Preface to the “Soft Matter Mechanics” Special Issue of *Acta Mechanica Solida Sinica*

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Different from ordinary solids, liquids and gases, soft matter is a subfield of condensed matter comprising a complexity of physical states and softness that are easily modulated by external stimuli and/or thermal fluctuations, with the featured sensitivity to tiny perturbations from the environment. The soft matter research is considered to be “the science of the 21st century,” which is rapidly evolving and growing at the interfaces of mechanics, physics, biology, material science, chemistry, etc.

Mechanics plays a crucial role in various systems of soft matter across different length and time scales, and many practical applications of soft materials rely on large deformation of these materials in response to external stimuli. There are many unsolved fundamental problems from the viewpoint of mechanics, and the in-depth studies on soft matter mechanics have opened up numerous new engineering applications. A great number of researchers from domestic universities and institutions have been actively engaged in the research related to soft matter mechanics. In recent years, many outstanding scholars have emerged, and tremendous progress has been achieved on the topics of soft robotics, flexible electronics, dielectric elastomers, hydrogels, liquid crystal elastomers, growth instability, surface effects, tissue mechanics, etc.

In May 2018, the Chinese Society of Theoretical and Applied Mechanics (CSTAM) officially approved the establishment of the Working Group on Soft Matter Mechanics. In November 2018, the 1st National Conference on Soft Matter Mechanics was held in Hangzhou. To provide a platform for further academic exchanges, the international journal *Acta Mechanica Solida Sinica* (AMSS) sponsored by CSTAM proposed to organize a special issue on “Soft Matter Mechanics.” This special issue invited leading experts nationwide in the fields related to soft matter mechanics, aiming to bring new ideas/concepts, boost development of fundamental research and promote growth of young scholars in the country. The selected 11 papers in this special issue focus on either the fundamental mechanics of emerging soft materials or the rapid development in cutting-edge technologies for various applications.

Hydrogels have increasingly demanding applications in biomedical devices, soft robotics, etc., where modeling and characterization of the materials are critically important. In this issue, Hu and Qu [1] investigated the effect of inclusion size on the mechanical properties of particle–hydrogel composite by generating a 3D representative volume element in a finite element approach. Combined with the macroscopic experimental results, Xu et al. [2] established a three-dimensional model of random fiber networks to characterize the microstructure and mechanical behaviors of polyvinyl alcohol hydrogel. Wu et al. [3] focused on the morphing behavior of swelling/non-swelling hydrogel bi-strips, in which

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the differential swelling capabilities and mismatch strain in the composites drive the strips into various configurations.

Biological tissues, cells/vesicles and structures from nature bring inspirations and paradigms to the research of soft matter. Ye et al. [4] explored the torsion instability of an anisotropically growing tube with fiber reinforcement that mimics tubular organs. Bu et al. [5] examined the creep deformation and stress relaxation of different human cells with the atomic force microscope. Based on the Helfrich membrane theory, Tang et al. [6] performed a theoretical investigation to explore the mechanical behaviors of pressurized elastic fluid nanovesicles indented by a rigid cylindrical punch. Li et al. [7] reviewed the basic models, cutting-edge achievements and perspectives of water collection by soft fibrous structures in nature.

Stimuli-responsive materials, including shape-memory polymers, piezoelectric materials, dielectric elastomers, etc., endow soft matter with novel functions that are tightly coupled to their mechanical deformation. Xin et al. [8] reviewed the current status of mechanical modeling for shape-memory polymers, shape-memory nanocomposites and shape-memory polymer composites, with an in-depth discussion on spatially deployable structures and 4D printing. Lü et al. [9] theoretically derived the output power of ultrathin flexible piezoelectric energy harvesters under a variety of excitation modes. Cao et al. [10] reviewed the actuation mechanisms and performances of representative soft linear actuators made from smart materials such as dielectric elastomers, thermal responsive hydrogels, pneumatic artificial muscles and conducting polymers. Ma et al. [11] designed an experimental setup to quantify the out-of-plane vibrations and different response modes of a circular dielectric elastomer actuator.

The further development of soft matter mechanics calls for combination and synergy of advances in theories/modeling, computational techniques and experimental methods. We hope that this themed collection will help bring scholars from diverse disciplines together to work convergently as a global community.

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