Editorial Note on Mechanics of Carbon Nanomaterials

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Received: January 04, 2021; **Accepted:** January 15, 2021; **Published:** January 22, 2021

Citation: Paul M (2021) Editorial Note on Mechanics of Carbon Nanomaterials. J Appl Mech Eng. 10:345. doi: 10.35248/2168-9873.20.9.340 10:345.

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EDITORIAL

Carbon nanomaterials (carbon nanotubes, graphene, etc.) have received significant attention from the academia and industry in the past two decades owing to their superior material properties. Mechanicians have played a major role in the fundamental understanding of the mechanical properties of carbon nanomaterials, and in their wide-range applications.

This focused section on Mechanics of Carbon Nanomaterials represents an important collection of papers from leading mechanicians in this field. The papers cover different materials, properties, and applications, and will serve as good references for young mechanicians to learn the state-of-the-art on mechanics of carbon nanomaterials.

Soon after the discovery of carbon nanotubes, it was realized that the theoretically predicted mechanical properties of these interesting structures–including high strength, high stiffness, low density and structural perfection–could make them ideal for a wealth of technological applications. The experimental verification, and in some cases refutation, of these predictions, along with a number of computer simulation methods applied to their modeling, has led over the past decade to an improved but by no means complete understanding of the mechanics of carbon nanotubes. We review the theoretical predictions and discuss the experimental techniques that are most often used for the challenging tasks of visualizing and manipulating these tiny structures.

We also outline the computational approaches that have been taken, including ab initio quantum mechanical simulations, classical molecular dynamics, and continuum models. The development of multiscale and multiphysics models and simulation tools naturally arises as a result of the link between basic scientific research and engineering application; while this issue is still under intensive study, we present here some of the approaches to this topic. Our concentration throughout is on the exploration of mechanical properties such as Young's modulus, bending stiffness, buckling criteria, and tensile and compressive strengths. Finally, we discuss several examples of exciting applications that take advantage of these properties, including nanoropes, filled nanotubes, nanoelectromechanical systems, nanosensors, and nanotube-reinforced polymers.