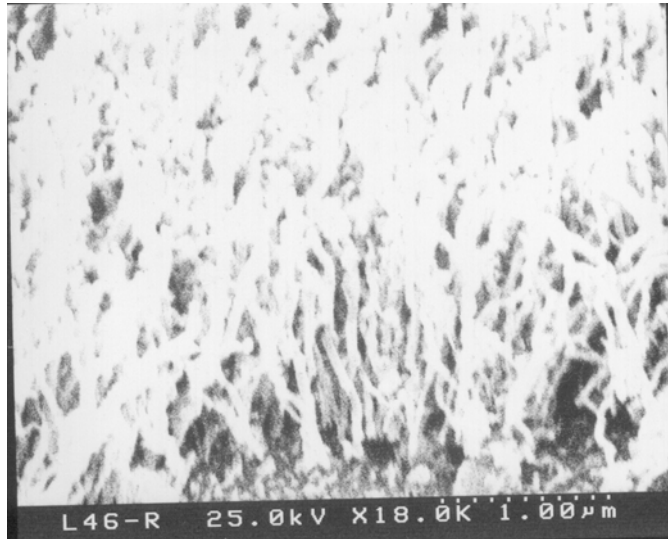
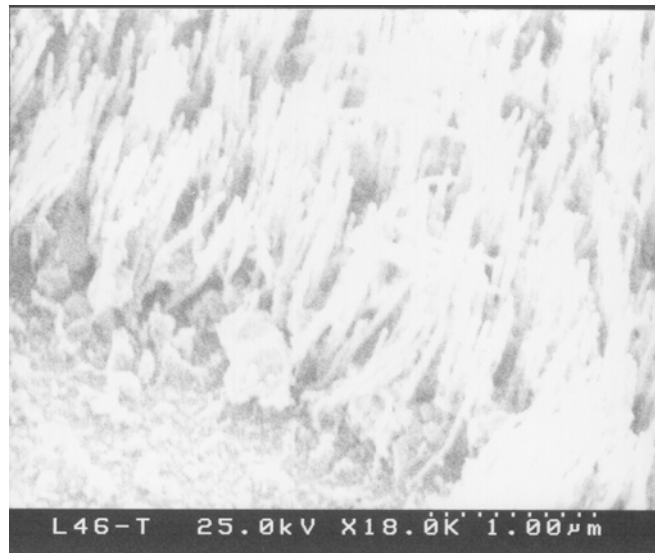


圖 4.1 觸媒薄膜經過前處理後 AFM 觀察顆粒大小

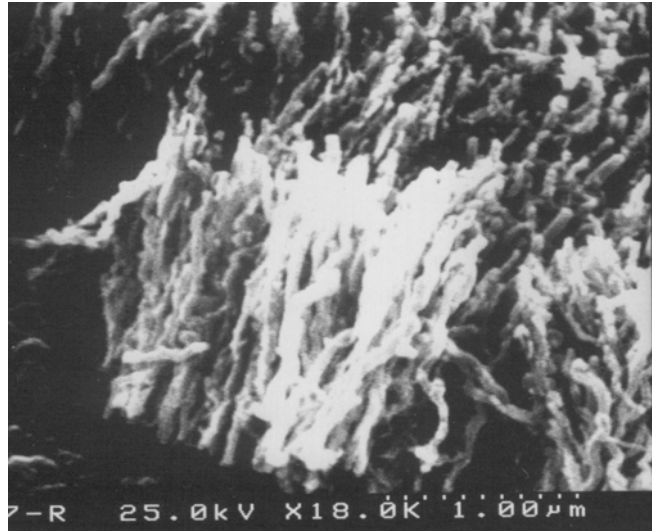


(a)

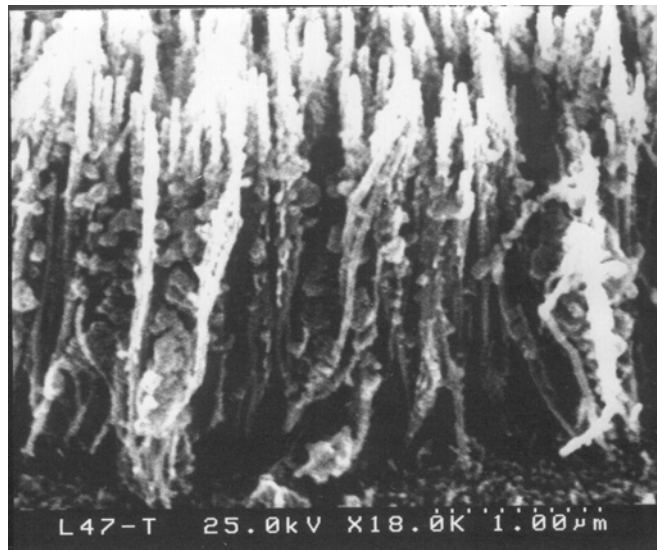


(b)

圖 4.2 (a)鎳觸媒 和(b)鈷觸媒以甲烷為碳源成長 30 分鐘初成長  
CNTs 之 SEM 形貌(試片編號分別為 A1, B1)



(a)

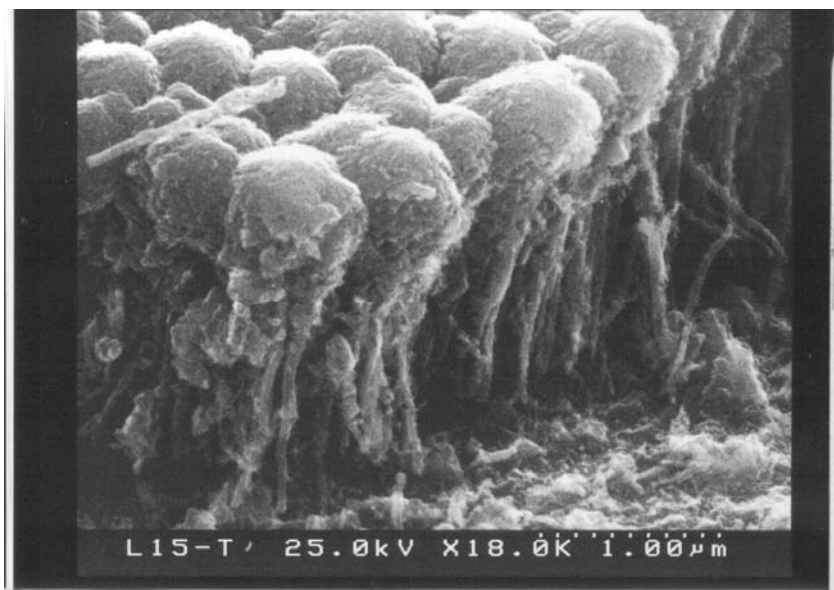


(b)

圖 4.3 (a)鎳觸媒 和(b)鈷觸媒將乙炔控制載入比例降到 25%，成長  
30 分鐘初成長 CNTs 之 SEM 形貌  
(試片編號分別為 A2, B2)

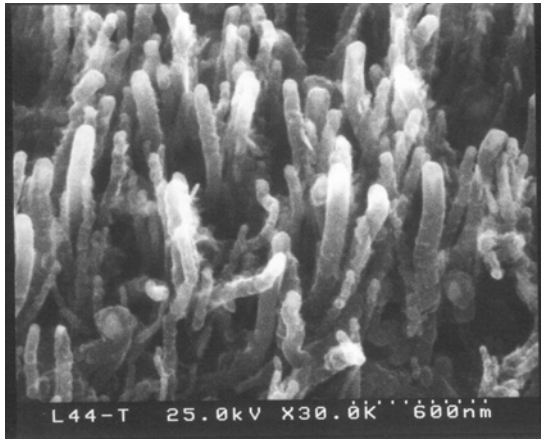


(a)

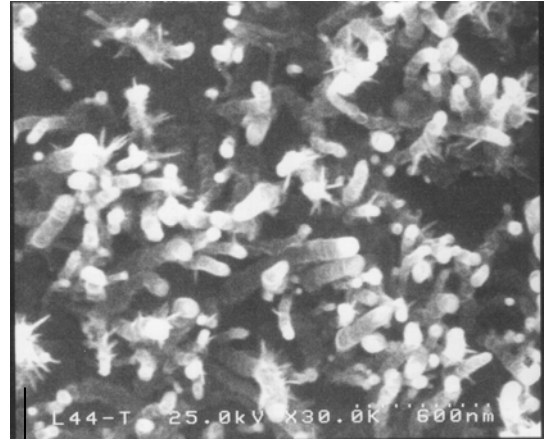


(b)

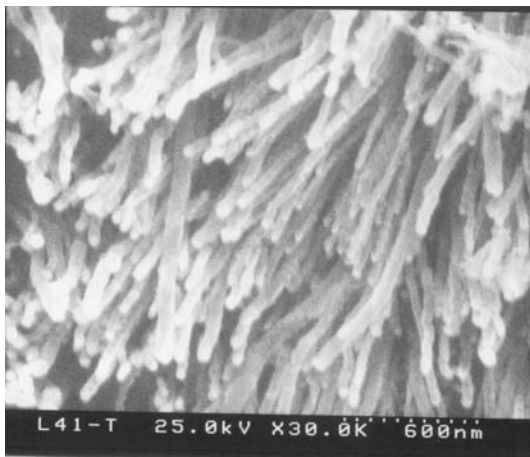
圖 4.4 鈷觸媒載入碳源(a) $C_2H_2/H_2=10/20$  sccm/ sccm 成長 30 min, (b)先以  $CH_4/H_2=10/20$  sccm/ sccm 成長 25 min,再通入  $C_2H_2/H_2$  同比例成長 25 min 初成長 CNTs 之 SEM 形貌 (試片編號分別為 C3, B4)



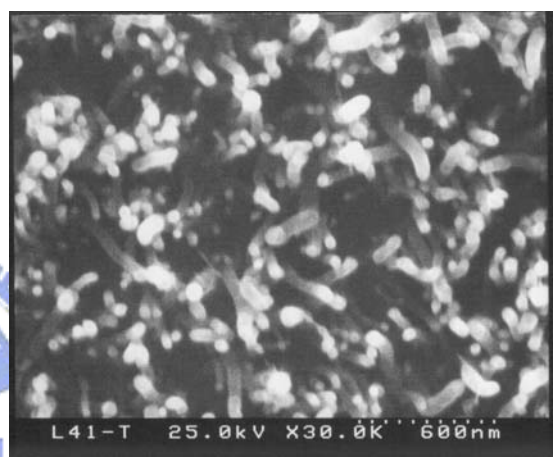
(a) 側視圖



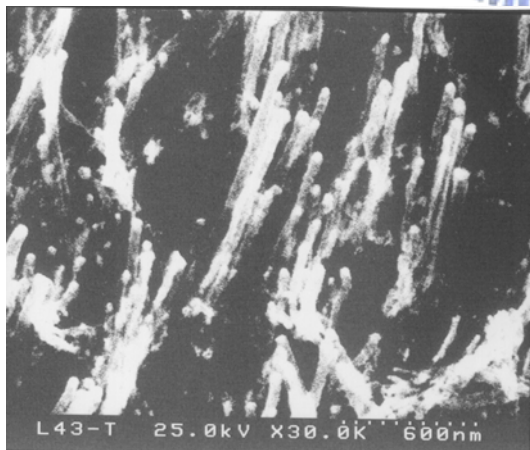
↓ 碳膜沉澱 (d) 俯視圖



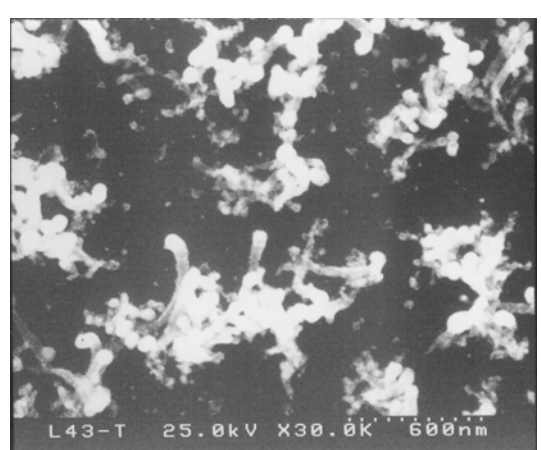
(b) 側視圖



(e) 俯視圖



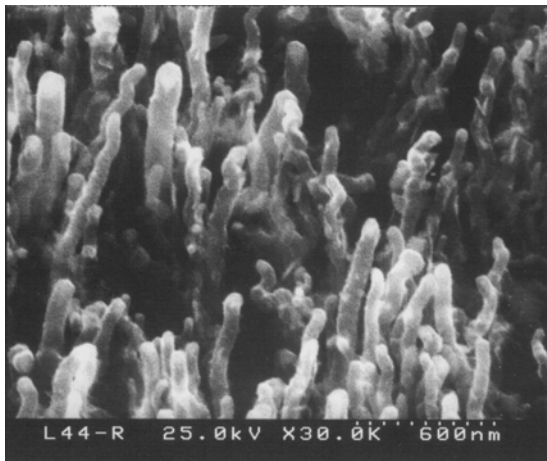
(c) 側視圖



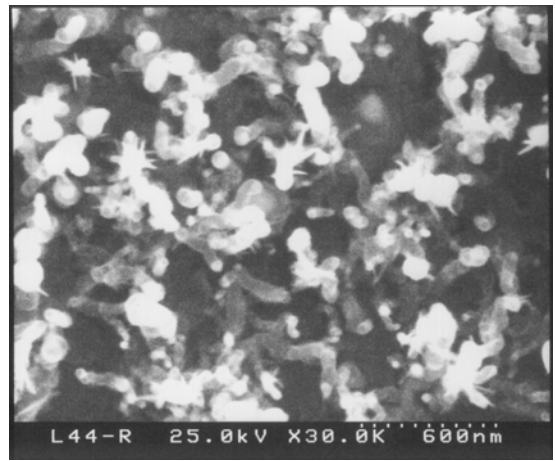
(f) 俯視圖

圖 4.5 以鈷觸媒在不同 CH<sub>4</sub>/H<sub>2</sub> 比例下,初成長 CNTs 之 SEM 形貌變化, (a)&(d) 20/2, (b)&(e) 11/11 和(c)& (f) 2/20 sccm/sccm (試片編號分別為 B5, B6 和 B7)

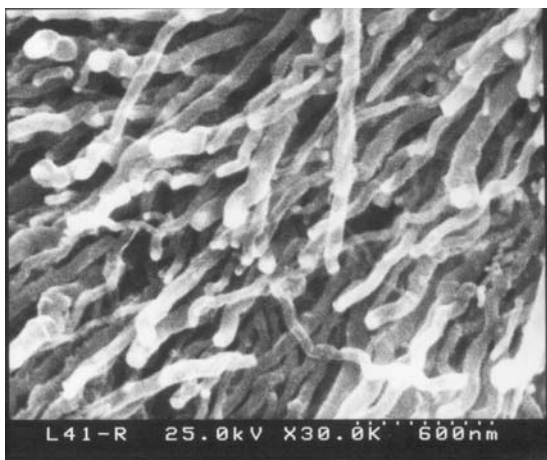




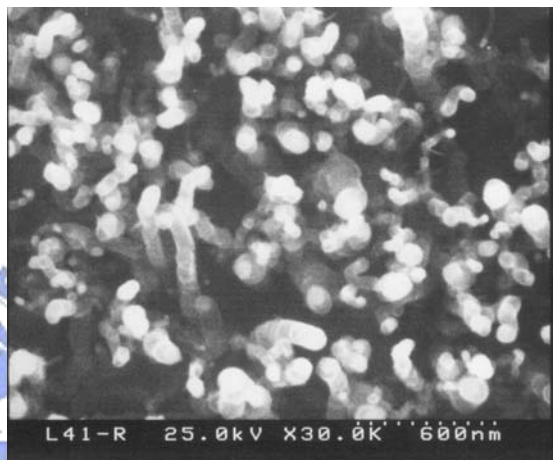
(a) 側視圖



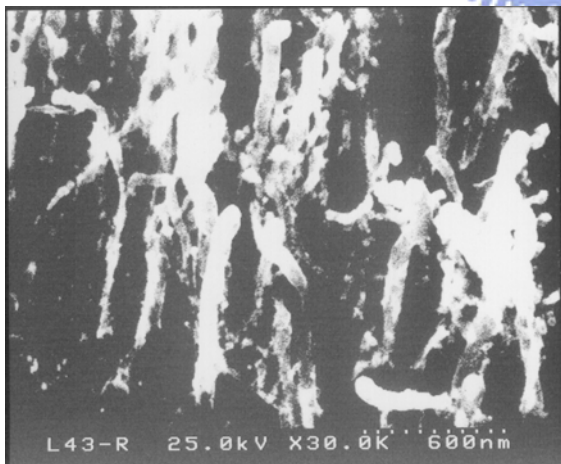
(d) 俯視圖



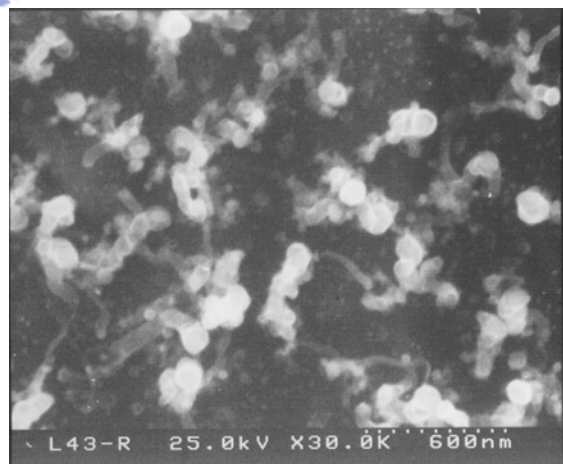
(b) 側視圖



(e) 俯視圖



(c) 側視圖



(f) 俯視圖

圖 4.6 以鎳觸媒在不同  $\text{CH}_4/\text{H}_2$  比例下,初成長 CNTs 之 SEM 形貌變化,

(a)&(d) 20/2, (b)&(e) 11/11 和(c)& (f) 2/20 sccm/sccm

(試片編號分別為 A5, A6 和 A7)