From the Guest Editors of Part one

THERMODYNAMICS IN NANOTECHNOLOGY
A New Approach to Revealing Hidden Phenomena

by

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Thermodynamics becomes remarkably important in nanotechnology and other fields as well [1-4], where the energy relationship with heat and temperature is a significant factor to reveal hidden phenomena. For example, the well-known capillary phenomenon is a thermodynamic process produced by a geometrical potential, which was introduced by Liu and He (in this issue, p. 31). According to this new introduced theory, a boundary will produce a force, for example, the surface of our spherical Earth produces a gravity. The geometrical potential was successfully applied to explain the permeability, thermal and wetting properties of nanofiber membranes [5]. When the boundary becomes sharp, stress concentration occurs in mechanical design, however when the boundary tends to some a nanoscale, nanoeffort [6] arises, which implies some extreme/extraordinary surface properties independent of their bulk materials. For example the thermal-resistance, R, of a nanofiber membrane can be expressed:

$$R = R_0 + \frac{k}{d^{\alpha}}$$

where R_0 is the thermal-resistance of the bulk material, d – the diameter of the nanofibers, k – the material constant, and α – the scaling exponent. This property can be used for optimal design of a fire-protection clothing.

Thermodynamics is becoming tremendously fascinating and extremely challenging in all science and technology. Using fractional calculus [7-10], thermodynamics can well explain some bio-properties of cocoons [11] and polar bear hairs [12], this might lead to a new direction of mimics. Hereby we solicited 9 papers on last development of thermodynamics. Wang *et al.* (in this issue, p. 39) reveal the energy absorption of nanoscale boundary, instead of fiber's properties, for the stab-proof application, implying that energy can be absorbed through the boundary. On the other hand, the nanoscale boundary can also produce energy, this concept was first proposed by El Naschie [13], whose new finding on nanoreactors, which is to produce

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energy from boundary of the nanomaterials, has become a hot topic in both physics and nanoscience. Liu *et al.* (in this issue, p. 43) illustrate the nanoscale flow has a high surface energy and can be used to control fiber's diameter during the electrospinning process.

Bubbles are an everyday phenomenon which are formed thermodynamically for minimization of the surface energy, and polymer bubbles are widely used for mass-production of nanofiber by either the bubble electrospinning [14, 15] or the bubbfil spinning [16, 17]. Sun *et al*. (in this issue, p. 47) give a theoretical prediction of jet speed of a fragment when a bubble is broken, the high jet speed is a significant factor to control fiber's morphology in the bubble electrospinning. Shao *et al* (in this issue, p. 1) obtain highly aligned nanofibers using the bubble electrospinning, and a thermodynamic model is established to reveal the phenomenon.

Yan *et al.* (in this issue, p. 9) show that adsorption performance is a thermodynamic process, and Wang *et al.* (in this issue, p. 15) reveal that air permeability of a membrane can be greatly improved by enhancing surface energy, Yao *et al.* (in this issue, p. 27) find that temperature plays an important role in the fabrication of aramid paper. It becomes obvious that the development of modern textile becomes strongly depends upon thermodynamics, and its influence will be remarkably enhanced in near future.

Wang *et al.* (in this issue, p. 21) give a fractional mKdV equation for discontinuous flows, and the model can be effectively used for controlling solitary waves or preventing tsunamis [18]. Wei Tan *et al*. [19] give a dynamical analysis of a bilinear KdV equation, revealing some new solution properties different from the classic KdV equation.

This collection of 9 papers is especially helpful for engineers in textile science, material science, nanotechnology, and other fields to enhance applications of thermodynamics to their practical problems to discover hidden mechanisms of various phenomena.

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