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Axisymmetric compressive buckling of multi-walled carbon nanotubes under different boundary conditions

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Abstract The paper studies the axisymmetric compressive buckling behavior of multi-walled carbon nanotubes (MWNTs) under different boundary conditions based on continuum mechanics model. A buckling condition is derived for determining the critical buckling load and associated buckling mode of MWNTs, and numerical results are worked out for MWNTs under fixed and simply supported boundary conditions, for different aspect ratios. It is shown that the critical buckling load of MWNTs is insensitive to boundary conditions, except for nanotubes with smaller radii and very small aspect ratio. The associated buckling modes for different layers of MWNTs are in-phase, and the buckling displacement ratios for different layers are independent of the boundary conditions and the length of MWNTs. Moreover, for simply supported boundary conditions, the critical buckling load is compared with the corresponding one for axial compressive buckling, which indicates that the critical buckling load for axial compressive buckling can be well approximated by the corresponding one for axisymmetric compressive buckling. In particular, for axial compressive buckling of double-walled carbon nanotubes, an analytical expression is given for approximating the critical buckling load. The present investigation may be a help in further understanding the mechanical properties of MWNTs.

Keywords: Carbon nanotube Buckling Van der Waals forces

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