Preface

In the past decade, nano- and bio-technologies have received unprecedented attention from the government and private sectors as well as the general public owing to their potential in impacting our lives through fundamental discoveries, innovation, and translational research efforts. Engineers and applied scientists have played a major role in developing these technologies and made essential contributions to applying them to a wide range of industries, including manufacturing, healthcare, agriculture, energy, and defense.

Consistent with this, research in nano-mechanics and the mechanics of living cells and biomolecules has become a frontier in applied mechanics. Studies in this exciting research area are interdisciplinary in nature and draw engineers and scientists from a diverse range of fields, including nanoscale science and engineering, biology, statistical and continuum mechanics, and multiscale-multiphysics modeling and experimentation. As a result, original contributions to the development of nano- and cell-mechanics are published in a large number of specialized journals, which prompted us in editing this book. The book documents, for the first time, many recent developments in nano- and cell-mechanics and showcases emergent new research areas and techniques in engineering that are at the boundaries of mechanics, materials science, chemistry, biology, and medicine. As such, this book allows those entering the field a quick overview of experimental, analytical, and computational tools used to investigate biological and nanoscale phenomena. This book may also serve as a textbook for a graduate course in theoretical and applied mechanics, mechanical engineering, materials science, and applied physics.

The 17 chapters in this book are organized in four sections: (1) Biological phenomena, (2) Nanoscale phenomena, (3) Experimentation, and (4) Modeling. The biological phenomena section covers cell–receptors interactions, regulatory molecular motors, and the role of tension in neuronal growth and memory. The nanoscale phenomena section examines superhydrophobicity, multiscale mechanics of hierarchical carbon-based materials, mechanics of twinning in hierarchical metals, and size-dependent strength in single-crystalline metallic nanostructures. The experimentation section discusses *in-situ* electron characterization of nanomaterials, the engineering of nano-probes for live-cell imaging of gene expression, high-throughput cell mechanic assays for research and clinical applications, and microfabrication technologies for cell mechanics studies. The last section, modeling, spans a number of methods and applications: atomistic reaction pathway sampling, mechanics of curvilinear electronics, single molecular pulling, modeling of hierarchical protein materials, geometric models of protein secondary structure formation, and multiscale modeling for the vascular transport of nanoparticles.

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