In situ Observation of Ni Catalyzed Bamboo-like Carbon Nanotubes Growth by Current-Induced Annealing

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Over a past few decades, carbon nanotubes (CNTs) have attracted much attention for their unique properties, although their formation mechanism is not well understood. Recent advances in in situ techniques now open up the new possibility of studying solid phase interaction at atomic level. Here, we report the direct observation of bamboo-like CNTs formation by in situ transmission electron microscopy (TEM) [1]. In our approach, nickel incorporated carbon nanofiber (Ni-CNF) was grown on the edge of graphite foil by ion irradiation of Ar⁺ at room temperature [2]. Ni-CNF then was mounted on cathode microprobe and bamboo-like CNTs formation was investigated during current-voltage (I-V) measurement. TEM images revealed that the Ni-CNF was amorphous and polycrystalline in nature initially, and the current flow in I-V process induced the dramatic change in the crystalline structure of CNF; formed bamboo-like CNTs. The nickel metal platelets agglomerated during the I-V process and disappeared to leave the crystalline bamboo-like CNTs structure. The structural transformation resulted in improvement of electrical properties where the current produced was remarkably increased, which is 30µA.

Fig. 1 (a) TEM image of Ni-CNF before current flow. (b) TEM image of bamboo-like CNTs formed after current flow. (c) I-V plot of Ni-CNF during current flow.

References: