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The study of drawing on the heterogeneous materials for the unidirectional alignment of carbon nanofiber in metal matrix nanocomposite

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Abstract

In current study, Nanocomposites are reinforced with carbon nanofiber, carbon nanotube and SiC, etc. Since the nano reinforcements have the excellent mechanical, thermal and electrical properties compared with that of existing composites, it has lately attracted considerable attention in the various areas. Cu have been widely used as signal transmission materials for electrical electronic components owing to its high electrical conductivity. However, it's size have been limited to small ones due to its poor mechanical properties. Until now, strengthening of the copper alloy was obtained either by the solid solution and precipitation hardening by adding alloy elements or the work hardening by deformation process. Adding the alloy elements lead to reduction of electrical conductivity. In this aspect, if carbon nanofiber is used as reinforcement which have outstanding mechanical strength and electric conductivity, it is possible to develope Cu matrix nanocomposite having almost no loss of electric conductivity. It is expected to be innovative in electric conducting material market. The unidirectional alignment of carbon nanofiber is the most challenging task developing the copper matrix composites of high strength and electric conductivity.

In this study, the unidirectional alignment of carbon nanofibers which is used reinforced material are controlled by drawing process and align mechanism as well as optimized drawing process parameters are verified via numerical analysis. The materials used in this study were pure copper and the nanofibers of 150nm in diameter and of 10~20μm in length. The materials have been tested and the tensile strength was 75MPa with the elongation of 44% for the copper. it is assumed that carbon nanofiber behave like porous elasto-plastic materials. Compaction test was conducted to obtain constitutive properties of carbon nanofiber. Optimal parameter for drawing process was obtained by analytical and numerical analysis considering the various drawing angles, reduction areas, friction coefficient, etc. The lower drawing angles and lower reduction areas provides the less rupture of cu tube is noticed during the drawing process and the better alignment of carbon nanofiber is obtained.

Key Words : carbon nanofiber, metal matrix nanocomposite, Cu, drawing angle, reduction area, unidirectional alignment, heterogeneous material

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