Journal of Heat Transfer

Guest Editorial

Special Issue on Energy Nanotechnology

It is with great pleasure that we present this special issue of the *Journal of Heat Transfer*, dedicated to Energy Nanotechnology. This focus area is the natural convergence of two subjects of tremendous and lasting importance. The ever-growing global demand for energy in both developing and industrialized nations is widely recognized as one of modern society's greatest challenges. To have a positive worldwide impact, new energy technologies must not only have the potential to be large scale and cost effective but must also address concerns about national security and environmental issues such as global climate change. As we strive to improve all aspects of the energy cycle—from primary production and extraction to storage, transmission, utilization, and mitigation—our attention naturally turns to nanotechnology because its additional degrees of freedom offer great potential for innovative breakthroughs.

In the heat transfer community, interest in research at nanoscale length and time scales has grown steadily over the past two decades, as evidenced, for example, by previous special issues of the *Journal of Heat Transfer* in April 2002 and January 2007. Early nanoscale heat transfer research was largely driven by the manufacturing and microelectronics industries, and it is only relatively recently that major attention has turned to energy applications. At a fundamental level, nanoscale effects can lead to significant changes in the ways that energy is stored and transported in nanostructures compared to macrostructures. Although the details vary, these phenomena are present for all types of energy carriers, including electrons, phonons, molecules, and photons. Thus, there is rich potential to exploit nanoscale phenomena in a wide range of energy technologies, many of which are described in this special issue.

Beginning with energy sources, one paper in this issue presents a model for the photoelectrochemical production of hydrogen at a proton-exchange membrane. Two contributions describe the synthesis of carbon nanotubes and their hybridization with nanoparticles, which may be useful for solar cells, fuel cells, batteries, and hydrogen storage. A related report describes the enhanced thermal conductance of phase change materials loaded with carbon nanotubes, with applications in the thermal management of electronics. Several papers add to the lively discussion about enhanced heat transfer in nanoparticle colloids, known as "nanofluids," which may lead to more efficient heat exchangers in large-scale power plants. Theoretical and experimental efforts detail conduction, convection, and boiling in nanofluids and at nanostructured surfaces, under both transient and steady-state conditions. Related papers describe heat transfer through porous media, narrow gaps, and flow visualization in microchannels, all of which may prove valuable for optimizing heat exchangers on a smaller scale. Finally, two papers can be related to energy scavenging (through nanocomposite thermoelectrics or a waveguide-ballistic device), which "closes the loop" by recovering energy from waste heat to create another energy source.

This special issue is in large part an outcome of the First Energy Nanotechnology International Conference (ENIC), held at the Massachusetts Institute of Technology on June 26–28, 2006. The conference was chaired by one of us (G.C.), and we would like to thank the Program Chair, Yang Shao-Horn, and the Organizing Committee, Arun Majumdar, Samuel Mao, and Ernie Moniz. Their efforts helped make this first-of-its-kind conference a success: there were over 100 technical contributions including talks, tutorials, posters, and panel sessions. This special issue contains papers submitted at ENIC as well as selected additional papers submitted directly to the journal. All have undergone full peer review. We hope that you, the reader, will find this issue both informative and thought provoking.

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