Table 3-1 Process conditions of hydrogen plasma pretreatment for Co-coated Si substrate

Condition designation	Pressure (Torr)	Microwave power (Watt)	Substrate temperature (℃)	Average Co catalyst size (nm)	Morphology of as-pretreated surface
PT1	9	400	497	20~70	Fig.4-1(a) (b)
PT2	16		517	30~90	Fig.4-1(c) (d)
PT3	23		534	40~95	Fig.4-2(a) (b)
PT4	30		545	40~95	Fig.4-2(c) (d)
PT5	9	500	557	30~80	Fig.4-3(c) (d)
PT6		600	587	>100	Fig.4-3(a) (b)
PT7		700	606	>100	Fig.4-4(c) (d)

NOTE:

Substrate: 10 nm-cobalt-coated silicon [(100) P-type] wafer.

Other pretreatment conditions: H_2 flow rate 100 sccm for 10 min.

Table 3-2 Specimen designation of the as-grown CNTs on silicon wafer and their process conditions.

Specimen designation	Gas flow ratio (sccm/sccm)	Substrate temperature (℃)	Time (min)	Bias (V)	CNTs orientation	As-grown CNTs morphology
A1	H_2/CH_4 (80/3)	702	10	0	random	Fig.4-5(a)
A2	Ar/C_2H_2 (80/5)	680			aligned	Fig.4-5(b)
A3	NH_3/C_2H_2 (160/40)	695			aligned	Fig.4-5(c)
A4	$NH_3/N_2/C_2H_2$ (110/50/40)	695	5	0	aligned	Fig.4-8(a)
A5		695	10		aligned	Fig.4-8(b)
A6		710	15		aligned	Fig.4-8(c)
A7		688	10	-50	aligned	Fig.4-7(b)
A8		683		-150	aligned	Fig.4-7(c)
A9		685		-250	aligned	Fig.4-7(d)

NOTE:

Substrate: 10 nm-cobalt-coated silicon [(100) P-type] wafer.

Pretreatment conditions: PT1, as shown in Table 3-1.

Other CNTs deposition conditions: microwave power 800 W, pressure 16 Torr.

Table 3-3 Process conditions of plasma post-treatment for CNTs of Specimen A5

Condition designation	Gas to generate plasma	Substrate temperature(℃)	Post-treated CNTs morphology
OT1	hydrogen	480	Fig.4-14(a) (b)
OT2	nitrogen	460	Fig.4-15(a) (b)
OT3	argon	355	Fig.4-16(a) (b)
OT4	ammonia	490	Fig.4-17(a) (b)

NOTE: Other post-treatment conditions: flow rate 100 sccm, pressure 9 Torr, microwave power 400 W, process time 5 min.

Table 3-4 Specimen designation of as-grown CNCs on silicon wafer and their process conditions.

<table>
<tr><th>Specimen designation</th><th colspan="2">Ratio of gas flow rates (sccm/sccm)</th><th>Substrate temperature (℃)</th><th>Time (min)</th><th>Bias (V)</th><th>As-grown CNCs morphology</th></tr>
<tr><td>B1</td><td colspan="2" rowspan="5">H_2/CH_4 (80/5)</td><td>624</td><td rowspan="5">10</td><td>0</td><td>Fig.4-23(a)</td></tr>
<tr><td>B2</td><td>644</td><td>-50</td><td>Fig.4-23(b)</td></tr>
<tr><td>B3</td><td>637</td><td>-150</td><td>Fig.4-23(c)</td></tr>
<tr><td>B4</td><td>640</td><td>-200</td><td>Fig.4-23(d)</td></tr>
<tr><td>B5</td><td>646</td><td>-300</td><td>Fig.4-23(e)</td></tr>
<tr><td>B6</td><td rowspan="4">H_2/CH_4</td><td>(80/1)</td><td>645</td><td rowspan="4">10</td><td rowspan="4">-200</td><td>Fig.4-25(a)</td></tr>
<tr><td>B7</td><td>(80/5)</td><td>640</td><td>Fig.4-25(b)</td></tr>
<tr><td>B8</td><td>(80/10)</td><td>622</td><td>Fig.4-25(c)</td></tr>
<tr><td>B9</td><td>(80/15)</td><td>617</td><td>Fig.4-25(d)</td></tr>
</table>

NOTE:

Substrate: 10 nm-cobalt-coated silicon [(100) P-type] wafer

Pretreatment conditions: PT4, as shown in Table 3-1

Other CNCs deposition conditions: pressure 9 Torr, microwave power 800 W