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# Preface

Mechanical properties of low-dimensional and nanostructured materials have attracted great scientific interests as nanomaterials are distinctly different in both properties and functions from their macroscopic counterparts especially under multifields. At nanoscale, as the local fields of matters consisting of the electronic structure, molecular orbit, charge density and spin states become strongly coupled with the applied mechanical forces or strain, external electric field, magnetic field or optical action, one have to unify the traditional mechanics principles with the quantum mechanics theory to develop physical mechanics.

This special issue partly publishes a collection of research articles contributed by six excellent young scientists based on their invited talking on the IUTAM Symposium of Nanoscale Physical Mechanics (held in Nanjing, Jiangsu, China, 23–27 May 2016). Organized by the International Union of Theoretical and Applied Mechanics, the symposium was jointly hosted by State Key Laboratory of Mechanics and Control of Mechanical Structures of Nanjing University of Aeronautics & Astronautics, the Chinese and Jiangsu Society of Theoretical and Applied Mechanics, and Beijing International Center for Theoretical and Applied Mechanics. Nearly a hundred experts, scholars and researchers from 11 countries and regions, such as Britain, France, USA, and Germany etc. attended the symposium. The main topics of the symposium are about mechanical properties of nanoscale materials, physical mechanics of nanodevices and biosystems, experiments of nanomechanics, surface and interface mechanics of nanomaterials and nanodevices, and multiscale theory and computation. The latest researches on physical mechanics of nanomaterials and nanodevices and the latest advances in theoretical method and technique were introduced and discussed in the symposium, and the challenges facing nanoscale physical mechanics today were also discussed.

Especially, a specific section for excellent young scientists was held at the beginning of the symposium to reflect the rapid moving frontier in the interdisciplinary field of nanoscale physical mechanics. Parallel to the IUTAM proceedings of the symposium, which collected 14 articles from the senior invited speakers, this special issue in *Acta Mechanica Solida Sinica* collects a set of articles contributed by six invited speakers on the specific young scientist section of the IUTAM symposium and their colleagues. The papers in this issue range from mechanics of two-dimensional materials, ice on silicon, diffusion of nanoparticles in bio-environment and physical mechanics of lithiation. Senbo Xiao et al. from Norwegian University of Science and Technology reported their recent study on nanosized ice-cube adhering on silicon surface and proposed an atomistic model for probing nanoscale ice adhesion mechanics. The model is helpful to understand the mechanism of nano-sized ice adhesion and enrich the numerical ability for anti-icing simulations (pp. 224–226). Jin-Wu Jiang from Shanghai University revealed the hinge-like mechanism in single-layer black phosphorus, and proposed an AAC-SW potential for materials with puckered configuration under large deformation (pp. 227–233). Yinfeng Li et al. from Shanghai Jiao Tong University reported their comprehensive analyses on the interlayer interactions and friction in graphene/graphene, h-BN/graphene, and h-BN/h-BN bilayers by molecular dynamics simulations, which deepen our understanding of mechanical properties of graphene-like materials (pp. 234–240). Xinghua Shi et al. from National Center for Nanoscience and Technology study the diffusion of nanoparticles in modeled mucus layer by a coarse-grained molecular dynamics model, which could provide a better understanding of the diffusion of nanoparticles in mucus and be useful for the design and optimization of nanoparticle-based drug delivery system (pp. 241–247). Yong Ni et al. from University of Science and Technology of China introduce their recent progress on stress-mediated lithiation in nanoscale phase transformation electrodes. The results will be useful for lithiation related applications (pp. 248–253). Zhiping Xu, Huajian Gao and co-workers from Tsinghua University study the lithiation of graphene-covered silicon by first-principle calculations, revealing that the interfacial charge transfer and cohesive/sliding strength can be enhanced by lithium aggregation at the graphene/$Li_xSi$ interface and the presence of mono-vacancy defects in graphene. These understandings can guide the design of silicon/graphene hybrid anodes for stable and efficient energy storage applications (pp. 254–262). All these works highlight new insights for the advanced fields of nanoscale physical mechanics and will be helpful for the development of nanomaterials and nanodevices.

Wanlin Guo
Daining Fang

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