Prof Huajian Gao

Education

- PhD (Engineering Science), Harvard University 1988
- MS (Engineering Science) Harvard University 1984
- BS (Engineering Mechanics) Xi'an Jiaotong University 1982

Biography

Huajian Gao received his Bachelor of Science 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. At the age of 24, he became one of the youngest faculty members at Stanford University. After going through the academic ranks of Assistant, Associate and Full Professors at Stanford, he was recruited by the Max Planck Society of Germany to be a Director at the Max Planck Institute for Metals Research in 2001. In 2006, he was recruited to Brown University, one of the most preeminent centers of Solid Mechanics, as the Walter H. Annenberg Professor of Engineering.

For his academic accomplishments and leadership roles in his field, he has been elected to Memberships in the National Academy of Sciences, the National Academy of Engineering, the German National Academy of Sciences Leopoldina, and the Chinese Academy of Sciences. He is the Editor-in-Chief of Journal of the Mechanics and Physics of Solids (JMPS), the flagship journal of his field. He has also received numerous honors and awards, ranging from a Guggenheim Memorial Fellowship in 1995 to recent awards including the Rodney Hill Prize in Solid Mechanics from International Union of Theoretical and Applied Mechanics in 2012, the Alexander von Humboldt Research Award in 2012, the William Prager Medal from Society of Engineering Science in 2015, the Nadai Medal from American Society of Mechanical Engineers in 2015 and the Theodore von Karman Medal from American Society of Civil Engineers in 2017. He has been twice (2015, 2018) included among "The World's Most Influential Scientific Minds," a list of highly cited researchers in 21 science and social science fields compiled by Thomson Reuters.

Professor Gao works in the field of solid mechanics and at its boundaries with materials science and biology. He has published many highly cited scientific papers and played substantial leadership roles in his field, serving as a term being President of the Society of Engineering Science (SES) and Chair of the Applied Mechanics Division, the largest Division of American Society of Mechanical Engineers (ASME) with over 5000 active members. He has also served on many prestigious committees, including the US National Committee on Theoretical and Applied

Mechanics, the International Union of Theoretical and Applied Mechanics Solids Symposium Committee (currently its Chair), the Department of Energy Basic Energy Sciences Review Committees of Sandia and Los Alamos National Laboratories, and the Scientific Advisory Board of Garching Supercomputer Center of the Max Planck Society.

Prof. Gao's research has been focused on the understanding of the basic principles that govern mechanical properties and behaviors of materials in both engineering and biology by analytical and computational approaches. His research covers a wide range of topics, including fracture mechanics, thin film mechanics, plasticity, indentation size effect, stress assisted diffusion, dynamic fracture, mechanics of hierarchically structured biological materials, biological adhesion, cell mechanics, endocytosis, cell uptake of one- and two-dimensional materials, mechanics of hierarchical nanotwinned materials, and mechanical degradation in lithium ion batteries. He combines analytical and finite element (FEM) methods in continuum mechanics, discrete dislocation (DD) methods, and molecular dynamics (MD) and ab initio (DFT) methods to reveal how the deformation characteristics of materials depend on their internal microstructures and associated length- and time-scales. He has studied how metallic and semiconductor materials behave in thin films and nanocrystalline forms, and how biological materials such as bone, gecko and cells achieve their mechanical functions through structural hierarchy and internal organization. Systems and phenomena of interest include hierarchical structures of mollusk shells and bone, hierarchical adhesion systems of gecko and insects, cell adhesion, cell motility, endocytosis, cell uptake of one- and two-dimensional nanomaterials, soft materials, thin films, nanotwinned and nanolaminated metals, dynamic fracture, carbon nanotubes, graphene, and biomolecules. Fundamental concepts include diffusion, dislocation, fracture, grain boundary, stiffness, toughness, contact, adhesion, viscoelasticity, convergent evolution, flaw tolerance, size effects, shape optimization, self-assembly, and bottom-up hierarchical materials design. Applications of research include microelectronic and optoelectronic devices, nanotechnology, nanomechanical devices, smart and active structures and materials, nano- and hierarchical materials engineering, adhesion, bio-inspired robotics, biomimetics, biomaterials, nanotoxicology, bio-sensing, and gene/drug delivery systems.

Research Interests

- Solid Mechanics, nanomechanics, biomechanics
- Mechanics of thin films and hierarchically structured materials
- Mechanics of nanostructured and nanotwinned materials
- Mechanics of biological and bio-inspired materials
- Mechanics of cell-nanomaterials interactions
- Mechanics of energy storage materials
- Mechanics of cell adhesion
- Mechanics of amorphous alloys

Selected Publications

- W.P. Zhu, A. von dem Bussche, X. Yi, Y. Qiu, Z.Y. Wang, P. Weston, R.H. Hurt, A.B. Kane and H.J. Gao, "Nanomechanical Mechanism for Lipid Bilayer Damage Induced by

Carbon Nanotubes Confined in Intracellular Vesicles," 2016, Proceedings of the National Academy of Sciences of USA, Vol. 113(44), pp. 12374-12379.

- Q.S. Pan, H.F. Zhou, Q.H. Lu, H.J. Gao and L. Lu, "History-Independent Cyclic Response of Nanotwinned Metals," 2017, Nature, Vol. 551(7679), pp. 214-217. DOI: 10.1038/nature24266
- J.Y. Li, B. Ni, T. Zhang and H.J. Gao, "Phase Field Crystal Modeling of Grain Boundary Structures and Growth in Polycrystalline Graphene," 2018, Journal of the Mechanics and Physics of Solids, Vol. 120, pp. 36-48.
- A.B. Kane, R.H. Hurt and H.J. Gao, "The Asbestos-Carbon Nanotube Analogy: An Update," 2018, Toxicology and Applied Pharmacology, Vol. 361, pp. 68–80.
- W.S. Kim, W.P. Zhu, G.L. Hendricks, D. Van Tyne, A.D. Steele, C.E. Keohane, N. Fricke, A.L. Conery, S. Shen, W. Pan, K.H. Lee, R. Rajamuthiah, B.B. Fuchs, P.M. Vlahovska, W.M. Wuest, M.S. Gilmore, H.J. Gao, F.M. Ausubel, E. Mylonakis, "A New Class of Synthetic Retinoid Antibiotics Effective against Bacterial Persisters", 2018, Nature, Vol. 556, pp. 103–107.
- Z. Cheng, H.F. Zhou, Q.H. Lu, H.J. Gao and L. Lu, "Extra Strengthening and Work Hardening in Gradient Nanotwinned Metals," 2018, Science, Vol. 362(6414), eaau1925.