Vibration of Double-walled Carbon Nanotubes Predicted by Timoshenko Beam Models and Molecular Dynamics

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Vibrations of double-walled carbon nanotubes (DWCNTs) are studied by using different beam models of continuum mechanics and the molecular dynamics (MD) simulations. The models of the double-Euler beam and the double-Timoshenko beam, with the energy of van der Waals interaction between layers taken into consideration are applied to predict the natural frequencies of DWCNTs with one ends fixed. For the relatively long DWCNTs, the results obtained by the double-Euler beam model and the double-Timoshenko beam model are very colse, and the MD simulations show that these two models can predict the natural frequencies well. However, for the vibrations of the relatively short DWCNTs, the difference between the double-Euler beam model and the double-Timoshenko beam model becomes obvious, and the double-Timoshenko beam model offers much better predictions than the double-Euler beam model.

Keywords: double-walled carbon nanotubes, double-Timoshenko beam, molecular dynamics simulation, van der Waals, natural frequency