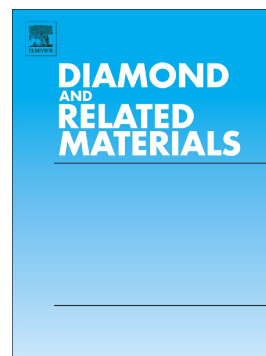


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Thermomechanical buckling of single walled carbon nanotubes by a structural mechanics method

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ABSTRACT

Single walled carbon nanotubes have excellent mechanical properties, are very tough, very rigid, the ability to withstand high working temperatures, and the highest strength-to-weight ratio of any known material. However, their buckling performance under compression and at high temperatures has not been studied to a sufficient extent. The aim of this work is to provide theoretical predictions concerning the compressive buckling response of SWCNTs of different chiralities and sizes under various thermal conditions. For this reason a structural mechanics numerical formulation is adopted that uses the temperature dependent molecular structure of the nanotubes while represents the interatomic interactions within the carbon nanostructures by introducing three dimensional, two-noded, bar finite elements. The temperature dependent stiffness matrices of the utilized finite elements are constructed in accordance with theoretical relationships which are provided by molecular theory. The critical buckling compressive loads and corresponding buckled shapes of variously sized zigzag, chiral, and armchair SWCNTs are thoroughly investigated with respect to the temperature. Then, some significant conclusions are discussed regarding the effect of the temperature, nanotube size and chirality on the structural stability performance of SWCNTs.

Keywords: Nanomaterial; thermomechanical; molecular mechanics; buckling; stability; critical load.

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