Intelligent Nano Materials and Technology

Wanlin Guo

Professor of Mechanics Key Lab. of Intelligent Nano Materials and Devices of MoE,
State Key Lab. of Mechanics and Control of Mechanical Structures
Nanjing University of Aeronautics and Astronautics, 29, Yudao Street, Nanjing, 210016, China.

E-mail: wlguo@nuaa.edu.cn, web: http://nsi.nuaa.edu.cn

Our understanding of the nature and universal and our ability of creation and production depend on how small we can see (spatial scale), how fast we can capture (temporal scale) and how weak signal we can distinguish (energy scale). When the spatial scale goes down from macroscale to nano- and pico-scale, temporal scale reduces to femto- to atto-second, and more importantly, the related energy scale of an externally applied field drops for eighteen orders from joule to atto-joule (1 nN times 1 nm = 6.42 eV), falling into the energy scale of the local fields of matter which consist of electronic structures, charge, molecular orbital and spin states, or well enter the regime of quantum mechanics. Therefore, at nanoscale, matters show distinctly different performances from their bulk materials mainly due to the strong coupling between the local fields of matter and external applied fields, turning common materials such as carbon, even insulators, into functional nanomaterials with exceptional properties we expected for nanoelectronics, spintronics as well as energy conversion devices, physical mechanics, a combination of classical mechanics with quantum mechanics to understand the structure-function correlation of matters, has witnessed its golden age in recent decades. Now with nanotechnology entering its fourth decade and nanoscience transforming into picoscience, our ability in spatial, temporal and energy resolutions has experienced revolutionized advance. This revolution is bringing us radical change in understanding not only low-dimensional nano materials, but also liquid-solid interfaces and hydro-ion-electron systems, harvesting electricity from water by hydrovoltaic effects, creating new generation artificial intelligence, leading to intelligent hydrovoltaics for understanding our brain. The challenges and chances will be outlined for discussions.