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Mojtaba Haghgoo, Reza Ansari, Mohammad Kazem Hassanzadeh-Aghdam

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Effective elastoplastic properties of carbon nanotube-reinforced aluminum nanocomposites considering the residual stresses

Mojtaba Haghgoo[1], Reza Ansari[1], Mohammad Kazem Hassanzadeh-Aghdam[2,*]

1- Department of Mechanical Engineering, University of Guilan, Rasht, Iran

2- Department of Mechanical Engineering, Ayandegan Institute of Higher Education, Tonekabon, Iran

Abstract. The residual stresses (RSs) can be generated by the thermal mismatch between the carbon nanotubes (CNTs) and aluminum (Al) matrix during the manufacturing process of this type of nanocomposite materials. It may play a significant role in the strengthening capability of the CNT/Al nanocomposites. In this work, a micromechanics-based method is developed to a comprehensive analyze the effect of thermal RSs on the overall elastoplastic behavior of the CNT/Al nanocomposites. Also, the micromechanical model includes an agglomerated state for the CNTs within the Al nanocomposites. Generally, a good agreement is observed between the results of the present model and available experiment. The results clearly emphasize that for a more realistic prediction in the case of the overall elastoplastic behavior of CNT/Al nanocomposites, the consideration of thermal RSs in the micromechanical analysis is essential. It is found that the thermal RSs can seriously reduce both the yield strength and ultimate tensile strength of the nanocomposites. Moreover, the proposed model is employed to investigate the influences of several important parameters such as volume fraction, aspect ratio and directional behavior of CNTs, degree of CNT agglomeration within the matrix on the elastic modulus, thermal expansion behavior and overall elastoplastic response of CNT-reinforced Al

* Corresponding author, Email: Mk.hassanzadeh@gmail.com, Tel./fax: +98 13 33690276.

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