عنوان مقاله:

Structural Mechanics Approach to Investigate the Hyperelastic Mechanical Behavior of Single and Multi-wall Carbon Nanotubes

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نویسندگان:

Masoumeh Rashidi - *Department of Materials Science and Engineering, K. N. Toosi University of Technology, Tehran, Iran*

Keivan Narooei - *Department of Materials Science and Engineering, K. N. Toosi University of Technology, Tehran, Iran*

خلاصه مقاله:

In the current research, a three-dimensional finite element model was considered to predict the mechanical behavior of Single Wall (SWCNTs) and Multi Wall Carbon Nanotubes (MWCNTs). Assuming the nonlinear elastic behavior of C-C bond in large strains, hyperelastic models were considered. Literature review revealed that the material parameters of the hyperelastic models have been determined from the uniaxial tension loading, although the nonlinear elastic behavior is not identical in the tension and compressions. Thereby, the energy-stretch curve of C-C bond was determined from the second-generation Brenner potential in uniaxial tension and compression conditions. The results were fitted to the Ogden, Moony-Rivlin, and Yeoh hyperelastic strain energy functions to derive the material parameter of the mentioned models. The results indicated that the second order Ogden model could describe the tensile and compressive hyperelastic behavior of the C-C bonds accurately. The results of SWCNT bending showed that a unique response could be captured by considering the tension and compression simultaneously in deriving of the material parameters. From the results of SWCNT, the mechanical behavior of MWCNTs were predicted by assuming the Van der Waals bonds between the layers using the Lennard-Jones potential. Results of loading on the external layer of MWCNTs showed that an increase in the layers causes a decrease in the stress so that the stress-strain curves become identical beyond 8 layers. Accordingly, the material parameters of the first order Ogden model were determined for MWCNTs considering the simultaneous response in tension and compression.

کلمات کلیدی:

SWCNT, MWCNT, Hyperelastic, Brenner potential, Lennard Jones potential