From the Guest Editors

SUPERCRITICAL CARBON DIOXIDE AND NANOSCALE FLOW

by

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Application of mathematics in thermal science is of utter importance. This issue focuses on supercritical carbon dioxide, nanoscale flow, and other topics relative to environment and building. All these frontiers require theoretical insight by modern applications of mathematics, e. g., fractal theory, fractional calculus, analytical methods, and numerical simulation. A simple Bernnouli equation can explain fabrics finishing by supercritical carbon dioxide, and a simple algebra equation of bubble's surface tension can be used for fabrication of nanofibers.

Key words: *beads, electrospinning, analytical solution, silk*

Introduction

The advanced calculus initialed by Newton and Leibnitz is to solve practical problems more effectively. Mathematics becomes vital only when it is applied to practical problems, and the development of mathematics mainly depends on its successful applications to frontier problems in modern science and technology. When the present mathematics cannot solve an emerging problem, a new branch of mathematics will be born. In 2011, a new fractal derivative was first published in *Thermal Science* to deal with approximately the heat conduction in porous medium [1], and now it becomes a relatively matured theory in fractional calculus, and can be found in wide applications [2-5]. On the other hand, the development of modern technology strongly depends upon the successful application of mathematics. This issue focuses on many edge frontiers of modern technology, especially thermodynamics in supercritical carbon dioxide (SC-CO_2) and nanoscale flow, and mathematics is a main tool to finding the hidden pearls in various complex phenomena.

The SC-CO_2 is a fluid state of CO_2, there are many fascinating applications of such fluid in treatment of materials, and their surface properties will be greatly affected. At a critical point (31.1 °C, 7.3 MPa), CO_2 is in the supercritical state. After CO_2 turns into the supercritical state, its density and solvation capacity are close to those of liquids, while its viscosity and diffusion coefficients are similar to those of a gas. The strong permeability and driving force of SC-CO_2 renders it an ideal medium for fabrics finishing, generally the treated fabrics

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gained good water/oil repellent properties while keeping good air permeability and improving mechanical property, similar to properties of silk [6].

Nanoscale flows become a hot topic because it arises in mass-production of nanofibers in bubbfil spinning [7, 8], which uses an external force of electrostatic force, mechanical force (*e. g*. centrifugal force), air force, and thermal force or their couples to break a polymer bubble to form thousands of fast moving nanoscale jets. As pointed out by Xu, *et al.* [9] that bubbfil spinning is the best technology so far for mass-production of various functional nanofibers. The SC-CO_2 can be used for surface treatment of nanofibers obtained by bubbfil spinning or bubble electrospinning, the technology is much cheaper than nanoimprint.

Both mathematical analysis and experimental study are included in this issue, making the issue much attractive to various fields, such as nanotechnology, materials science, chemistry, mathematics, and others.

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