



DEPARTMENT OF
Mechanical Engineering
UNIVERSITY OF WISCONSIN-MADISON

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Heat Transfer and Two-Phase Flow Characterization for the Design and Optimization of Energy Systems

Monday, November 19

Mechanical Engineering Building, Room 2188

4:00 PM

Supported by WISELI and the UW-Madison Department of Mechanical Engineering.



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Abstract

Compact and efficient energy conversion systems for power production, heating, and cooling will be critical in the future as available energy resources diminish and the negative environmental externalities associated with traditional fossil fuels increase. To realize significant efficiency gains, a wholistic approach is needed that leverages fundamental insights for component and system design and optimization. This presentation will discuss approaches to improve the performance of heat and mass exchangers for large- and small-scale energy systems and will show how enhancement strategies can affect the overall system efficiency.

For large power plant systems, the cooling requirements account for about 38% of freshwater withdrawals in the United States, which can lead to thermal pollution and result in tensions in water-stressed areas. Air-cooled condensers (ACCs) can nearly eliminate the need for freshwater in power plants, but air is a relatively poor heat transfer medium and dry-cooled plants are plagued with lower efficiencies than their wet-cooled counterparts. The first portion of this presentation will evaluate the use of novel heat transfer enhancement devices to improve the performance of dry-cooled power plants.

For smaller energy systems such as residential heating and air conditioning, researchers have recently been studying the use of mini- and microchannel heat exchangers for enhanced heat transfer. Microchannel heat exchangers have the potential to drastically decrease the size and cost of energy systems, but they often underperform due to flow maldistribution. Maldistribution can be particularly acute when a two-phase mixture enters a heat exchanger header, which is difficult to address because the flow phenomena in these situations are poorly understood. The second portion of this presentation will discuss distribution characteristics in microchannel heat exchangers and propose strategies to improve their performance.

Bio – Dr. Allison Mahvi

Allison Mahvi is a postdoctoral researcher in the Department of Mechanical Science and Engineering at the University of Illinois at Urbana-Champaign. She received her Ph.D. from the Georgia Institute of Technology in 2018 and her Bachelor's degree from the University of Wisconsin – Madison in 2012. Allison's research focuses on developing efficient and economically viable thermal systems for both large- and small-scale applications. Her current work focuses on developing novel surfaces and component architectures to enhance transport in two-phase heat and mass exchangers.

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