Tensile Characteristic of CNT-reinforced copper Nanocomposite

† Pengjie Wang[1], Qiang Cao[1, *], and Qing Peng[1, *]

[1]The Institute of Technological Sciences, Wuhan University, Wuhan 430072, China.

*Presenting author: pjwang@whu.edu.cn
†Corresponding author: caoqiang@whu.edu.cn (Q.C.); Qing.Peng@whu.edu.cn (Q.P.)

Abstract

On account of the three-dimension honeycomb structure, carbon nanotube (CNT) has been extensively explored in energy storage and conversion, nanoscale semiconductor fabrication, and high-strength nanocomposite, since its discovery. In the past decade, great attention has been attracted to the CNT-reinforced nanocomposite due to its broad potential applications. In particular, nanocomposite composed of metal-matrix and CNT has been increasingly attractive for research owing to the exceptional characteristics of high Young's modulus and high tensile strength of CNT. It is of great significance to make the CNT-reinforced metallic composite an ideal alternative to the pure metal in industrial fabrications for the lighter mass and higher modulus.

In this paper we investigated the tensile behaviors of the copper nanowire and the CNT/Cu nanocomposite in different cases using molecular dynamic (MD) simulations. For the nanocomposite, we adopted two types of C-C interaction cutoffs for comparison. It is found that the coated and embedded CNTs can increase the Young's modulus and max yield stress of the copper nanowire with varying degrees owing to the excellent loading bearing capacity of the CNT. A reinforcement of 68.7% and 534.7% in the Young's modulus and yield stress respectively, has been reached in the coated case in our models. Furthermore, it is demonstrated that high temperature can significantly reduce the whole strength and stiffness of the CNT/Cu nanocomposite by weakening the lattice intensity. The simulations of varied loading speeds reveal that the CNT/Cu nanocomposite has a higher yield stress with the faster loading speed.

Keywords: CNT/Cu nanocomposite; Tensile process; mechanical properties; Young's modulus; Yield stress