SM1L_12455

XXI International Congress of Theoretical and Applied Mechanics
Warsaw, Poland, August 15–21, 2004

Continuum Mechanics and Carbon Nanotubes

Marino Arroyo

Graduate Aeronautical Laboratories, California Institute of Technology, USA

The understanding of the mechanics of atomistic systems has greatly benefited from continuum mechanics. One appealing approach aims at deductively constructing continuum theories starting from models of the interatomic interactions. This viewpoint has become extremely popular with the quasicontinuum method. The application of these ideas to carbon nanotubes presents a peculiarity with respect to usual crystalline materials: their structure relies on a two-dimensional curved lattice. This renders the cornerstone of crystal elasticity, the Cauchy-Born rule, insufficient to describe the effect of curvature. We discuss the application of a theory which corrects this deficiency to the mechanics of carbon nanotubes. We review recent large scale simulations based on this theory, which have unveiled the complex nonlinear elastic response of thick multiwalled carbon nanotubes. We also discuss simplifications of the continuum theory, useful for fast engineering computations, and its application to the prediction of nanotube failure, refining other recent analysis.

View the extended summary