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Micro- and Nano-mechanics of Carbon Nanotubes Composites

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The constitutive relation and failure of carbon nanotube-reinforced composites are studied using methods of micromechanics and nanomechanics. First, we examined the factors that influence the overall mechanical property of carbon nanotube composites, including the weak bonding between carbon nanotubes and matrix, the curviness and agglomeration of carbon nanotubes. Even though the adhesion strength between the nanotubes and the matrix may significantly affect the strength and failure behavior of composites, its influence on the effective elastic modulus of composites can be negligible. A novel micromechanics model is then developed to consider the waviness or curviness effect and the agglomeration effect of nanotubes on the constitutive relations. It is established that these two mechanisms may significantly reduce the stiffening effect of carbon nanotubes. Second, we established a hybrid continuum/micromechanics/atomistic method theory to investigate the defect nucleation in a carbon nanotube embedded in a polymer matrix. We have given the critical tensile strains of defect nucleation and final fracture, which show a strong dependence on the chiral angle It is found that due to the interaction effect, the fracture strength of a carbon nanotube in a composite is lower than that of a free-standing nanotube.

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