

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

Nagoya Inst. of Tech.¹, Univ. Pend. Sultan Idris², Univ. Putra Malaysia³, Univ. Tech. Malaysia⁴

[✉]M.S. Rosmi^{1, 2}, Y. Yaakob^{1, 3}, M. Zamri^{1, 4}, G. Kalita¹ and M. Tanemura¹

E-mail: saufirosmi@gmail.com

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.

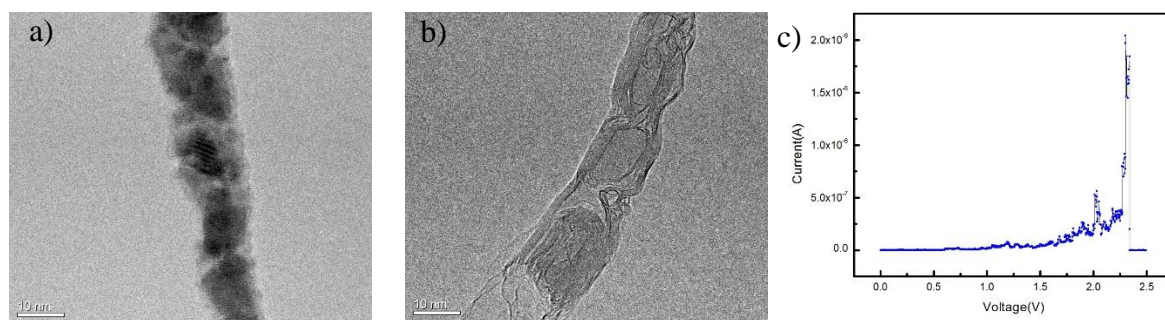


Fig. 1 (a) TEM image of Ni-CNF before current flow. (b) TEM image of bamboo-like CNTs formed after current flow. (c) I-V plot of Ni-CNF during current flow.

References:

- [1] M. Zamri, et al, ACS Nano **2012**, 6, 9567-9573.
- [2] M. Tanemura et al, Appl. Phys. Lett. **2004**, 84, 3831-3833.