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Chirality-Sensitive Elastic Behaviour of Small-Radius Singlewalled Carbon Nanotubes

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ABSTRACT

Recently, some chirality-dependent mechanical phenomena of small-radius single-walled carbon nanotubes (SWCNTs) have been reported in the literature, such as chirality-dependent Young and shear moduli, axial compression-induced torsion, torsion-induced axial elongation/compression, and chirality-dependent critical buckling strain. Motivated by these newly reported chirality-sensitive mechanical phenomena, an anisotropic elastic shell model is developed in the present work, for the first time to the best of my knowledge, to study curvature-derived elastic anisotropy of small-radius single-walled carbon nanotubes. The proposed model is based on an orthotropic in-plane elastic relation for symmetric zigzag and armchair SWCNTs from which an anisotropic in-plane elastic relation can be obtained for chiral SWCNTs of arbitrary chiral angle through a small-angle rotation of the coordinate system. The suggested model requests only four orthotropic in-plane elastic constants for zigzag and armchair small-radius SWCNTs. The model is used to study chirality-dependent coupling between axial, circumferential and torsional deformations, as well as the chirality-dependence of elastic moduli and critical pressure for elastic buckling under radial pressure. The main results obtained are in good agreement with known results available in the literature. The accuracy of the present model and its usefulness for multiwalled carbon nanotubes of small innermost radii request further research. In addition, refined anisotropic shell models based on more accurate elastic shell relations (such as the Flugge shell equations) would be another interesting issue for future work.

REFERENCES

[1] Ru, CQ. "Elastic models for carbon nanotubes". Encyclopedia of Nanoscience and Nanotechnology. HS Nalwa eds. American Scientific Publisher. Stevenson Ranch, California. Vol.2, 731-744 (2004).

[2] Ru, CQ. "Chirality-dependent mechanical behavior of carbon nanotubes based on an anisotropic elastic shell model". Mathematics and Mechanics of Solids (in press), special issue delicated to David Barnett in recognition of his contributions to materials science and elasticity.