- Research credit hours (and potential opportunities for financial compensation in the summer)
- Networking opportunities with academic and industry leaders

Interested? Apply here

You may also reach out to research mentors (PostDoc and grad students) directly