

## Preface

With the development of science and technology and the progress in human society, an increasing number of new scientific phenomena and problems will emerge and need to be explained and solved from a perspective of future scientific development. Development of new materials and new energies depends even more on proactive basic research and informatization, digitization, and intelligentization, which together pose new challenges to the development of science and technology. Mechanics plays an indispensable role in overcoming the challenges and creating opportunities for these engineering technology fields. As a classical branch of mechanics, solid mechanics and its evolution have long been based on developing basic scientific theories and methods, consistently adhered to the goal of solving problems of strength, toughness, failure, constitutive relations, and mechanical behaviors of materials in engineering technology, and thus significantly contributed to economic and social development. Physical mechanics is based on the exploration of micro-nano-scale mechanics and physical laws, and its multidisciplinary characteristics of combining mechanics, physics, chemistry, etc. have become more pronounced. In the past decade, the disciplines of solid mechanics and physical mechanics have individually achieved great development. At the same time, the two disciplines have gradually shown a trend of crossover and integration in their development process. In order to discuss the current progress and the future development trend of solid mechanics and physical mechanics, and to cordially congratulate Academician Tzu-Chiang Wang on his 80th birthday, we held a seminar entitled “Current progress in solid mechanics and physical mechanics” in Beijing Xijiao Hotel on June 16–17, 2018. The seminar specially invited a number of prestigious scholars in China who are committed to solid mechanics and physical mechanics. This special topic brings together the most recent research findings from some of them.

Academician Tzu-Chiang Wang graduated from the Department of Modern Mechanics of University of Science and Technology of China in 1963. Since then he has been working at Institute of Mechanics of Chinese Academy of Sciences, dedicating himself to solid mechanics and physical mechanics, and has achieved numerous academic achievements with great international influence. In solid mechanics, his excellence is embodied in his success in investigating and solving difficult solid mechanics problems, cross-scale mechanical problems, and multi-field coupled mechanics problems, etc. For example, for the characterization of nonlinear fracture mechanics problems and the problem of establishing fracture criterion for elastoplastic materials, he was the first in the world who obtained the high-order asymptotic solution at the crack tip and proposed an important fracture criterion based on the solution; he was also the pioneer who obtained the asymptotic solution for interfacial fracture of the elastoplastic materials and proved that the elastoplastic asymptotic solution near the crack tip has no oscillation singularity but has HRR singularity; aiming at the characterization of size effect on mechanical behaviors in micro-/nano-structured materials, he introduced a strain gradient theory without the high-order stress. In physical mechanics, he was the first to combine the first principle calculation with the large-deformation instability theory for the ideal crystal, to establish a rigorous algorithm for the theoretical strength of solids using the density functional theory, the pseudo-potential plane wave method, and the periodically structured supercell model, and to obtain the theoretical rupture strengths for metallic aluminum and diatomic constituent materials. In recent years, he has continued to work on the evolution of the discipline at the intersection of solid mechanics and physical mechanics, establishing a quasi-continuous solid constitutive theory that considers temperature effects. Professor Wang’s exceptional work greatly promoted the development of the interdisciplinary research between solid mechanics and physical mechanics.

I would like to respectfully dedicate this special topic to Academician Tzu-Chiang Wang for his 80th birthday!

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