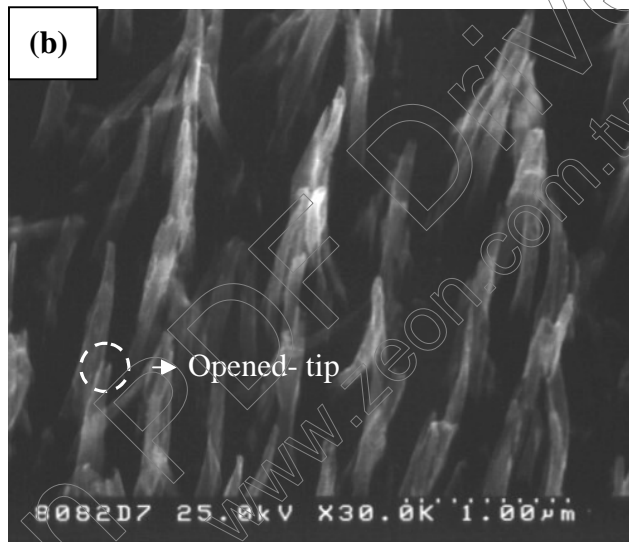


Top view (7 min H-plasma etching + 3 min chemical etching)



Side view (7 min H-plasma etching + 3 min chemical etching)

Figs. 4-4 Effect of H-plasma post-treatment and chemical etching on rattan-like CNTs morphology. (a) and (b) are the top view and side view SEM images of rattan-like CNTs post-treated by 7 min H-plasma etching and followed by 3 min chemical etching (Con. 6), respectively.

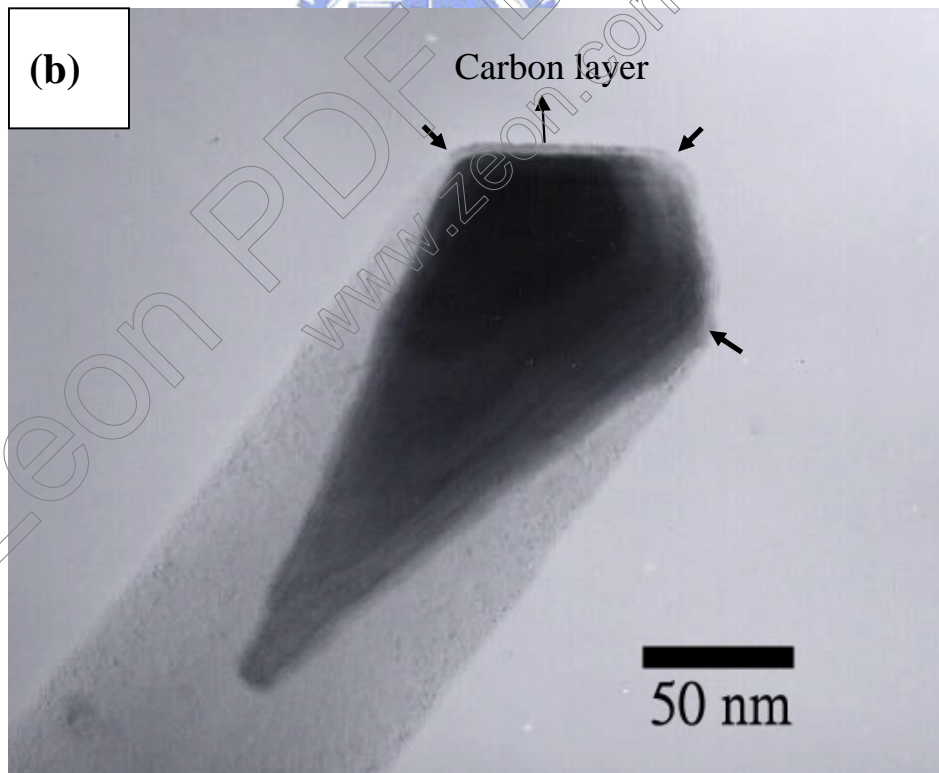
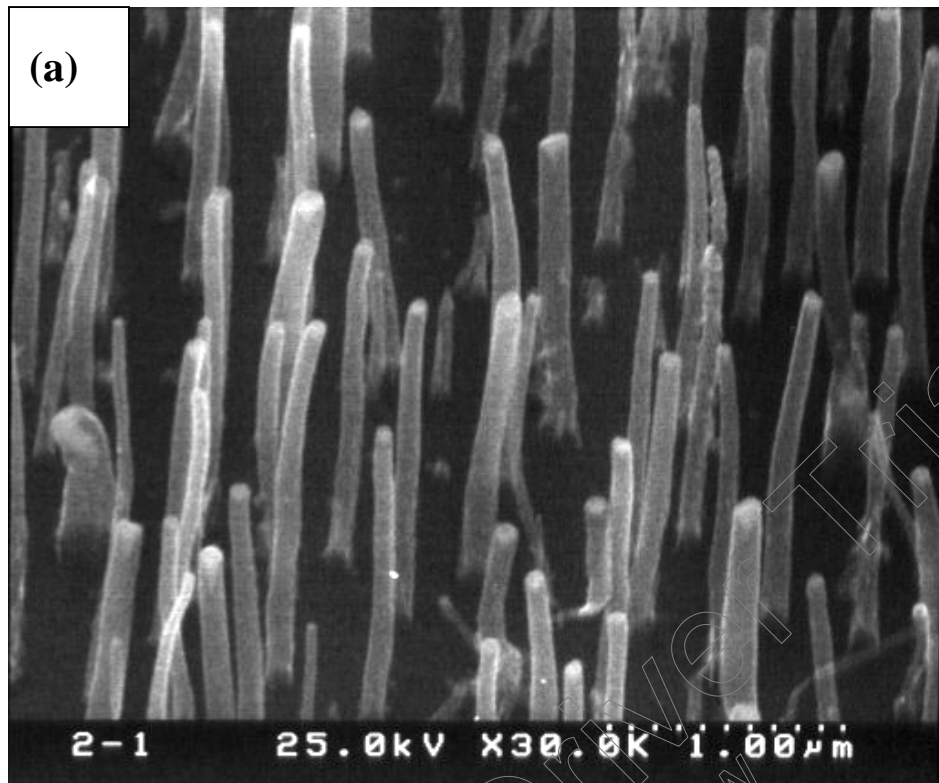
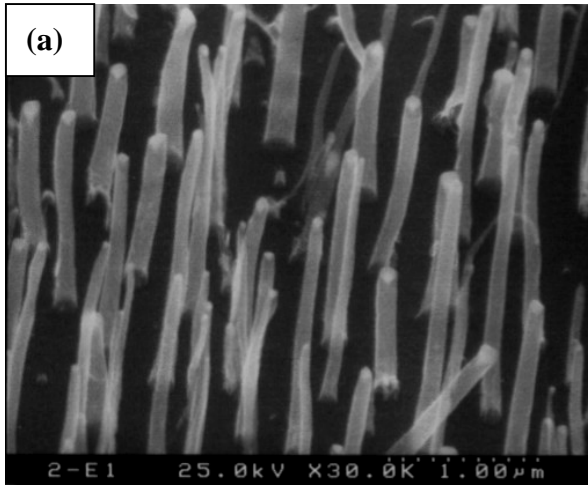
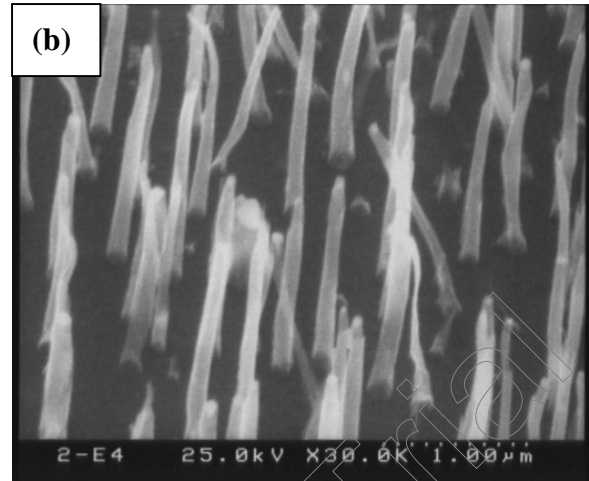


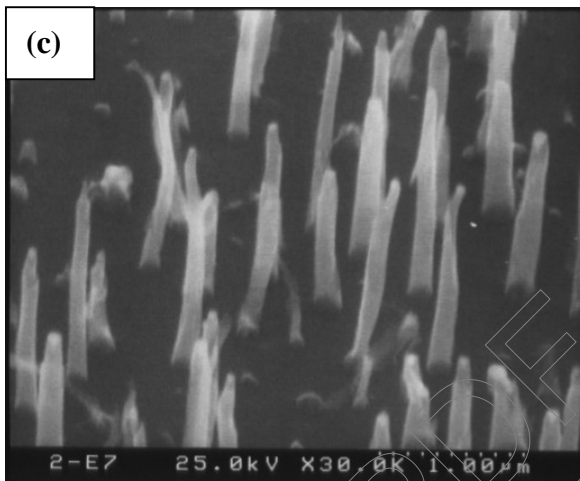
Fig. 4-5 (a) TEM and (b) SEM micrographs of as-grown CNTs with tip carbon layer (Specimen C1). Arrows mark the strained regions with largest curvature.



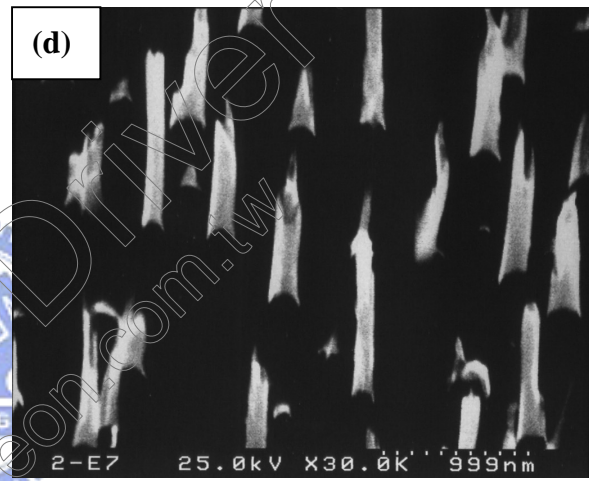
1 min H-plasma post-treatment



4 min H-plasma post-treatment



7 min H-plasma post-treatment



10 min H-plasma post-treatment

Figs. 4-6 The SEM morphologies of the CNTs after different H-plasma post-treatment times: (a) 1 min (Con. 1), (b) 4 min (Con. 4), (c) 7 min (Con. 5) and (d) 10 min (Con.7). (Specimen C1)

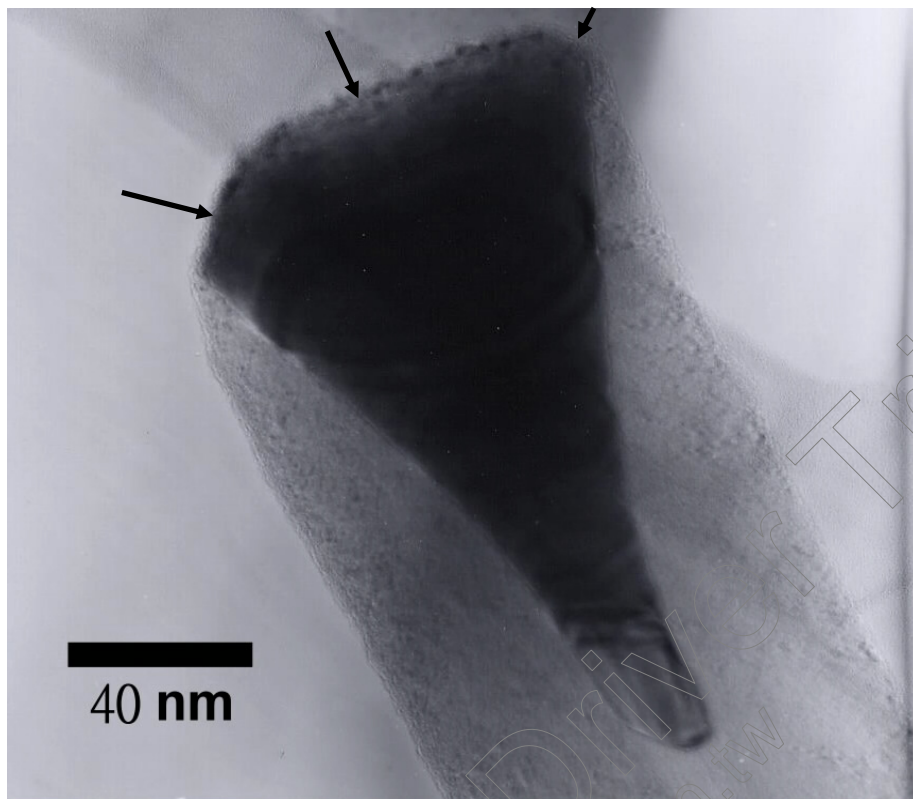


Fig. 4-7 TEM image of CNTs etched by H-plasma for 1 min (Specimen C1, Con. 1). Carbon layers have been removed. Arrows mark the preferred etched region.

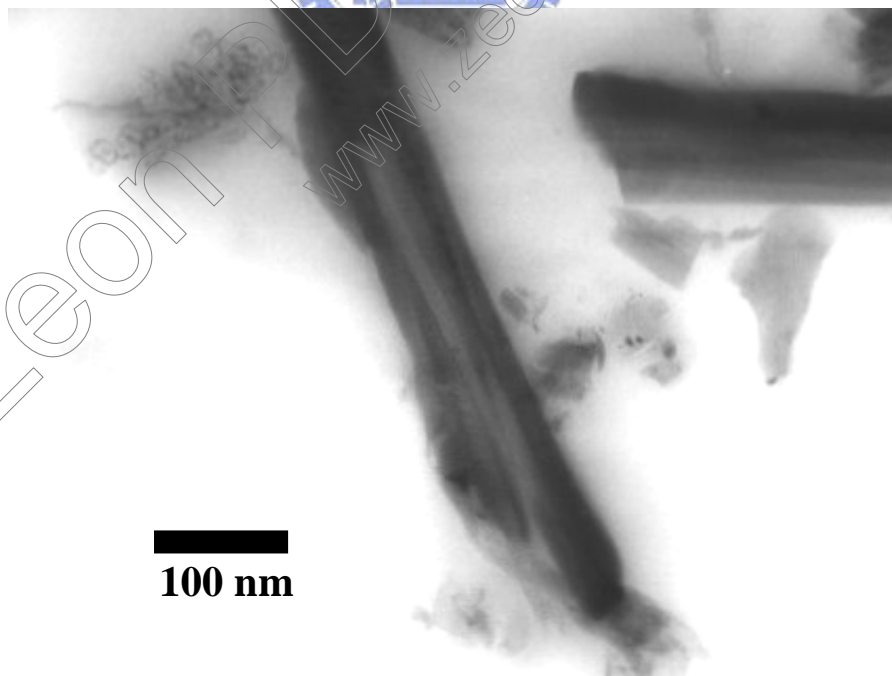
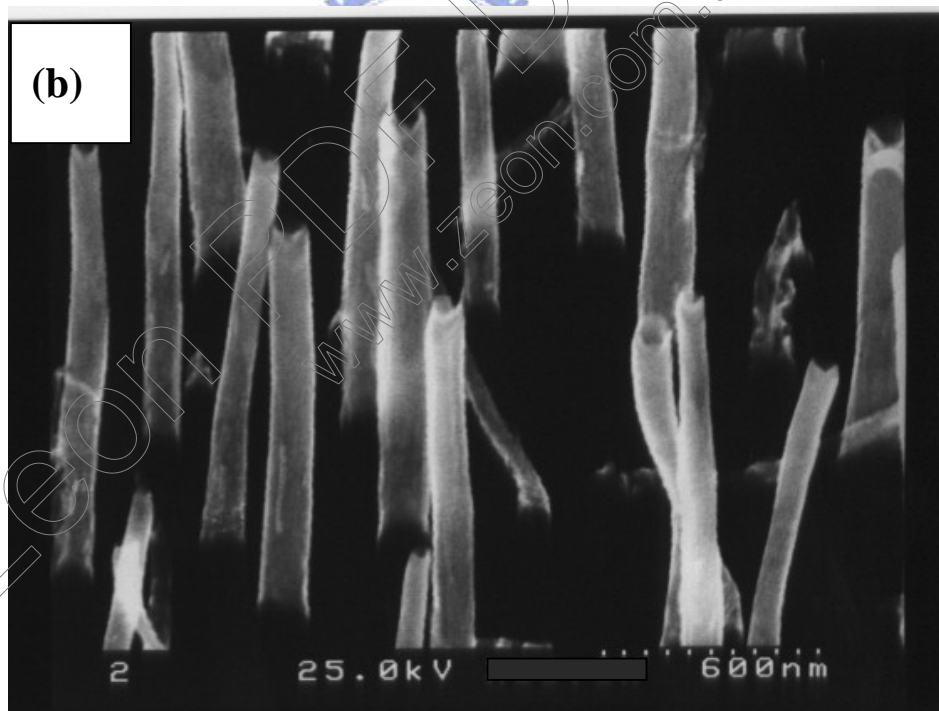


Fig. 4-8 TEM image of the CNTs etched by H-plasma for 10 min (Specimen C1, Con. 7).



1 min H-plasma etching + 2 min chemical etching



1 min H-plasma etching + 3 min chemical etching

Fig. 4-9 SEM morphologies of post-treated CNTs (a) H-plasma etched for 1 min and chemical etched for 2 min (Con. 2), (b) H-plasma etched for 1 min and chemical etched for 3 min (Con. 3). (Specimen C1)

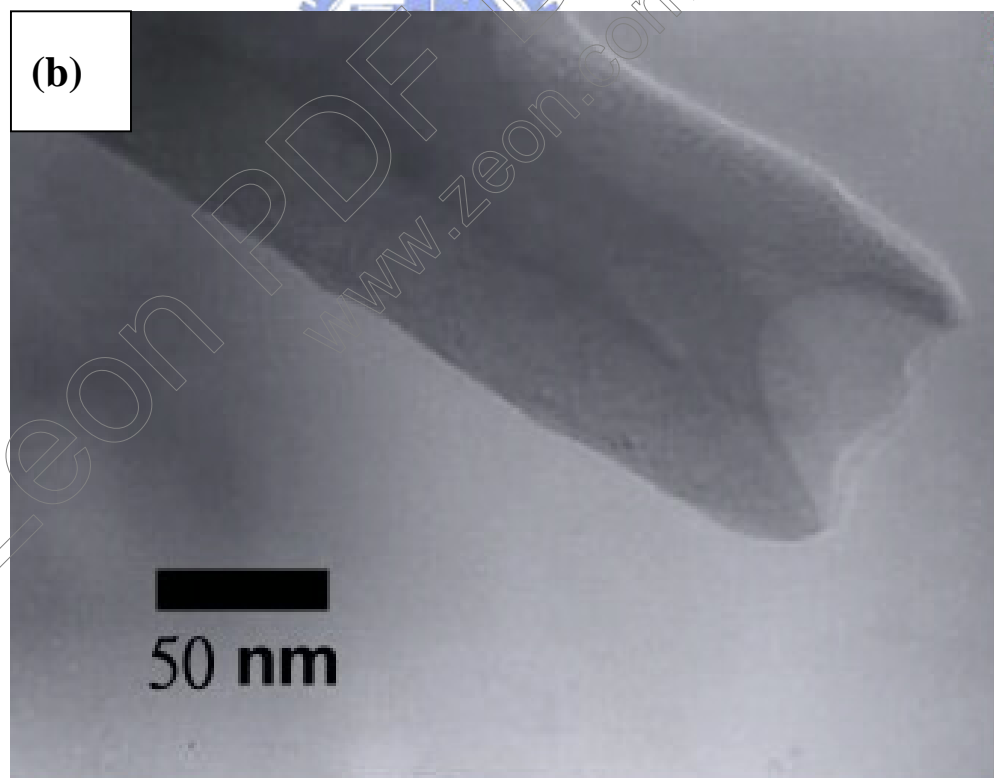
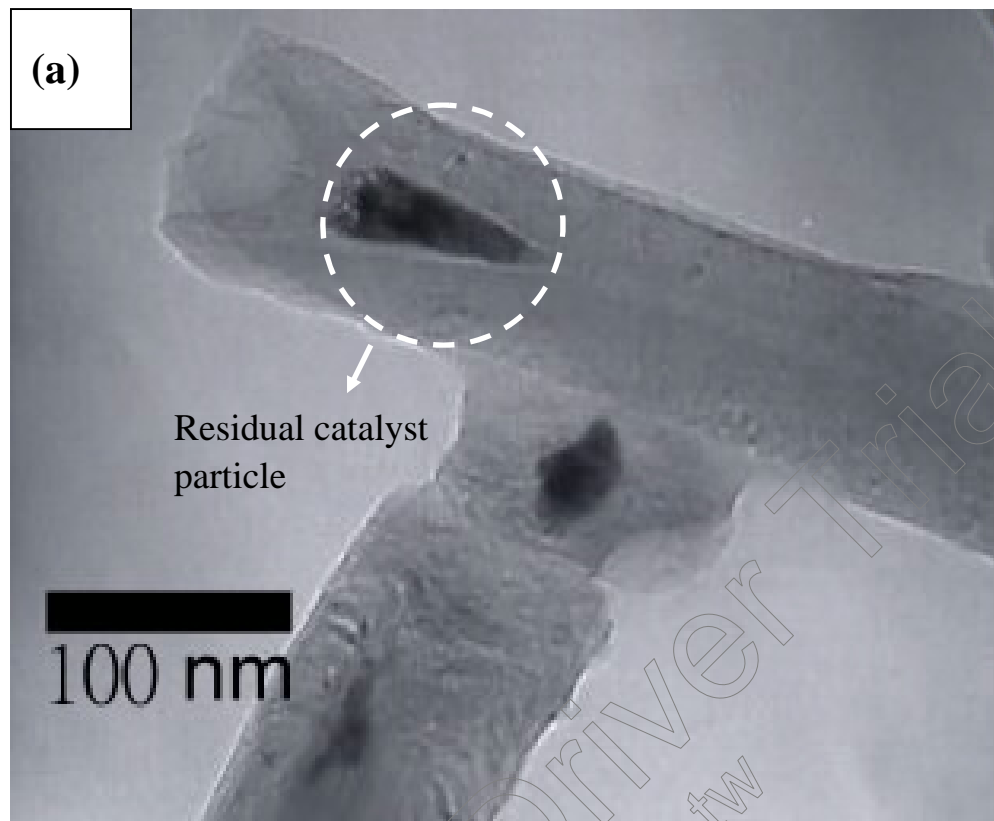
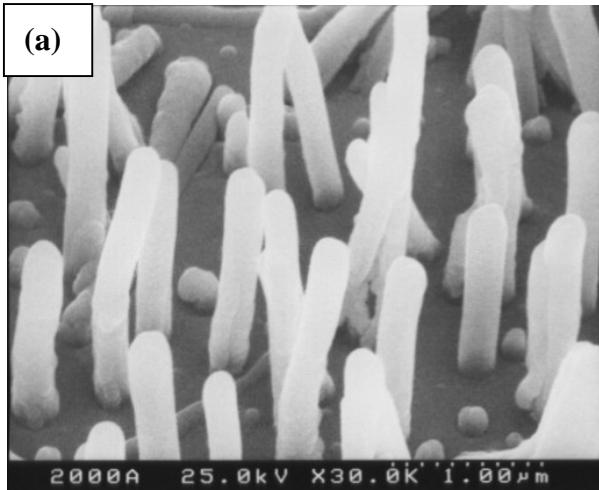
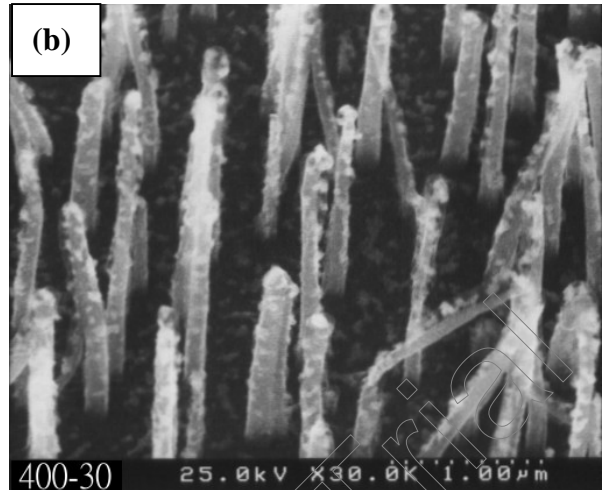


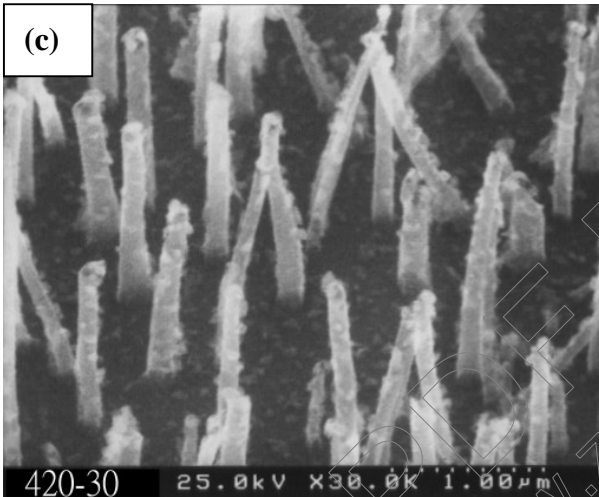
Fig. 4-10 Effect of chemical etching time on the catalyst. (a) and (b) are the corresponding TEM micrographs of Fig. 4-9 (a) and (b), respectively.



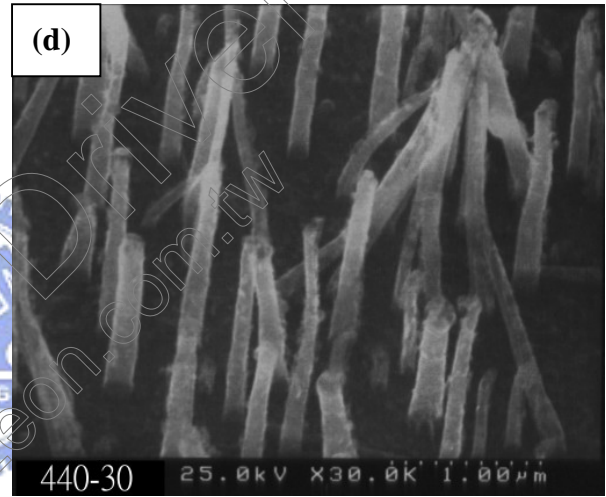
As- alloy-sputtered CNTs



400°C heating for 30 min



420°C heating for 30 min



440°C heating for 30 min

Fig. 4-11 SEM images of open-ended CNTs covered with 200 nm phase-change alloy, (a) as-alloy-sputtered CNTs, (b) after 400°C heating for 30 min, (c) after 420°C heating for 30 min, and (d) after 440°C heating for 30 min.

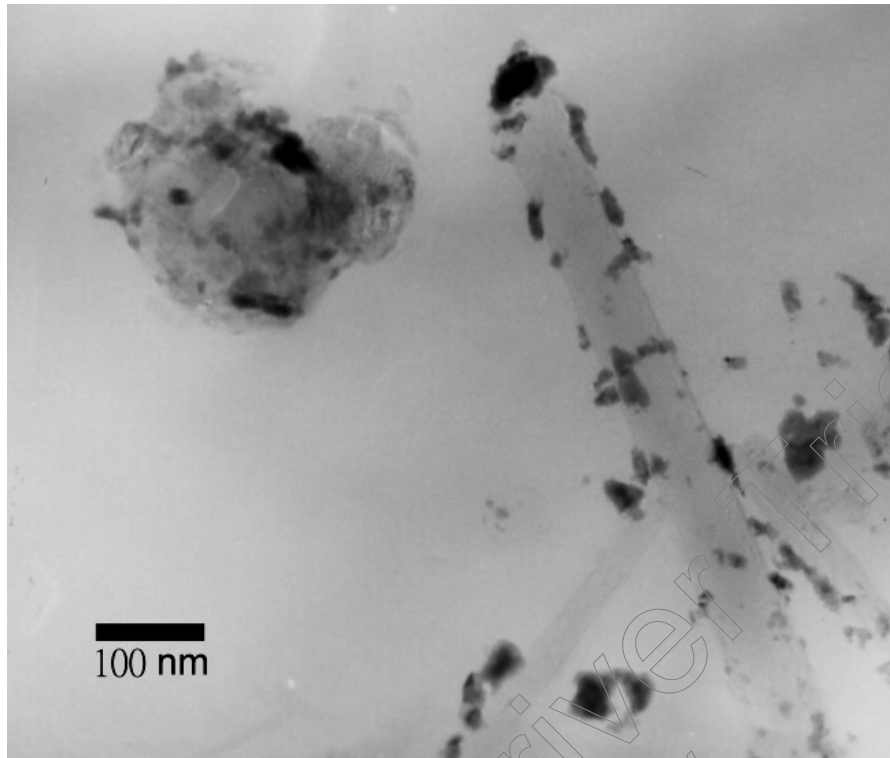


Fig. 4-12 The corresponding TEM micrograph of Fig. 4-11 (b).

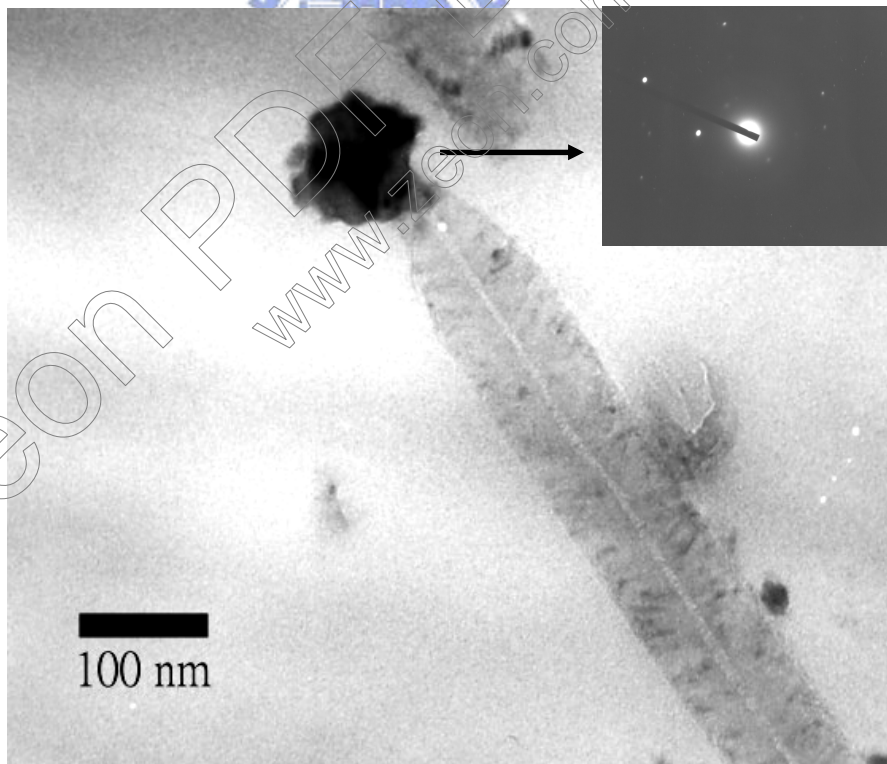


Fig. 4-13 The corresponding TEM micrograph of Fig. 4-11 (c). The upper right insert showed the selected-area electron diffraction (SAED) pattern of the residual phase-change alloy on CNTs tip.

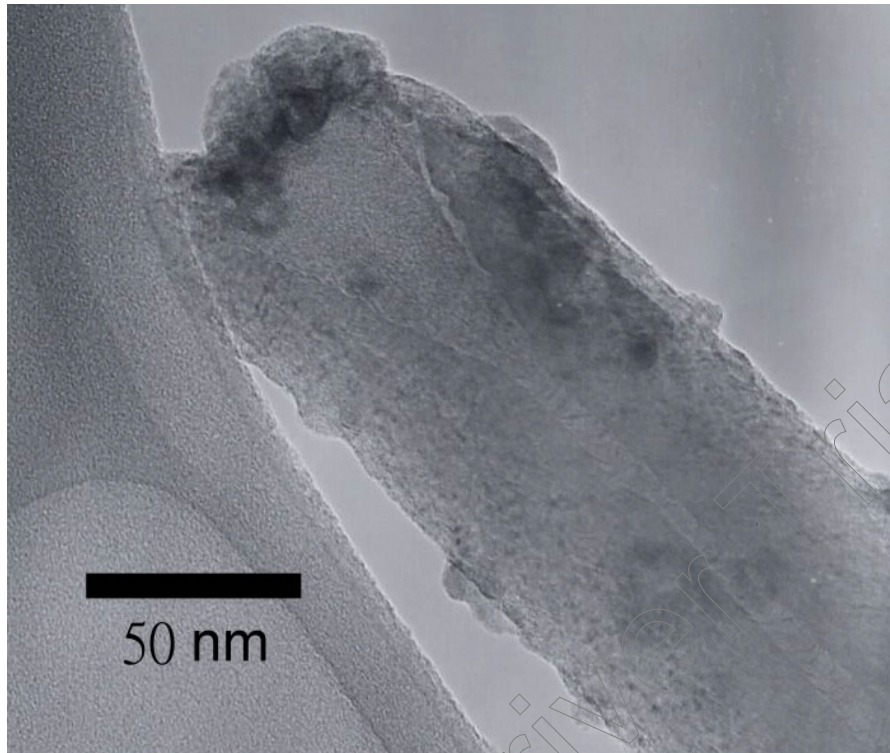


Fig. 4-14 The corresponding TEM micrograph of Fig. 4-11 (d).

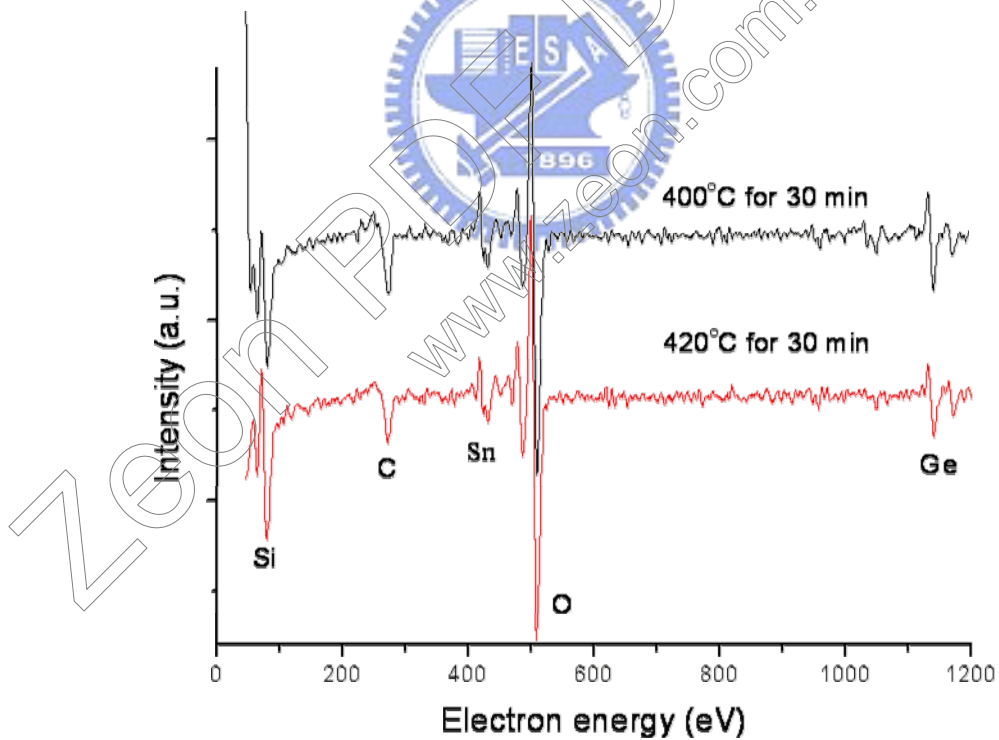


Fig. 4-15 The upper and under Auger spectra represent residual phase-change alloy on tips of open-ended CNTs covered 200 nm phase-change alloy post-treated by 400°C heating for 30 min and 420°C heating for 30 min, respectively.