表 2-1 以電弧放電法合成的碳包覆奈米磁性粒子之磁性性質。[Sun 00-157]

	T(K)	M_s (emu/g)	M_r (emu/g)	H_c (Oe)	d (nm)
Fe(C)	300	82.08	20.77	626	15±2
Co(C)	300	89.4	24.89	703	12.5±2
Ni(C)	300	8.55	2.59	295.5	11.5±2

表 2-2 記錄媒體每一記錄單位(bit)之特性尺寸[郭 04-P.1-9]

650 M Byte CD	→	$(1.27)^2$ μm^2/bit
4.7 G byte DVD	→	$(0.47)^2$ μm^2/bit
10 G byte/inch^2	→	$(0.25)^2$ μm^2/bit
20 G byte/inch^2	→	$(0.18)^2$ μm^2/bit
50 G byte/inch^2	→	$(0.13)^2$ μm^2/bit
100 G byte/inch^2	→	$(0.10)^2$ μm^2/bit

表 2-3 Fe、Co、Ni、Fe_3O_4 及 γ-Fe_2O_3 磁域之臨界尺寸 D_c[Leslie-1996-1770]

Material	**D_c(nm)**
Fe	14
Co	70
Ni	55
Fe_3O_4	128
r-Fe_2O_3	166

表 3-1 試片編號及其製程條件

Specimem designation[#]	Substrate temperature(℃)		CNTs growth conditions*		Remarks
	Pretreatment[^]	CNTs* Deposition	H_2/CH_4 (sccm)	Bias (V)	
A1	643	672	11/3	-150	Fig4-1(a) Fig4-2(a)
A2	641	668	15/3	-150	Fig4-1(b)
A3	643	667	20/3	-150	Fig4-1(c)
B2[+]	640	662	11/2	-150	Fig4-2(b)
B3	641	665	11/1	-150	Fig4-2(c)
C1	646	674	15/1	-150	Fig4-3(a)
C2	640	666	15/1	-100	Fig4-3(b)
C3	642	667	15/1	-50	Fig4-3(c)

Notes：

[#]Substrate：Si (100) wafer；Method of preparation of the catalyst preparation：sputtering

[^]Other H-plasma pretreatment condition：
H_2=11 sccm；magnetic field, 875 Gauss；microwave power, 800W；work pressure ~10^{-3} torr and H_2 flow rate ,11 sccm for 10 min.

*Other CNTs deposition conditions：
magnetic field, 875 Gauss；work pressure ~10^{-3} torr and microwave power, 800 W for 5 min.

[+]Conditions of post magnetic annealing treatment for specimen B2：
Work pressure~10^{-3} torr；magnetic field intensity 875 Gauss and substrate temperature 640^0C for 4 hour.

表 4-1 不同製程條件所成長碳奈米管之形貌比較表

Specimem designation	Length (nm)	Diameter (nm)	Tube number density (Gtube/inch^2)	CNTs morphology	Remarks
A1	855	100	14.2	Tubule-like + a-C	Fig4-1(a)
A2	447	63	15.5	Tubule-like + a-C	Fig4-1(b)
A3	178	54	23.2	Short tubule -like+ a-C	Fig4-1(c)
B2	550	88	20.6	Tubule-like + a-C	Fig4-2(b)
B3	289	55	21.9	Short tubule -like+ a-C	Fig4-2(c)
C1	178	52.7	28.4	Short tubule -like+ a-C	Fig4-3(a)
C2	150-225	40-157.5	18	Particle-like + a-C	Fig4-3(b)
C3	-	-	-	Petal-like Carbon film	Fig4-3(c)
$^+$Post-treated B2	550	54	23.2	Pure CNT	Fig 4-13(b)

Note:

$^+$Conditions of post magnetic annealing treatment for specimen B2：
Work pressure~10^{-3} torr；magnetic field intensity 875 Gauss and substrate temperature 640^0C for 4 hour.

a-C = amorphous carbon

表 4-2　碳奈米管經磁性退火後之特性比較表(試片編號：B2)

Features		**As grown CNTs**	**Post-treated CNTs**$^{\odot}$	**Remarks**
SEM morphology		CNTs+ a-C	Pure CNTs	Fig 4-13(a) Fig 4-13(b)
XRD features		Fe(BCC) Fe_3C(Simple Orthorhombic) Diamond(FCC)	Fe_3C(Simple Orthorhombic) Diamond(FCC)	Fig 4-11
Raman (I_G/I_D)	height	0.92	0.96	Fig 4-12
	area	0.78	0.89	
H_C (Oe)	T=350K	356	306	Fig 4-20(c) Fig 4-21(c)
	T=300K	360	310	Fig 4-20(b) Fig 4-21(b)
	T=10K	372	340	Fig 4-20(a) Fig 4-21(a)
M-T curve		T ↑ ⇨ M ↓	T ↑ ⇨ M ↓	Fig 4-19
Turn On voltage* (V/*m* m)		10.02	5.8	Fig 4-22 Fig 4-23
Threshold voltage$^{\#}$ (V/μm)		-	9.18	Fig 4-22 Fig 4-23
Current density^{+} (mA/cm^2)		$2.51*10^{-4}$	22.05	Fig 4-22 Fig 4-23

Notes：

$^{\odot}$Conditions of post magnetic annealing treatment for specimen B2：Work pressure~10^{-3} torr；magnetic field intensity 875 Gauss and substrate temperature 640^0C for 4 hour.

*Turn on voltage represents the value of voltage at emission current density = 0.01 mA/cm^2.

$^{\#}$Threshold voltage represents the value of voltage at emission current

density = 10 mA/cm^2.

$^+$Current density represents the value of emission current density at applied field = 10 V/ μ m.

M-T : magnetization versus temperature

a-C = amorphous carbon