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Science of transport at micro, nano and molecular-scale and its impacts on energy and environmental applications

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The energy and mass transport at or near the interface of different phases of matter plays a crucial role in the energy, environment, and life science applications. Performance, size, and cost of many devices and systems in these applications are often dictated by the limits of transport and reactive or non-reactive interactions at the micro-, nano-, and molecular-scale. Limits in gas-liquid separation or mixing rates, critical heat flux limits in the heterogeneous phase-change process, ions and molecular transport limits through ion channels, and rate-limiting interactions at the reacting interface sare examples of challenges, and opportunities, that face this area of science. Advancing the state of knowledge on the physics of these phenomena is of significant scientific and technological interest. In this talk, after an introduction of my research pertaining to the aforementioned scientific issues, I will present the relevance of heat and mass transport limitations to an energy conversion system. The energy conversion system in question is a lithium bromide-water (LiBr-water) absorption heat pump. Two of the main processes in the system involve absorption and desorption of water vapor to and from the LiBr-water solution in two separate heat exchangers. It will be shown that the absorption rate of water molecules into and from the LiBr-water solution can be significantly enhanced when the solution flow is mechanically constrained by highly permeable nanofibrous membranes and surface microstructures are used to mix the constrained flow. Finally, I will discuss an opportunity for exceeding the limits of critical heat flux in heterogeneous phase-change processes through the utilization of surface micro/nanostructures and novel flow arrangements.

Biography

Saeed Moghaddam is currently an Assistant Professor at the University of Florida. He received his Ph.D. in Mechanical Engineering from the University of Maryland at College Park in 2006. Before joining the University of Florida in 2010, he was a postdoc in the Chemical and Bimolecular Engineering Department at UIUC (2007-2010). His innovative research has been featured in Nano Science and Technology Institute (NSTI) Innovation Spotlight, New Scientist magazine, and 2010 Guinness World Records.

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