The Electric-Field Controlled Mechanical Response of the Water-Filled Carbon Nanotubes

***H.F. Ye[1], H.W. Zhang[1], Z.Q. Zhang[2], Y.G. Zheng[1]**

[1]State Key Laboratory of Structure Analysis for Industrial Equipment, Department of Engineering Mechanics, Faculty of Vehicle Engineering and Mechanics, Dalian University of Technology, Dalian 116024, P. R. China
[2]Micro/Nano Science and Technology Center, Jiangsu University, Zhenjiang 210013, P.R. China

*Corresponding author: yehf@dlut.edu.cn

The changeable mechanical response of the water-filled carbon nanotubes under the electric field is studied by the molecular dynamics simulations. The results reveal that the mechanical properties including the elastic modulus and the critical buckling stress can be enhanced through encapsulating the water molecules. Especially after introducing the electric field, the mechanical properties of the water-filled carbon nanotubes will further grow with the intensity increases due to the ice-like configuration of the water molecules. Moreover, it is found that for a water-filled carbon nanotube with an initial compressive deformation resisted by a spring, its height can be changed via adjusting the intensity of the electric field. The present research can provide valuable guidance for designing the controlling nanoequipment. This work has been supported by the NSFC (11232003, 11272003), the 111 Project (B08014), the 973 Program (2010CB832704, 2011CB013401), the Fundamental Research Funds for the Central Universities and China Postdoctoral Science Foundation.

Keywords: Water molecules, Carbon nanotubes, Electric field, Elastic property, Buckling behavior