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MODELING THE EFFECTIVE MECHANICAL PROPERTIES OF ''FUZZY FIBER'' COMPOSITES ACROSS SCALES LENGTH

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Abstract

We employ a variant of generalized Eshelby's homogenization method to deduce effective properties of multilayered nanostructured fiber composites where one layer is highly heterogeneous with respect to its mechanical response strain gradients. We focus on carbon (C) fibers coated by carbon nanotubes (CNT) embedded in polymeric matrix with the aid of CNT "blistered" interphase layer developed between the coating and the matrix during processing and/or use.

Each of the three phases is treated for simplicity by classical elasticity, while the interphase layer around the coated fibers ("fuzzy fibers") to provide adhesion, and is treated by the simple gradient elasticity (GradELa) model.

The novelty of the work lies on the fact of treating the CNT "fuzzy" layer by the GradEla model, that consequently allows to consider the extra gradient coefficient or internal length (characterizing this model) in relation to other constitutive and geometric parameters of the composite to optimize its overall mechanical properties and functionality. The method is general and can apply to treat other types of "fuzzy fiber" composites.

Key words: fiber reinforced polymer composites, carbon nanotubes, fuzzy fibers, generalized self-consistent (GSC) method, effective mechanical properties