FIG. 1

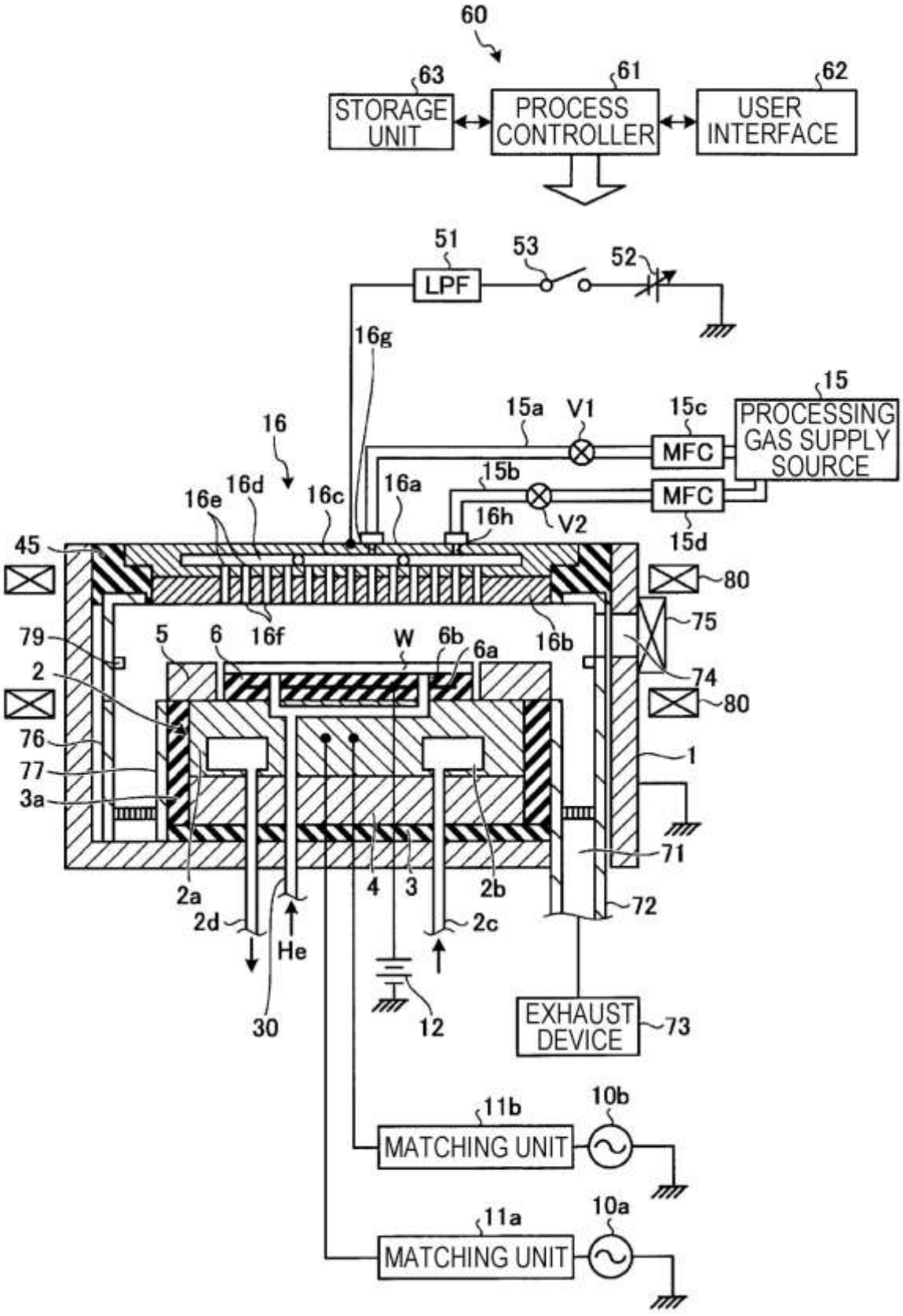

60
63
STORAGE UNIT
61
PROCESS CONTROLLER
62
USER INTERFACE
51
LPF
53
52
16g
15
PROCESSING GAS SUPPLY SOURCE
15a
V1
15c
MFC
16
15b
MFC
16e
16d
16c
16a
16h
V2
15d
45
80
75
79
5
6
16f
W
6b
6a
16b
2
74
80
76
1
77
3a
71
2a
4
3
2b
72
2d
He
2c
30
12
EXHAUST DEVICE
73
11b
10b
MATCHING UNIT
11a
10a
MATCHING UNIT

FIG. 2

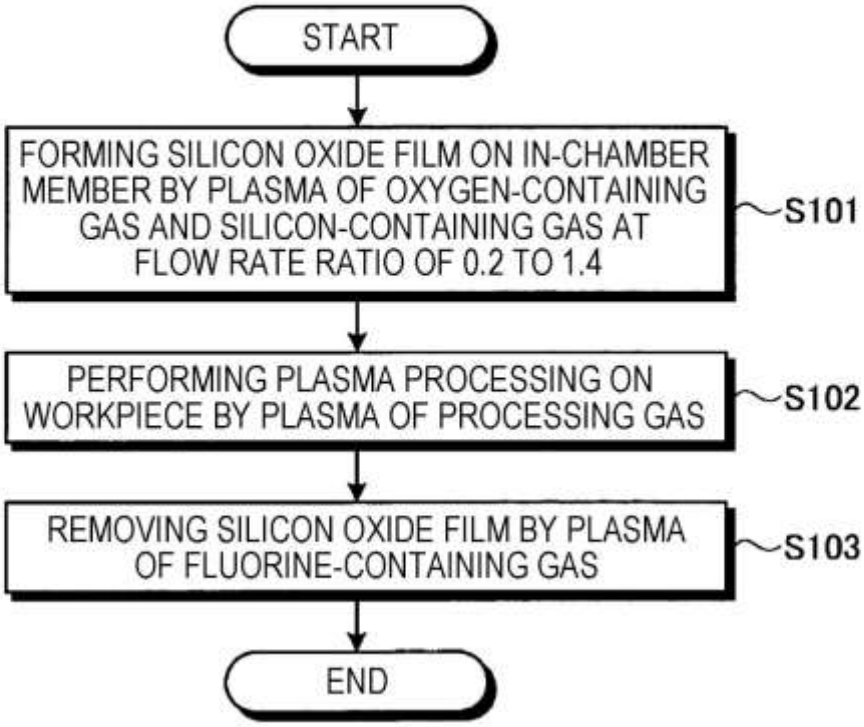

START
FORMING SILICON OXIDE FILM ON IN-CHAMBER MEMBER BY PLASMA OF OXYGEN-CONTAINING GAS AND SILICON-CONTAINING GAS AT FLOW RATE RATIO OF 0.2 TO 1.4
S101
PERFORMING PLASMA PROCESSING ON WORKPIECE BY PLASMA OF PROCESSING GAS
S102
REMOVING SILICON OXIDE FILM BY PLASMA OF FLUORINE-CONTAINING GAS
S103
END

FIG. 3

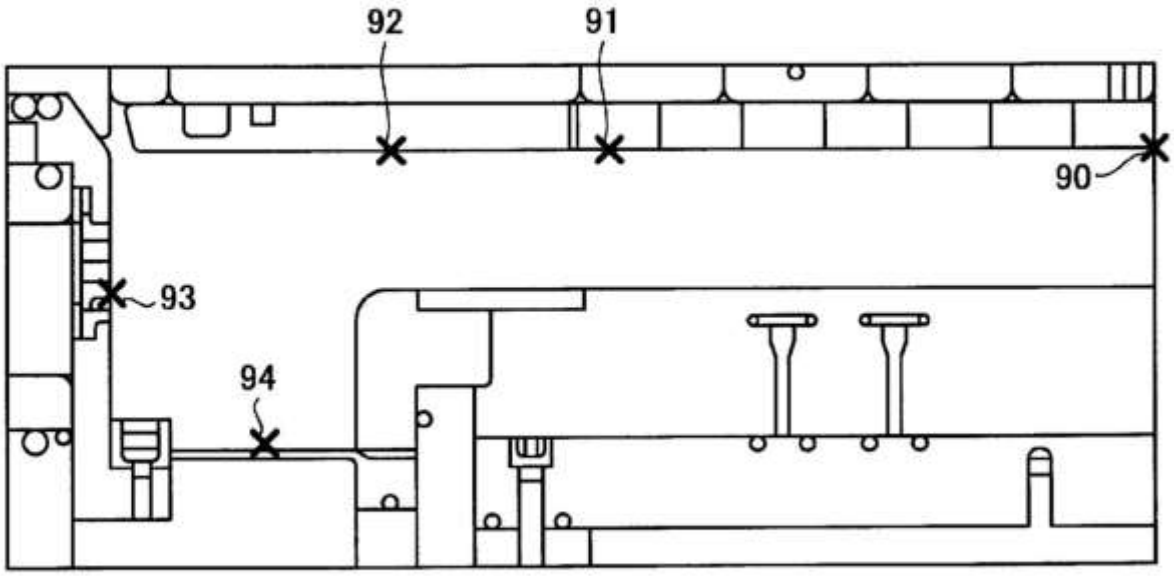

92
91
90
93
94

FIG. 4

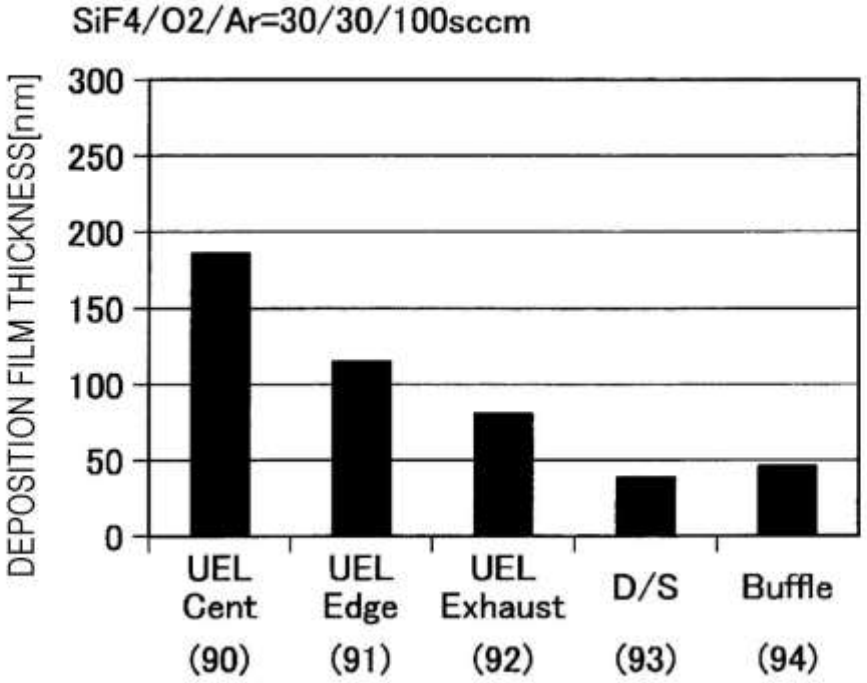

SiF4/O2/Ar=30/30/100sccm
DEPOSITION FILM THICKNESS[nm]
300
250
200
150
100
50
0
UEL Cent (90)
UEL Edge (91)
UEL Exhaust (92)
D/S (93)
Buffle (94)

FIG. 5

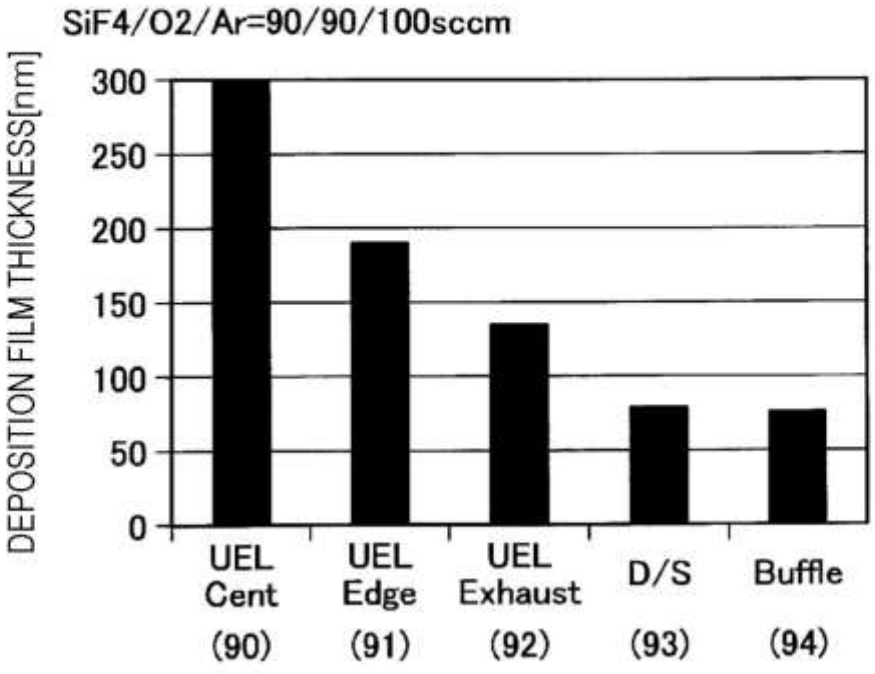

SiF4/O2/Ar=90/90/100sccm
DEPOSITION FILM THICKNESS[nm]
300
250
200
150
100
50
0
UEL Cent (90)
UEL Edge (91)
UEL Exhaust (92)
D/S (93)
Buffle (94)

FIG. 6

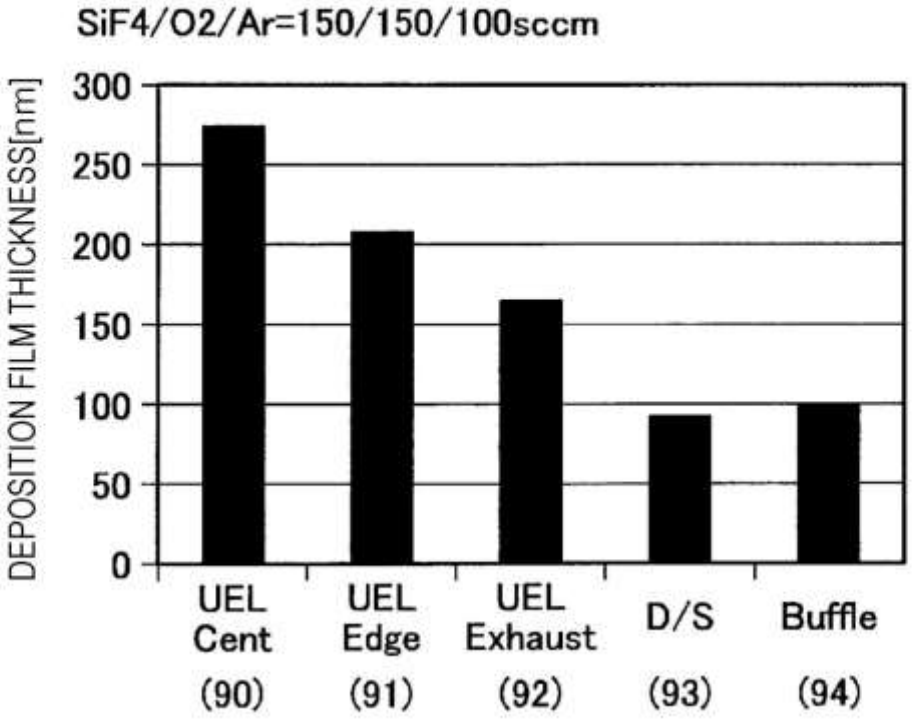

SiF4/O2/Ar=150/150/100sccm
DEPOSITION FILM THICKNESS[nm]
300
250
200
150
100
50
0
UEL Cent (90)
UEL Edge (91)
UEL Exhaust (92)
D/S (93)
Buffle (94)

FIG. 7

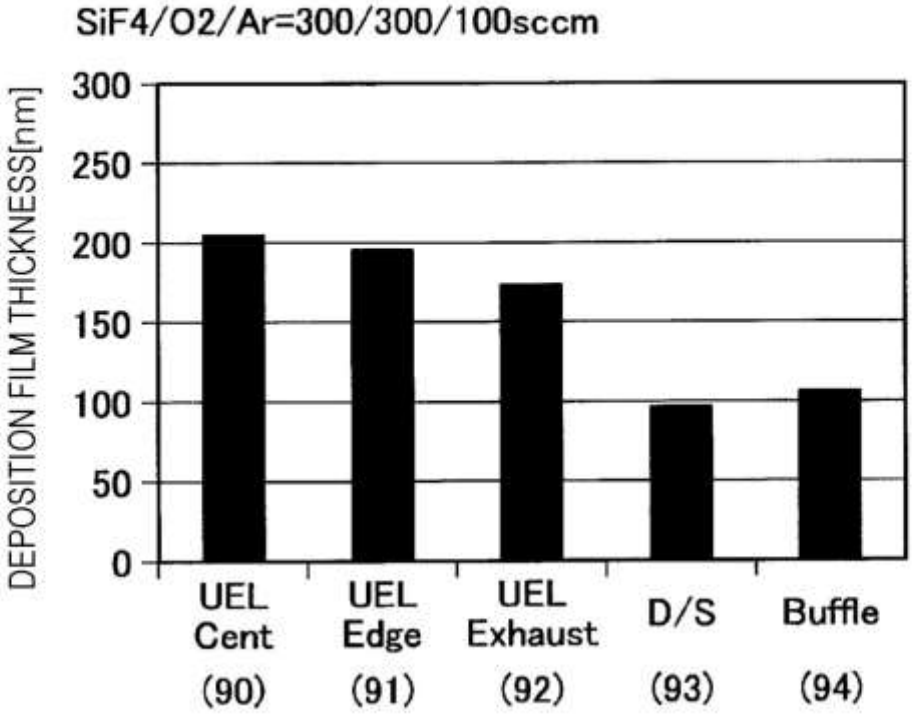

SiF4/O2/Ar=300/300/100sccm
DEPOSITION FILM THICKNESS[nm]
300
250
200
150
100
50
0
UEL Cent (90)
UEL Edge (91)
UEL Exhaust (92)
D/S (93)
Buffle (94)

FIG. 8

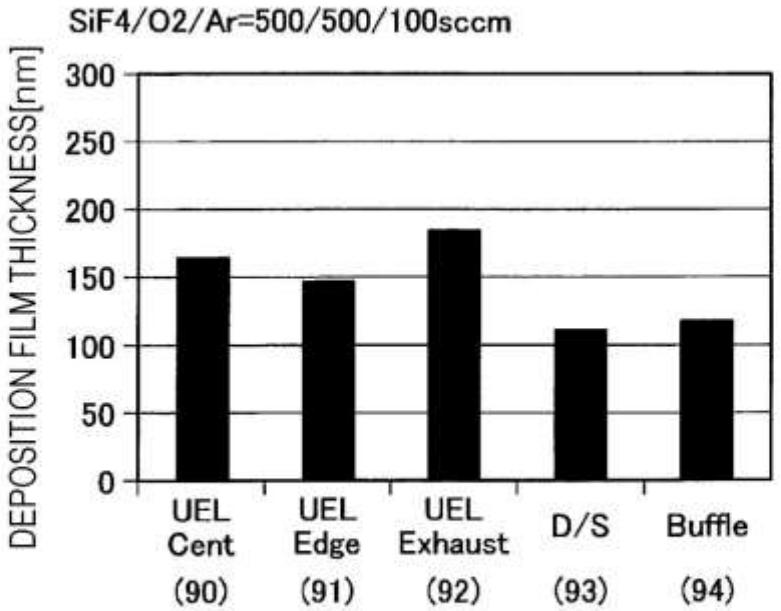

SiF4/O2/Ar=500/500/100sccm
DEPOSITION FILM THICKNESS[nm]
300
250
200
150
100
50
0
UEL Cent (90)
UEL Edge (91)
UEL Exhaust (92)
D/S (93)
Buffle (94)

FIG. 9

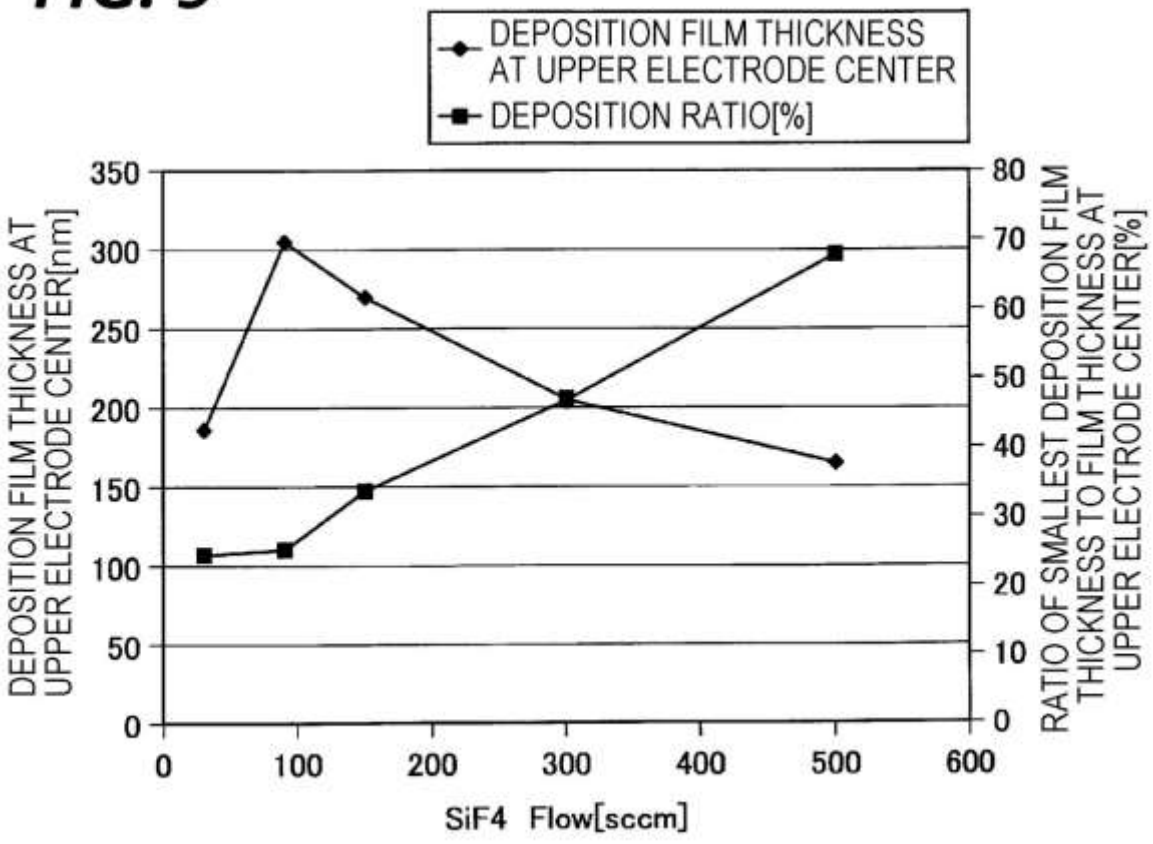

DEPOSITION FILM THICKNESS AT UPPER ELECTRODE CENTER
DEPOSITION RATIO[%]
DEPOSITION FILM THICKNESS AT UPPER ELECTRODE CENTER[nm]
RATIO OF SMALLEST DEPOSITION FILM THICKNESS TO FILM THICKNESS AT UPPER ELECTRODE CENTER[%]
350
300
250
200
150
100
50
0
80
70
60
50
40
30
20
10
0
0
100
200
300
400
500
600
SiF4 Flow[sccm]

FIG. 10

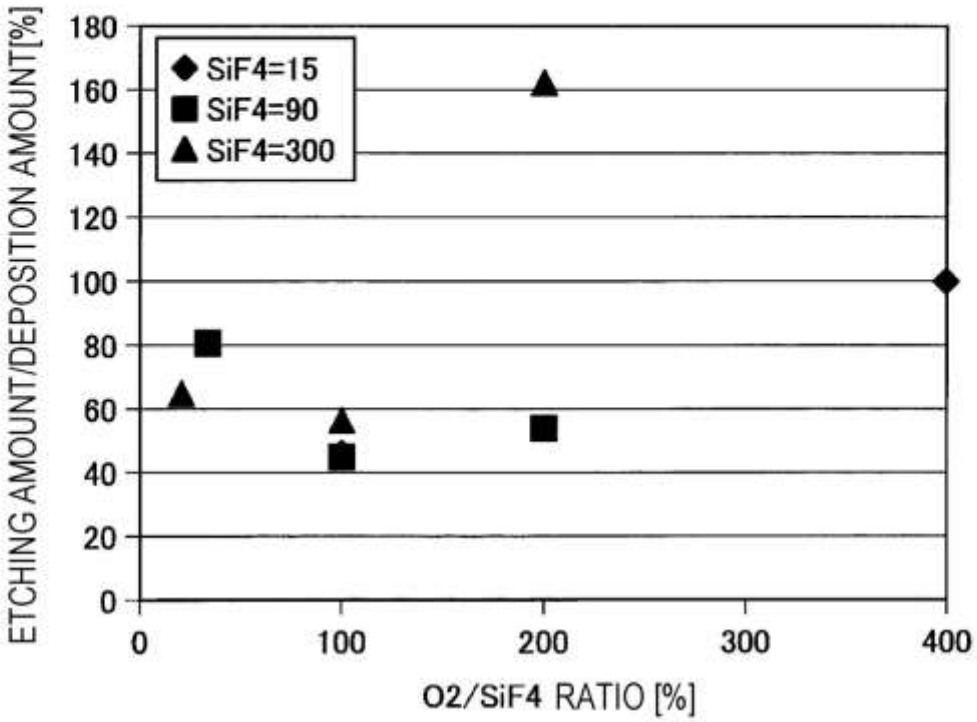

ETCHING AMOUNT/DEPOSITION AMOUNT[%]
180
160
140
120
100
80
60
40
20
0
SiF4=15
SiF4=90
SiF4=300
0
100
200
300
400
O2/SiF4 RATIO [%]

FIG. 11

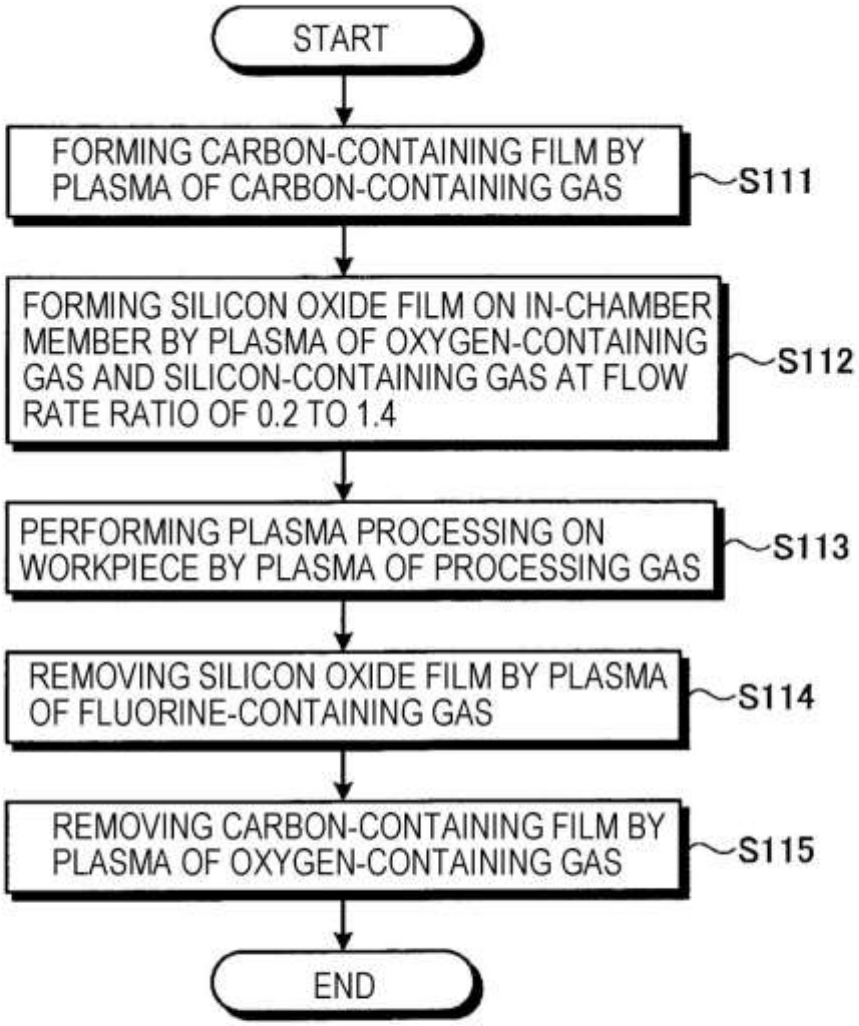

START
FORMING CARBON-CONTAINING FILM BY PLASMA OF CARBON-CONTAINING GAS
S111
FORMING SILICON OXIDE FILM ON IN-CHAMBER MEMBER BY PLASMA OF OXYGEN-CONTAINING GAS AND SILICON-CONTAINING GAS AT FLOW RATE RATIO OF 0.2 TO 1.4
S112
PERFORMING PLASMA PROCESSING ON WORKPIECE BY PLASMA OF PROCESSING GAS
S113
REMOVING SILICON OXIDE FILM BY PLASMA OF FLUORINE-CONTAINING GAS
S114
REMOVING CARBON-CONTAINING FILM BY PLASMA OF OXYGEN-CONTAINING GAS
S115
END

FIG. 12

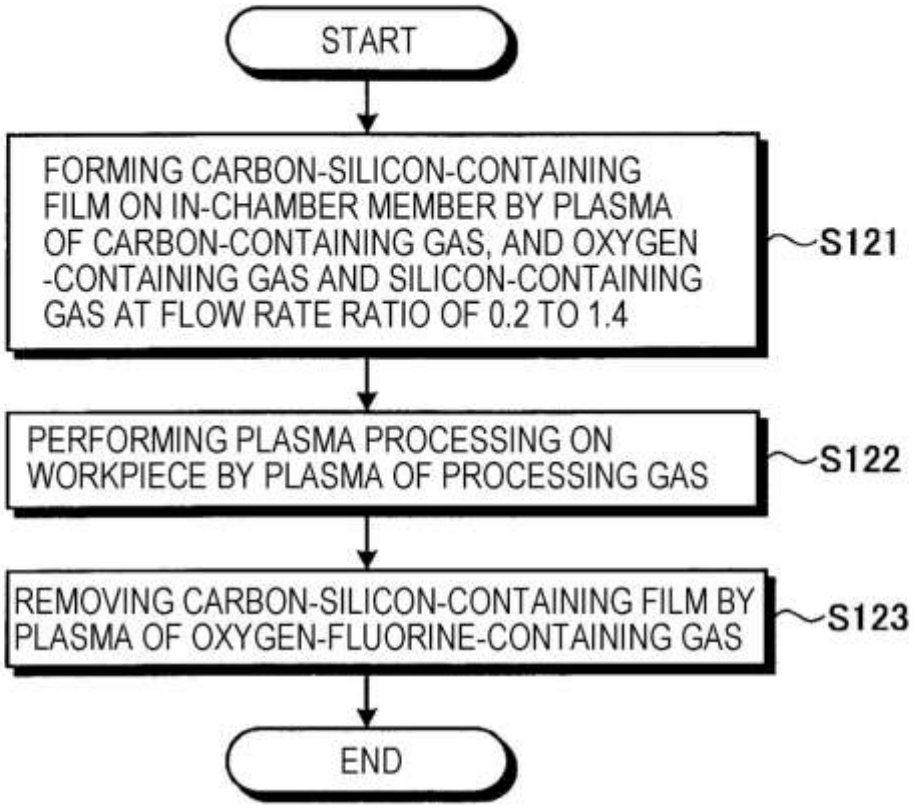

START
FORMING CARBON-SILICON-CONTAINING FILM ON IN-CHAMBER MEMBER BY PLASMA OF CARBON-CONTAINING GAS, AND OXYGEN -CONTAINING GAS AND SILICON-CONTAINING GAS AT FLOW RATE RATIO OF 0.2 TO 1.4
S121
PERFORMING PLASMA PROCESSING ON WORKPIECE BY PLASMA OF PROCESSING GAS
S122
REMOVING CARBON-SILICON-CONTAINING FILM BY PLASMA OF OXYGEN-FLUORINE-CONTAINING GAS
S123
END

FIG. 13

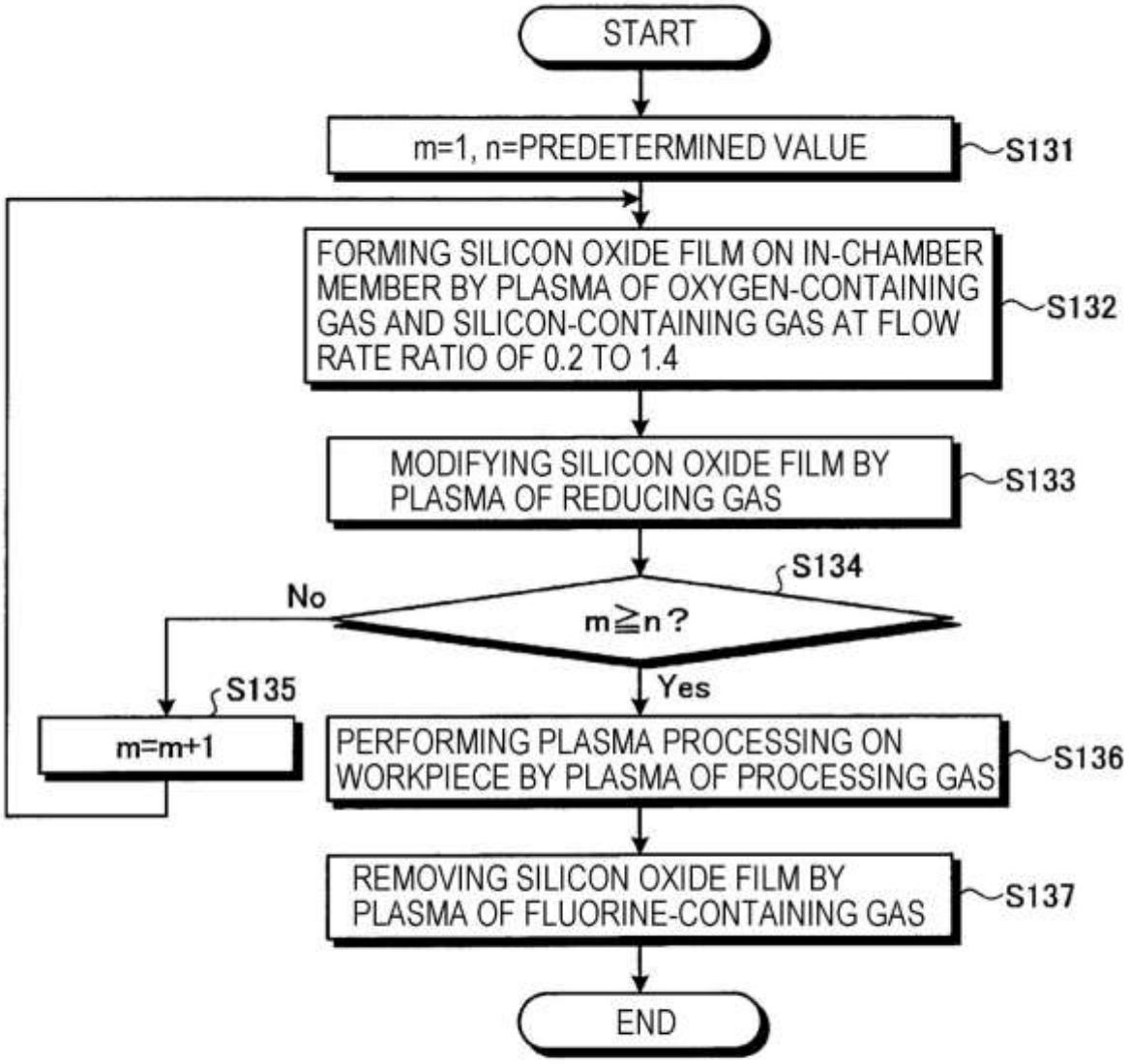

START
m=1, n=PREDETERMINED VALUE
S131
FORMING SILICON OXIDE FILM ON IN-CHAMBER MEMBER BY PLASMA OF OXYGEN-CONTAINING GAS AND SILICON-CONTAINING GAS AT FLOW RATE RATIO OF 0.2 TO 1.4
S132
MODIFYING SILICON OXIDE FILM BY PLASMA OF REDUCING GAS
S133
S134
m≧n?
No
Yes
S135
m=m+1
PERFORMING PLASMA PROCESSING ON WORKPIECE BY PLASMA OF PROCESSING GAS
S136
REMOVING SILICON OXIDE FILM BY PLASMA OF FLUORINE-CONTAINING GAS
S137
END

FIG. 14

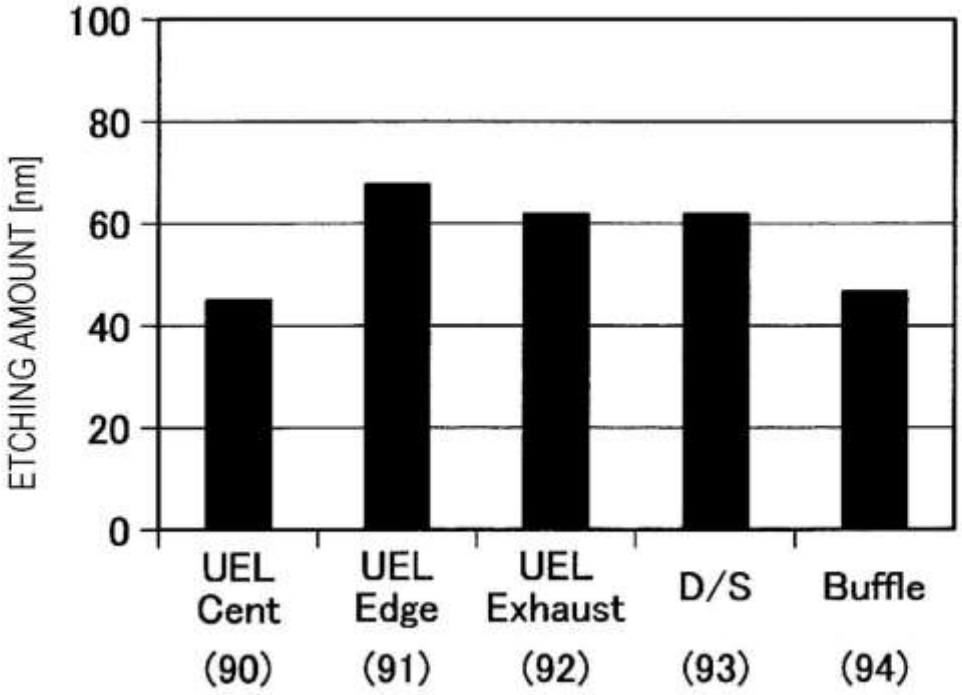

ETCHING AMOUNT [nm]
100
80
60
40
20
0
UEL Cent (90)
UEL Edge (91)
UEL Exhaust (92)
D/S (93)
Buffle (94)

FIG. 15

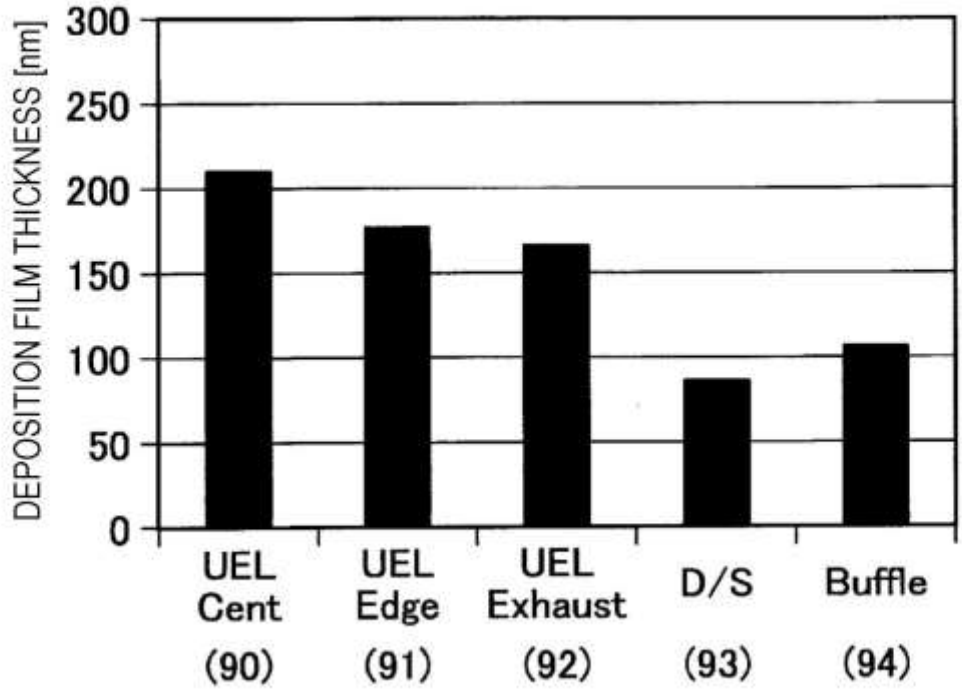

DEPOSITION FILM THICKNESS [nm]
300
250
200
150
100
50
0
UEL Cent (90)
UEL Edge (91)
UEL Exhaust (92)
D/S (93)
Buffle (94)

FIG. 16

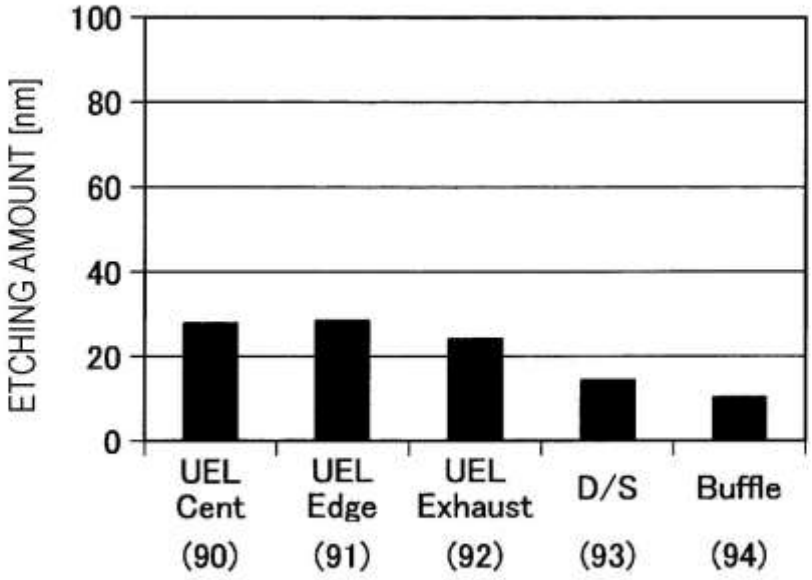

100
80
60
40
20
0
ETCHING AMOUNT [nm]
UEL Cent (90)
UEL Edge (91)
UEL Exhaust (92)
D/S (93)
Buffle (94)

FIG. 17

		UEL C (90)	UEL E (91)	UEL Ex (92)	D/S (93)	Buffle (94)
NON-MODIFICATION (SiF4/O2/Ar= 300/300/100)	DEPOSITION AMOUNT[nm]	210	192	171	96	108
	ETCHING AMOUNT[nm]	45.0	68.0	62.0	62.0	47.0
MODIFICATION (H2/Ar)	DEPOSITION AMOUNT[nm]	217	177	166	86	106
	ETCHING AMOUNT[nm]	28.0	29.0	25.0	15.2	11.0

FIG. 18

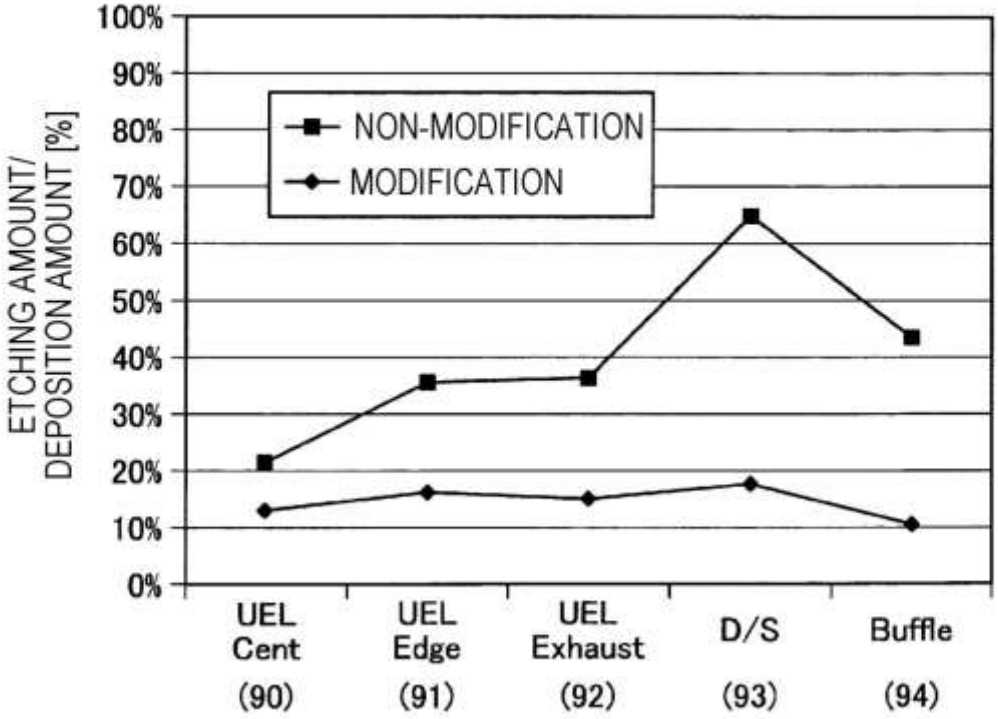

100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
ETCHING AMOUNT/
DEPOSITION AMOUNT [%]
NON-MODIFICATION
MODIFICATION
UEL
Cent
(90)
UEL
Edge
(91)
UEL
Exhaust
(92)
D/S
(93)
Buffle
(94)

FIG. 19

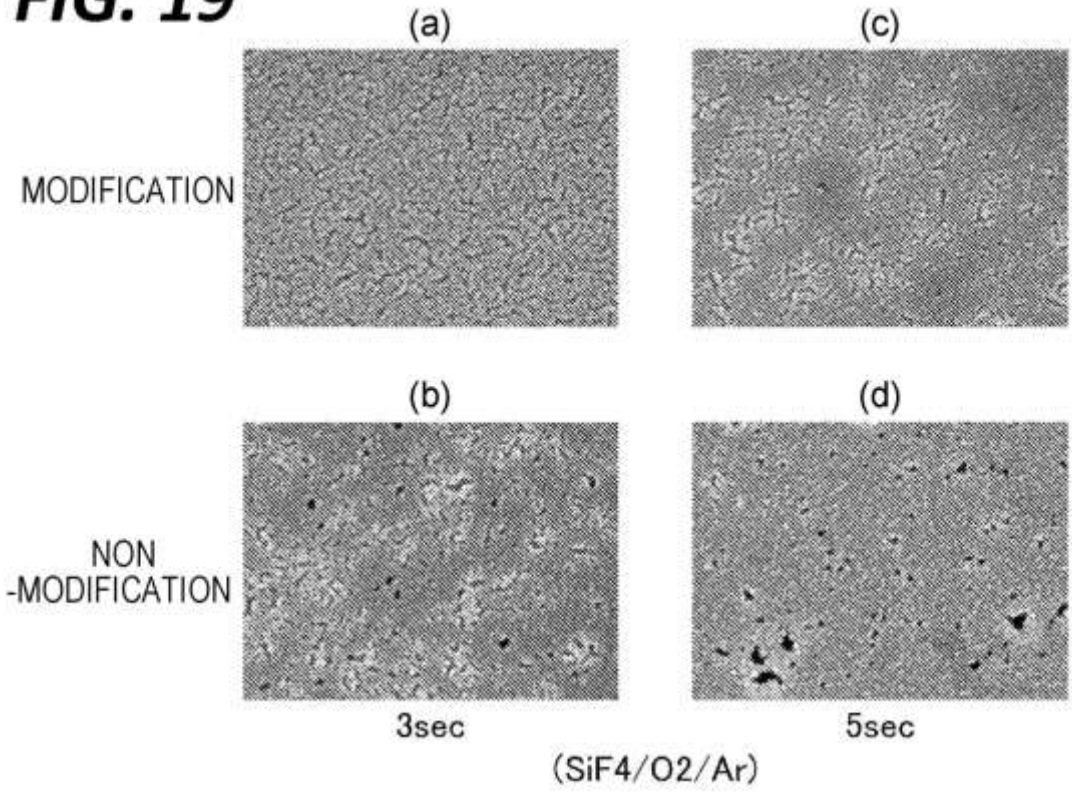

(a)
(c)
MODIFICATION
(b)
(d)
NON
-MODIFICATION
3sec
5sec
(SiF4/O2/Ar)

FIG. 20

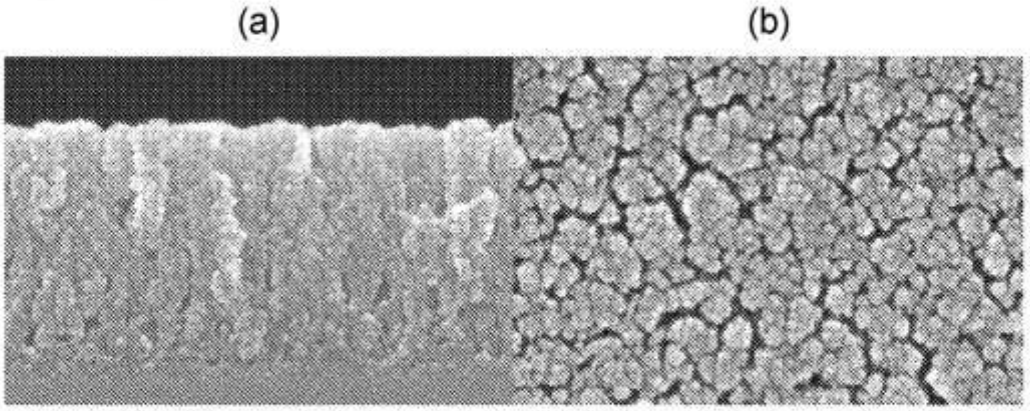


FIG. 21

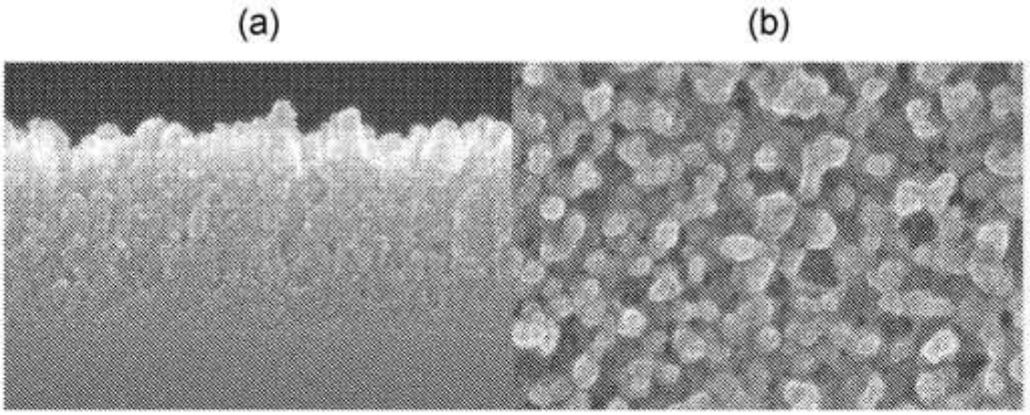


FIG. 22

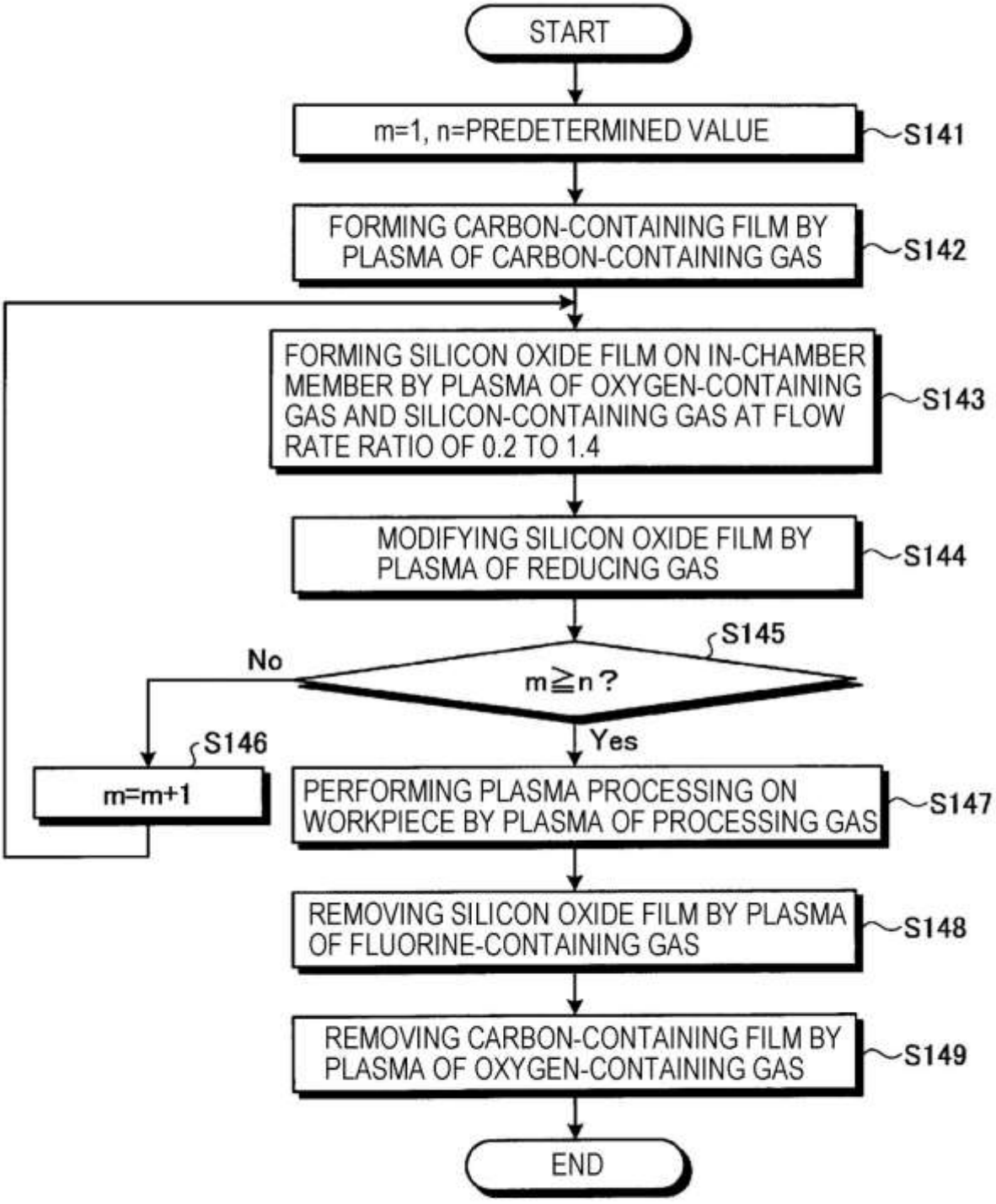
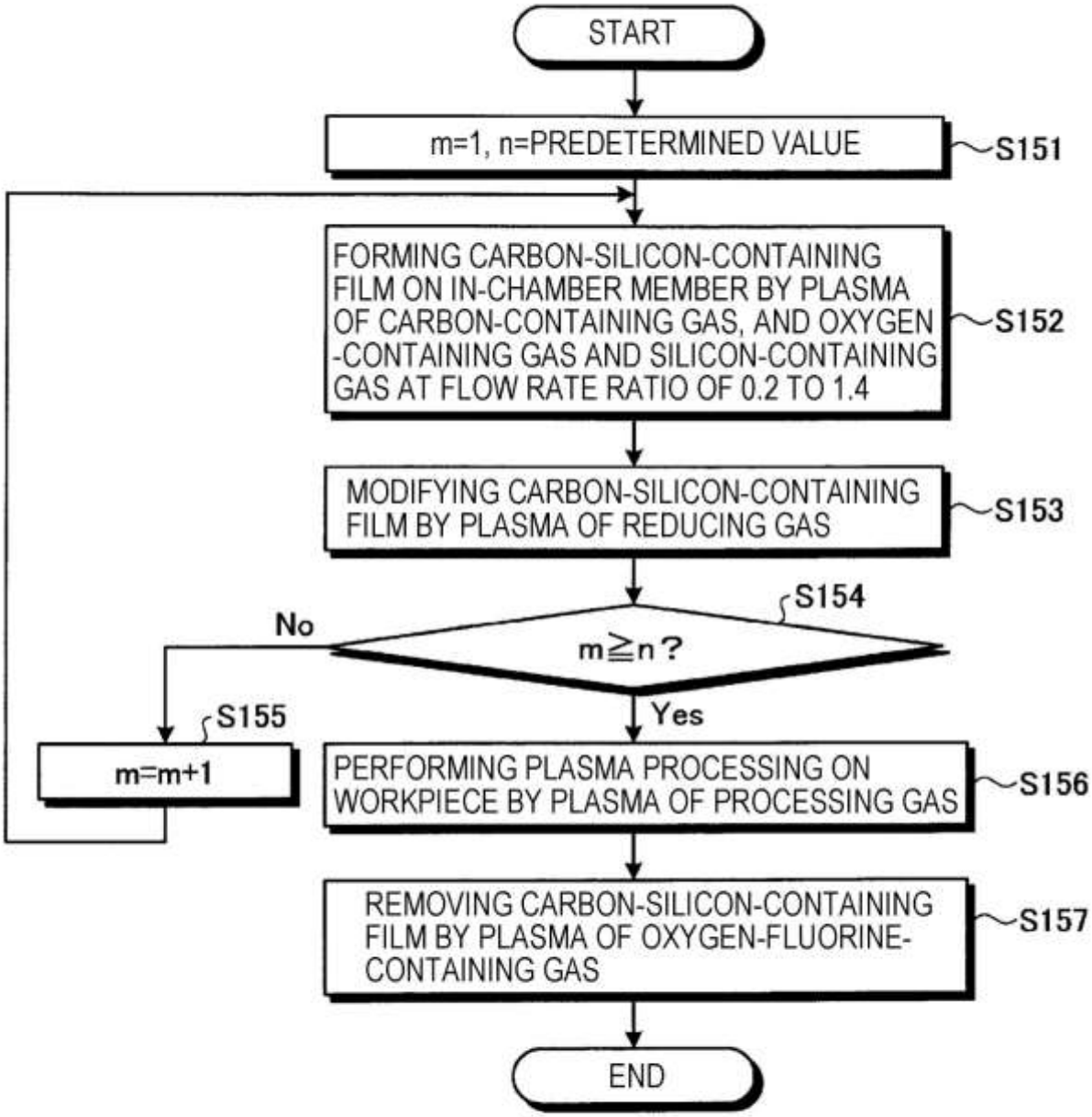

START
m=1, n=PREDETERMINED VALUE
S141
FORMING CARBON-CONTAINING FILM BY PLASMA OF CARBON-CONTAINING GAS
S142
FORMING SILICON OXIDE FILM ON IN-CHAMBER MEMBER BY PLASMA OF OXYGEN-CONTAINING GAS AND SILICON-CONTAINING GAS AT FLOW RATE RATIO OF 0.2 TO 1.4
S143
MODIFYING SILICON OXIDE FILM BY PLASMA OF REDUCING GAS
S144
S145
m≧n?
No
Yes
S146
m=m+1
PERFORMING PLASMA PROCESSING ON WORKPIECE BY PLASMA OF PROCESSING GAS
S147
REMOVING SILICON OXIDE FILM BY PLASMA OF FLUORINE-CONTAINING GAS
S148
REMOVING CARBON-CONTAINING FILM BY PLASMA OF OXYGEN-CONTAINING GAS
S149
END

FIG. 23


START
m=1, n=PREDETERMINED VALUE
S151
FORMING CARBON-SILICON-CONTAINING FILM ON IN-CHAMBER MEMBER BY PLASMA OF CARBON-CONTAINING GAS, AND OXYGEN -CONTAINING GAS AND SILICON-CONTAINING GAS AT FLOW RATE RATIO OF 0.2 TO 1.4
S152
MODIFYING CARBON-SILICON-CONTAINING FILM BY PLASMA OF REDUCING GAS
S153
S154
m≧n?
No
Yes
S155
m=m+1
PERFORMING PLASMA PROCESSING ON WORKPIECE BY PLASMA OF PROCESSING GAS
S156
REMOVING CARBON-SILICON-CONTAINING FILM BY PLASMA OF OXYGEN-FLUORINE-CONTAINING GAS
S157
END