PREFACE: HEAT AND MASS TRANSFER IN POROUS MEDIA

This topic will consist of three special issues, all with invited papers that were presented at the 15th International Heat Transfer Conference held on August 10–15, 2014, in Kyoto, Japan. This is an important conference in the field of heat transfer, which is held every four years. From over 700 papers, including around 30 keynote lectures, approximately 40 authors were invited to submit their papers to be peer reviewed within the scope of heat and mass transfer in porous media.

The effect of particle size, distribution, and orientation on heat conduction behavior in a porous medium was studied by a lattice Boltzmann model by Wang et al. in an article entitled "Lattice Boltzmann simulation of effective thermal conductivity of porous media with multiphase." When wetting fluid with lower thermal conductivity was absorbed on the porous matrix, the predicted effective thermal conductivity was found to be closer to the Hashin–Shtrikman lower bound. The experiments conducted by Gao et al., presented in "Thermal conductivity of monodisperse silica nanospheres," has shown that, via a spontaneous dissolution–regrowth process, monodisperse hollow silica nanospheres have a reduced thermal conductivity compared to corresponding solid silica nanospheres. The effects from microstructure anisotropy on thermal conductivity of open cell metal foams, and a proposed analytical model to capture the geometrical effects, is presented in an article by Kumar and Topin entitled "Impact of anisotropy on geometrical and thermal conductivity of metallic foam structures." A numerical model for predicting the effective thermal conductivity of fused silica fiber/aerogel composites by simultaneously considering the effect of fiber volume fraction and fiber diameter is presented in an article by Yang et al. entitled "Prediction of thermal conductivity of fiber/aerogel composites for optimal thermal insulation." Their results agreed well with the existing measured data. In another article, entitled "Analysis of improved-lumped models for property estimation from temperature field data using a fin-model," by Moreira et al. the ability of the improved lumped-differential models for estimating the thermal conductivity and phase fractions of two-phase systems from a given temperature field was validated. The article "Influence of volumetric fiber fraction and heating temperature on heat transfer characteristics of latent heat storage paraffin with aluminum fiber materials" by Haruki et al. discusses the heat storage and heat release process of the paraffin with metal fiber materials as a function of volumetric fiber fraction and heating temperature by experiments.

Chinige et al., in an article entitled "An optimization study of heat transfer enhancement due to jet impingement over porous heat sinks using the lattice Boltzmann method," present an optimization study involving five variable parameters used in evaluating the thermal performance of the air jet flow impingement over porous heat sinks in a mixed convection regime by simulating the objective functions in terms of the Nusselt number and pressure drop using the lattice Boltzmann method. The article "Effects of dielectric permittivity of solid structure on electro-osmotic permeability in porous media" by Zhang and Wang solved the Poisson equation with discontinuous properties to acquire the local electrical field strength by the lattice Boltzmann method. Their results indicate that electro-osmotic permeability decreases with the dielectric permittivity of solid structures. Predictions by assuming constant electrical field strength underestimated the electro-osmotic permeability, while it led to overestimated values by leaving the solid as an ideal dielectric. The article "Evolution of the homogenized volumetric radiative properties of a family of α-SiC foams with growing nominal pore diameter," by Guévelou et al., presents a numerical foam generation method to design open cell foams with prescribed and realistic textural features (porosity, volumetric surface, pore size distribution, and pore–pore distance distribution). The radiative properties of a set of numerical α-SiC foams with real textural features, identified by the radiative distribution function identification method, were compared at $T = 300$ K to obtain a practical relationship between the extinction coefficient and the pore nominal diameter at fixed porosity. The flow and heat transfer characteristics of supersonic transpiration cooling through sintered porous flat plates with air as the coolant, investigated experimentally and numerically in a Mach 2.81 wind tunnel, are presented in an article entitled "Investigation of supersonic transpiration cooling through sintered metal porous flat plates" by Huang et al. Their measured surface temperature distributions demonstrated that a small amount of coolant injec-

tion strongly reduced the surface temperatures and higher thermal conductivity of the porous matrix improved the cooling effect and surface temperature uniformity. The article "Numerical simulation of thermomagnetic convection of air in a porous cubic enclosure with an electric coil inclined in general orientations using a LTNE model" by Jiang et al. investigates thermomagnetic convection of air in a porous cubic enclosure with an inclined coil around the Y and Z axes in the presence or absence of a gravity field. Their results showed that both the magnetic force and the coil inclination had a significant effect on the flow field and heat transfer in a porous cubic enclosure, and the thermomagnetic convection heat transfer of air could be enhanced or controlled by applying the gradient magnetic field. The article "Capturing analytically the transition to weak turbulence and its control in porous media convection" by Vadasz predicted analytically and numerically the transition point from steady to weak turbulent convection in a porous layer heated from below via a weak nonlinear analysis using an asymptotic expansion. The article "Numerical treatment and global error estimation of natural convective effects on gliding motion of bacteria on a power-law nanoslime through a non-Darcy porous medium" by Abou-zeid et al. studied the two-dimensional mixed convection of gliding motion of bacteria for power-law nanoslime through a non-Darcy porous medium numerically and presents an estimation of the global error by using the Zadunaisky technique.

Transport in porous media has important applications in energy and environmental systems. For applications in oil and gas recovery, the article "Simulation of the experimental results of miscible gravity drainage performance in a stack of matrix blocks" by Zobeidi et al. presents results of several experiments that were carried out to investigate the immiscible and miscible gravity drainage performance in a stack of matrix blocks for both gas/oil and solvent/oil systems. In the article "Pressure distribution measurements for CO_2 foam flow in porous media" by Du et al., the pressure distributions for CO_2 foam flow in porous media were measured by computed tomography technology to predict its flow behavior in underground reservoirs. Their results clearly show a piston-like propagation behavior and indicate the entrance effect for CO_2 foam flooding due to the high water saturation in the inlet region of the porous media. In the article "Relative permeabilities characterization in chemical flooding with the consideration of viscosity ratio and interfacial tension by pore-scale network model" by Liu and Shen, a dynamic pore-scale network model for investigating the effects of interfacial tension and oil–water viscosity on relative permeability during chemical flooding is presented. In the article "A dynamic discrete fracture approach for modeling multiphase flow and transport in fractured porous media" by Lei et al., a numerical study to analyze multiphase fluid flow and transport processes in naturally fractured rocks during long-term water flooding operations was conducted. For the applications in water treatments, the article "A volume averaging approach for analyzing a spiral-wound reverse osmosis desalination module" by Sano et al. proposes a mathematical model for spiral-wound reverse osmosis systems by taking into account the concentration polarization associated with spiral-wound reverse osmosis desalination systems. Their analysis revealed that there was an optimal brine pressure for attaining the maximum permeate flow rate for a given pumping power. For higher membrane performance in the concentration of bioethanol and dehydration of organic solvents, the article "Concentration of bioethanol and dehydration of organic solvents by porous membranes" by Uragami et al. proposes applying hydrophobic porous poly[1-(trimethylsilyl)-1-propyne] and hydrophilic porous chitosan membranes to a temperature-difference controlled evapomeation method to selectively concentrate ethanol from aqueous ethanol solutions and dehydrate water in aqueous dimethyl sulfoxide solutions.

Guest Editors:
Moran Wang
Department of Engineering Mechanics,
Tsinghua University, Beijing, China

Michel Quintard
Institut de Mécanique des Fluides de Toulouse,
Toulouse, France

Ning Pan
Department of Biological & Agricultural Engineering,
University of California at Davis, Davis, CA, USA

Kambiz Vafai
Department of Mechanical Engineering,
University of California at Riverside,
Riverside, CA, USA