Micro/Nanotransport Phenomena in Renewable Energy and Energy Efficiency

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As a result of serious concerns about climate change, high oil prices, and peak oil, energy has become one of the most important issues of our time. Renewable energy and energy-saving technologies are potentially crucial parts of the ultimate solutions to both energy sustainability and climate change. The set of papers in this special issue of “Micro/nanotransport phenomena in renewable energy and energy efficiency” address some of the basic aspects of renewable energy harvest/conversion, emission control, and optimization of energy issues of today.

Contained herein, Vorobyev and Guo [1] develop a new method based on Femtosecond laser to fabricate high-quality metallic light absorbers. This method significantly enhances broadband absorption of electromagnetic radiation by creating a complex of nano- and microstructures. These artificially made surfaces can be used to improve the energy conversion efficiency such as thermophotovoltaics and solar energy absorbers. Hydrogen and fuel cell technologies emerged as one of the most favorable solutions to diversity energy resources and to energy sustainability and environment. Fell cell technology is a significant component in this special issue. Topics include the experimental and numerical study of cold startup of Proton Exchange Membrane (PEM) fuel cell [2], which is one of most promising solutions for the next generation of purely electric automobiles, development of a continuum model for water transport in the Ionomer-phase of catalyst-coated membranes for PEM [3], and mesoscopic modeling based on the lattice Boltzmann method for water management in fell cells [4]. Emission control is attracting more attention and is also addressed in this special issue. Nanosized cerium oxide particles as additives on biodiesel were found to appreciably reduce the emission levels of hydrocarbon and NO\textsubscript{x} through enhancing hydrocarbon oxidation and promoting complete combustion [5]. Mesoscopic modeling of multiphysicochemical transport phenomena in porous media based on the lattice Boltzmann method (LBM) has been found to be especially effective to model the dissolving process of supercritical CO\textsubscript{2} into geologic formations such as limestone rock [4], which may provide a comprehensive numerical tool to simulate the long-term fate of CO\textsubscript{2} after injection into the geologic formations. Thermal management is important to concentrated solar technology. Flat-plate oscillating heat pipes are shown to be capable of cooling photovoltaic cells with high concentration ratios because of their superior performance under high-heat flux conditions [6]. Nanoparticles can be used to improve the convective heat transfer at high Reynolds number [7]. The optimization of energy in the end use is included in this special issue since it is important to energy sustainability and the environment. The “field synergy principle” proposed by Guo (see [8–11]) is illustrated to be an effective tool to optimize the energy and mass flow in energy system [12].
References


