Synthesis and Physical Properties of Macroscale Carbon Nanotube Architectures

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Macroscale carbon nanotube (CNT) architectures such as films and fibers have superior properties and promising application prospects. We synthesize large-area transparent, highly conductive and strong single-walled carbon nanotube(SWNT) films through floating catalyst CVD method, and perform series researches to their physical properties. The correlation between the properties of films and fibers with that of individual carbon nanotubes is also explored. Based on the synthesized SWNT films, macroscale SWNT fibers are fabricated through a twisting process. We record the Raman spectra when the films and fibers are strained, and analyze the micromechanical process based on the change of G' Raman mode, propose the concept of strain transfer factor and its influence on the mechanical performance of macroscale SWNT architectures. By infiltrating polymer molecules into the interspace of the continuous carbon nanotube network, we fabricate novel high-strength composite fibers. Their mechanical properties are tested and correlated with the micromechanical process. We compare the microscale load-transfer manner of such continuous CNT network based composite with that of discrete CNT reinforced composites, and point out the invalidity of rule of mixture coming from traditional composite theory when it is used to predict the mechanical properties of CNT reinforced composites.

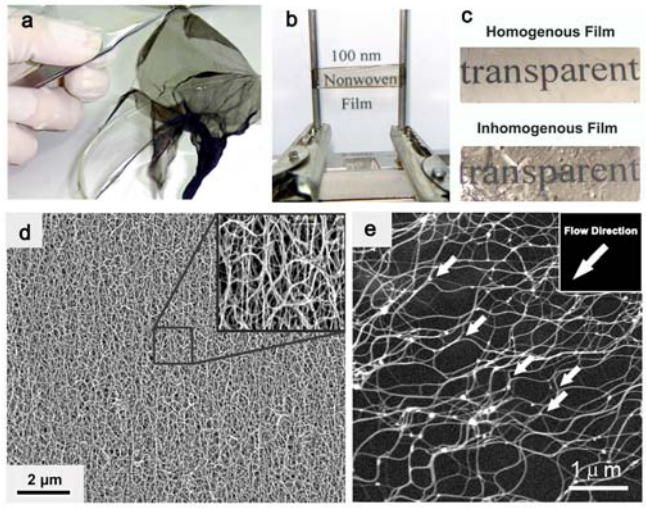

Fig.1 (a) Photo image of an as prepared 250-nm-thick film. (b) A transparent 100-nm-thick film freely stands between metallic pillars. (c) 150-nm-thick homogenous (upper one) and inhomogeneous films. The importance of homogeneity is obvious. (d) Large scale SEM image of a 250-nm-thick film. The inset image is taken at higher magnification. (e) SEM image of SWNT network in a single layer. The white arrows in the image point out the Y-type junctions and the flow direction.

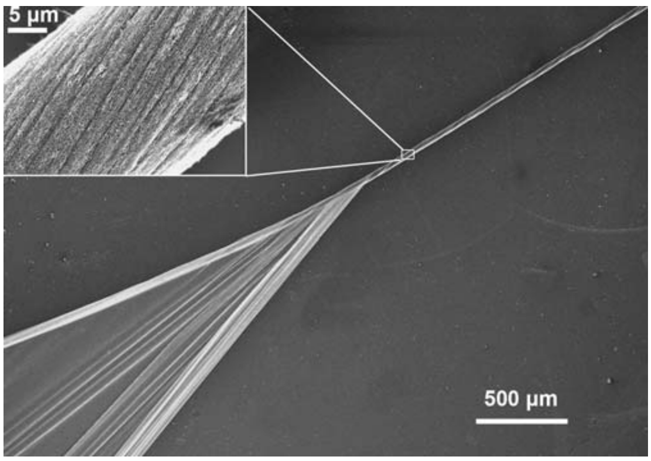

Fig.2 SEM image shows a piece of as-grown film with width of 2 mm and thickness of 200 nm being twisted into a fiber.

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References

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