 ICCES, vol.9, no.2, pp.95-95

A Rigid-fiber-based Boundary Element Model for Strength Simulation of Carbon Nanotube Reinforced Composites

H. T. Wang[1], Z. H. Yao[2]

Summary

Carbon nanotubes (CNTs) may provide ultimate enhancement in stiffness and strength for composite materials. This paper presents a rigid-fiber-based boundary integral equation formulation for the numerical simulation of debonding process and the corresponding strength of CNT reinforced composites. The CNT/matrix interfaces are assumed to fail when the interfacial shear force reaches a prescribed threshold, and the CNTs and matrix are considered to be detached in the failed areas. The matrix with one or several tens of originally well-bonded CNTs is subjected to an incremental tensile load and the effective stress-strain relations are readily obtained by the introduction of CNT/matrix debonding processes. An equivalent strength of CNT composites is also defined to study the effect of fracture process. In order to analyze considerable CNTs by use of the fast multipole method, a rigid-fiber-related preconditioning technique is introduced to deal with the case of CNT/matrix detachment. The boundary element model is solved on a desktop computer by using both the traditional GMRES solver and the fast multipole method. The impact of several micro-structural parameters on the debonding process and strength of CNT reinforced composites is discussed in the numerical tests, and some results are compared with experimental ones reported in the literature.

keywords: boundary element; carbon nanotubes; composites; strength; fast multipole

[1]Institute of Nuclear & New Energy Technology, Tsinghua University, Beijing, 100084, China. Email: wanght@mail.tsinghua.edu.cn

[2]Corresponding author. School of Aerospace, Tsinghua University, Beijing, 100084, China. Email: demyzh@mail.tsinghua.edu.cn