

Mechanics of cell-nanomaterial interactions and some applications in nanomedicine and nanotoxicity

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ABSTRACT

Nanomaterials, including various types of nanoparticles, nanowires, nanofibers, nanotubes, and atomically thin plates and sheets have emerged as candidates as building blocks for the next generation electronics, microchips, composites, barrier coatings, energy harvesting and conversion systems, biosensors, and nanomedicine. There is now an urgent societal need to understand the biological interactions and environmental impact of nanomaterials which are being produced and released into the environment by nearly a million tons per year, as well as to explore applications of nanomedicine to treat diseases. This talk aims to discuss mechanics as an enabling tool in this emerging field of study. The discussions will touch upon some of the recent experimental, modelling and simulation studies on cell uptake pathways of nanomaterials with different geometrical (e.g., size, shape, orientation), mechanical (e.g., stiffness) and chemical (e.g., surface functionalization) properties of nanomaterials; cellular and Intracellular packaging of nanomaterials and cytotoxicity; and toxicity and damage mechanisms of nanomaterials to cells and membranes.

Short Bio of Prof. Huajian Gao



Huajian Gao received his B.S. degree from Xian Jiaotong University of China in 1982, and his M.S. and Ph.D. degrees in Engineering Science from Harvard University in 1984 and 1988, respectively. He served on the faculty of Stanford University from 1988-2002, as Director of the Max Planck Institute for Metals Research from 2001-2006, and as Walter H. Annenberg Professor of Engineering at Brown University from 2006-2019. In 2019, after becoming a Professor Emeritus at Brown, he joined the Nanyang Technological University (NTU) in Singapore, the world's fastest rising young university, as one of five Distinguished University Professors at NTU. At the same time, he has been appointed as Scientific Director of the Institute of High Performance Computing (IHPC) of Singapore's Agency for Science, Research and Technology (A*Star).

Professor Gao's research has been focused on the understanding of basic principles that control mechanical properties and behaviors of materials in both engineering and biological systems. He is Editor-in-Chief of the Journal of the Mechanics and Physics of Solids, a top journal in his field. For his research accomplishments and leadership roles in the field, he has been elected to American Academy of Arts and Sciences, National Academy of Engineering, National Academy of Sciences, Chinese Academy of Sciences, German National Academy of Sciences Leopoldina and Academia Europaea. He has also received numerous academic honors, from a John Simon Guggenheim Fellowship in 1995 to recent honors including the Rodney Hill Prize in Solid Mechanics from the International Union of Theoretical and Applied Mechanics in 2012, the Prager Medal from Society of Engineering Science in 2015, the Nadai Medal from American Society of Mechanical Engineers in 2015 and the Theodor von Karman Medal from American Society of Civil Engineers in 2017.