FIG. 1

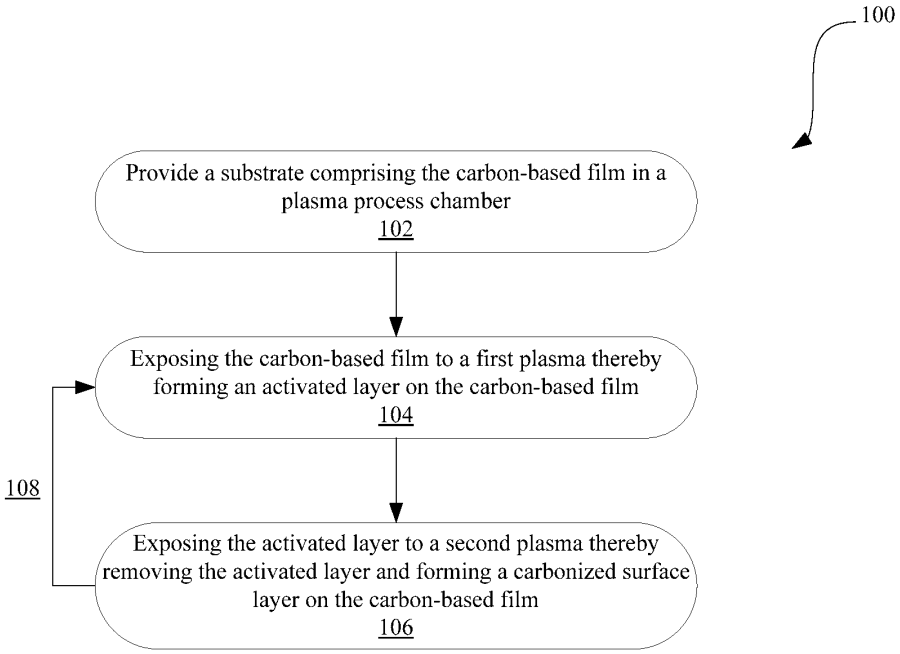

100
Provide a substrate comprising the carbon-based film in a plasma process chamber
102
Exposing the carbon-based film to a first plasma thereby forming an activated layer on the carbon-based film
104
108
Exposing the activated layer to a second plasma thereby removing the activated layer and forming a carbonized surface layer on the carbon-based film
106

FIG. 2

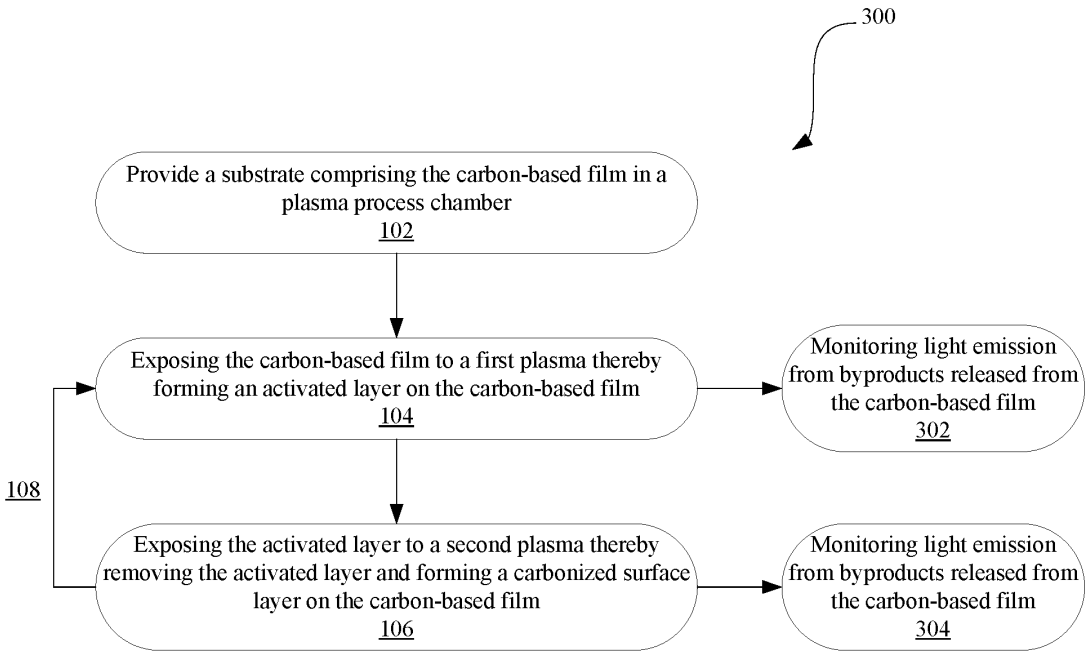

300
Provide a substrate comprising the carbon-based film in a plasma process chamber
102
Exposing the carbon-based film to a first plasma thereby forming an activated layer on the carbon-based film
104
Monitoring light emission from byproducts released from the carbon-based film
302
108
Exposing the activated layer to a second plasma thereby removing the activated layer and forming a carbonized surface layer on the carbon-based film
106
Monitoring light emission from byproducts released from the carbon-based film
304

FIG. 3

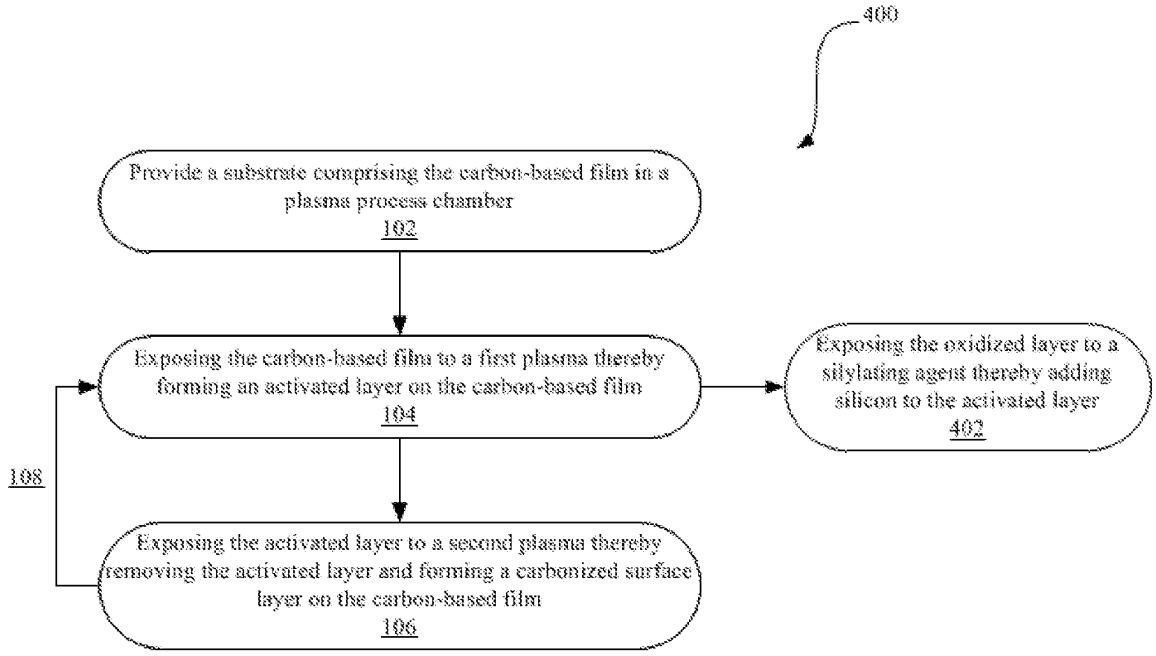
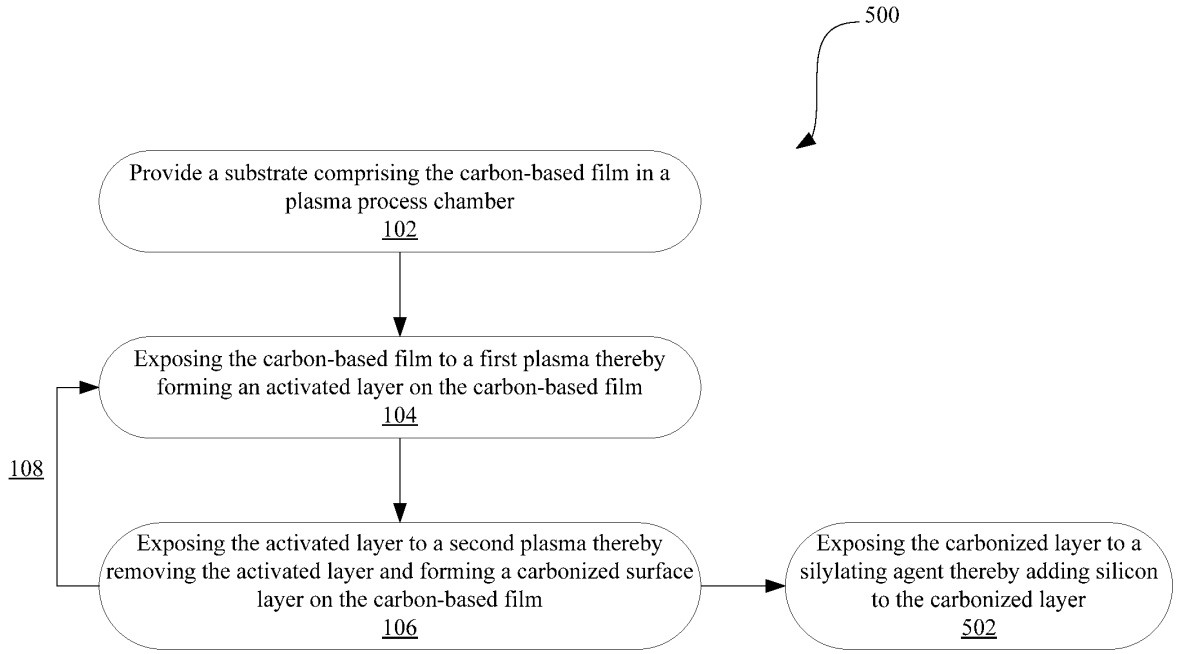
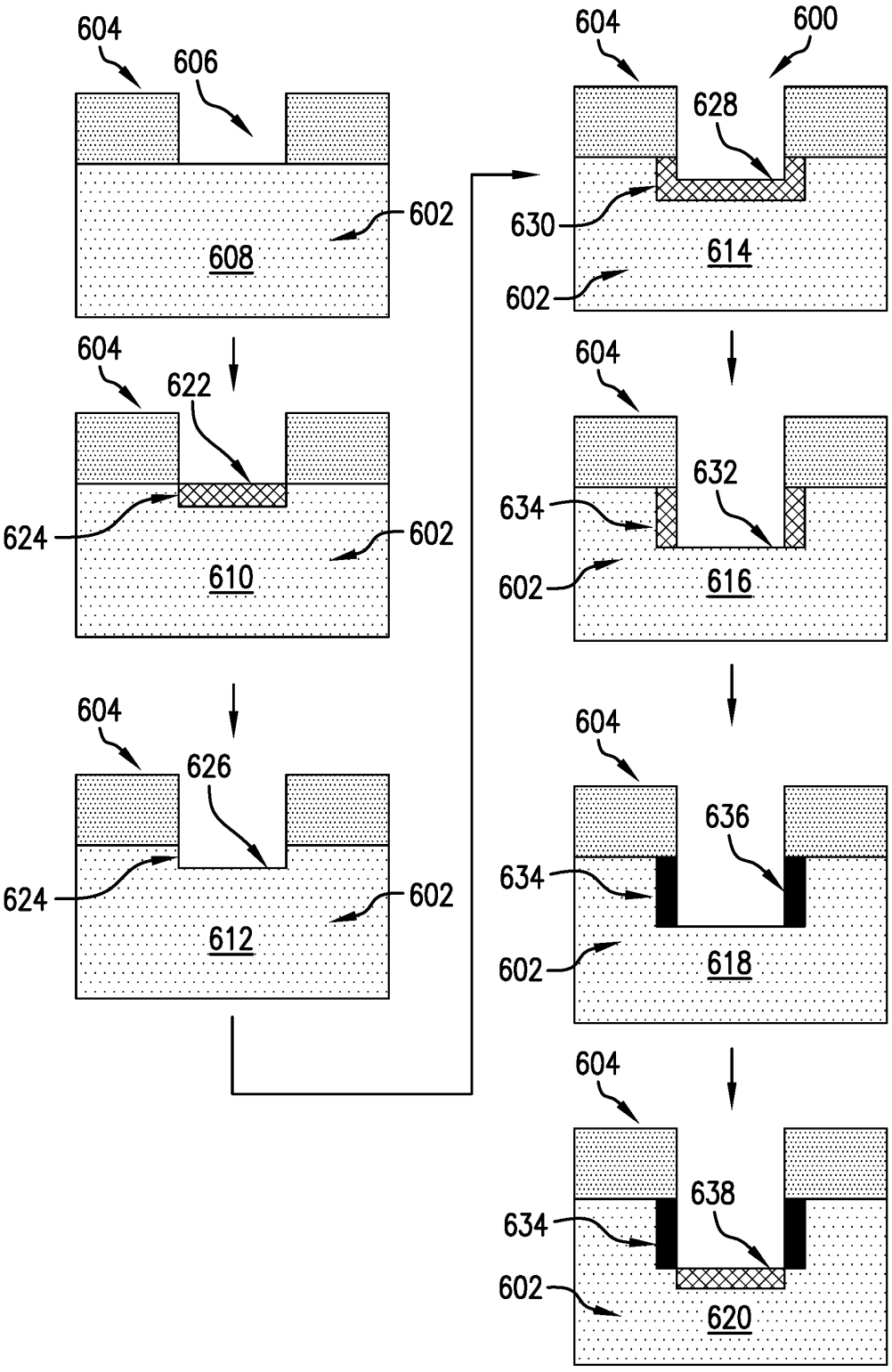

400
Provide a substrate comprising the carbon-based film in a plasma process chamber
102
Exposing the carbon-based film to a first plasma thereby forming an activated layer on the carbon-based film
104
Exposing the oxidized layer to a silylating agent thereby adding silicon to the activated layer
402
108
Exposing the activated layer to a second plasma thereby removing the activated layer and forming a carbonized surface layer on the carbon-based film
106

FIG. 4


500
Provide a substrate comprising the carbon-based film in a plasma process chamber
102
Exposing the carbon-based film to a first plasma thereby forming an activated layer on the carbon-based film
104
108
Exposing the activated layer to a second plasma thereby removing the activated layer and forming a carbonized surface layer on the carbon-based film
106
Exposing the carbonized layer to a silylating agent thereby adding silicon to the carbonized layer
502


604
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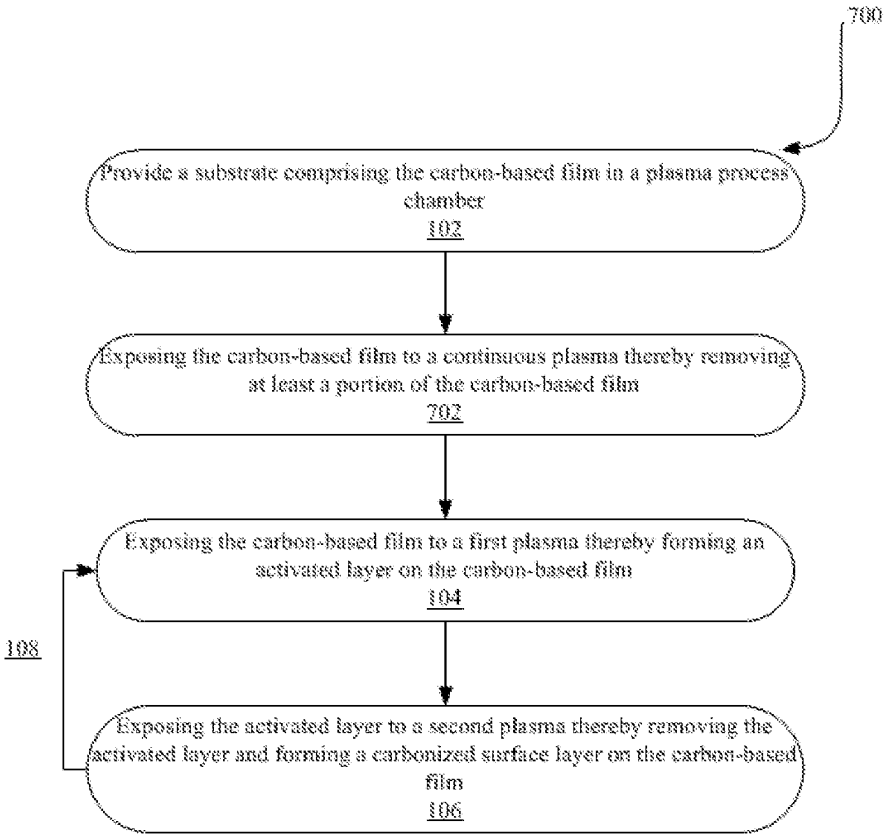
602
620

FIG.5

FIG. 6


700
Provide a substrate comprising the carbon-based film in a plasma process chamber
102
Exposing the carbon-based film to a continuous plasma thereby removing at least a portion of the carbon-based film
702
Exposing the carbon-based film to a first plasma thereby forming an activated layer on the carbon-based film
104
108
Exposing the activated layer to a second plasma thereby removing the activated layer and forming a carbonized surface layer on the carbon-based film
106

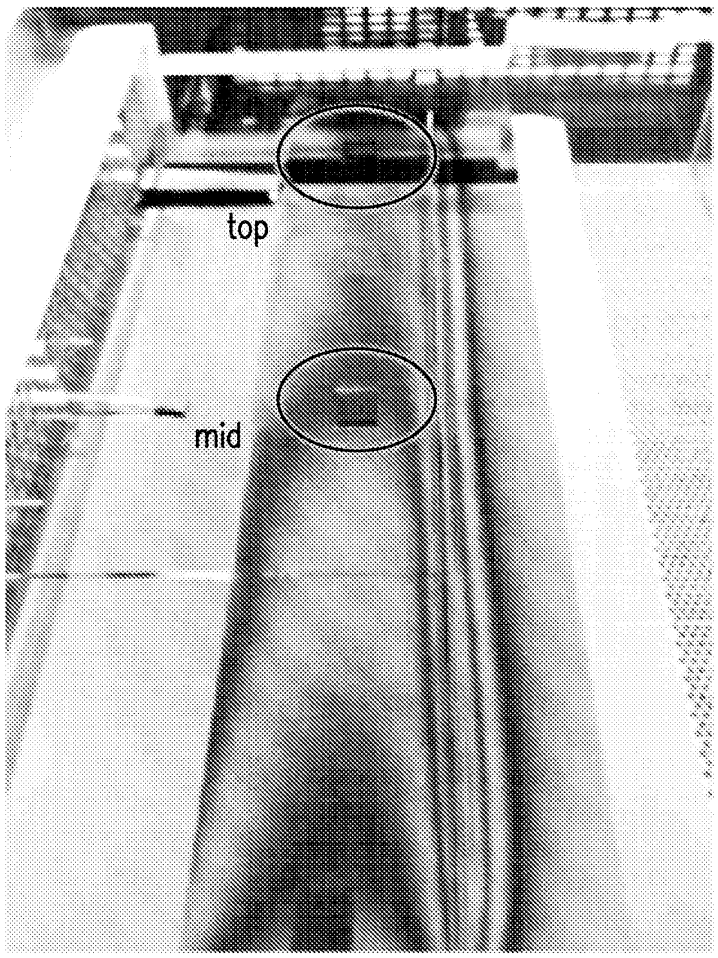


FIG.7

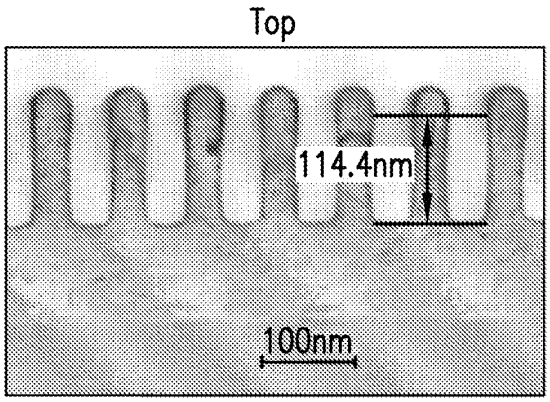


FIG.8A

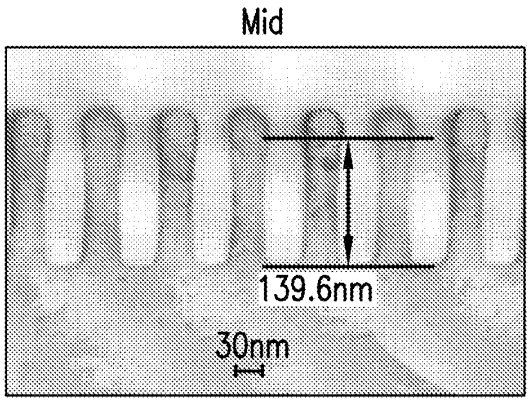


FIG.8B

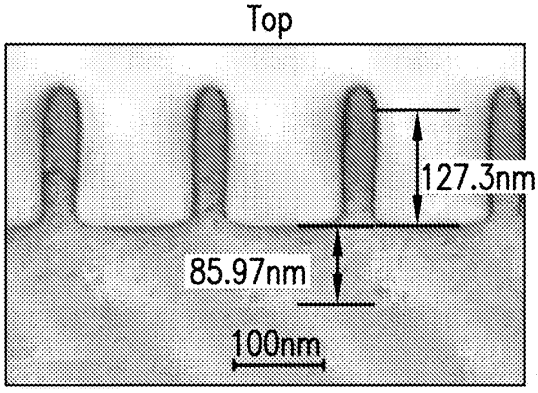


FIG.8C

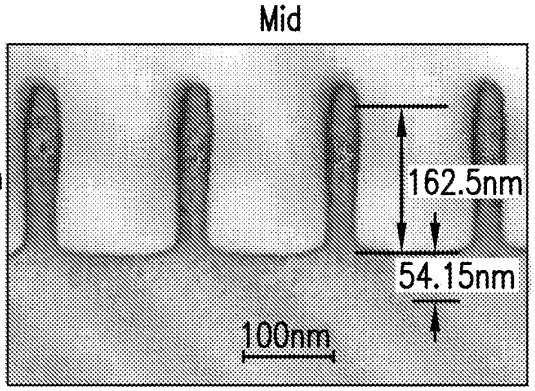


FIG.8D

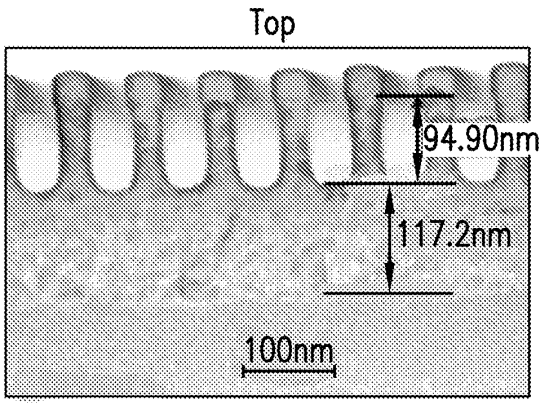


FIG.9A

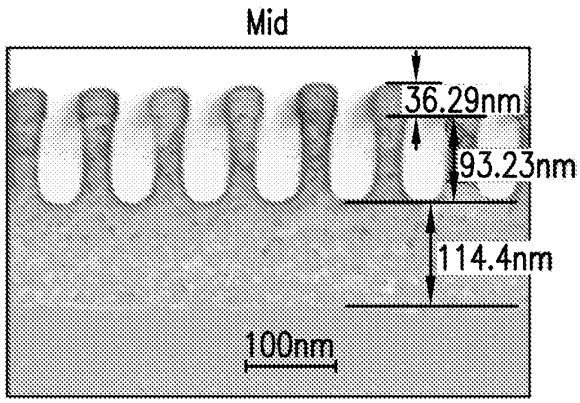


FIG.9B

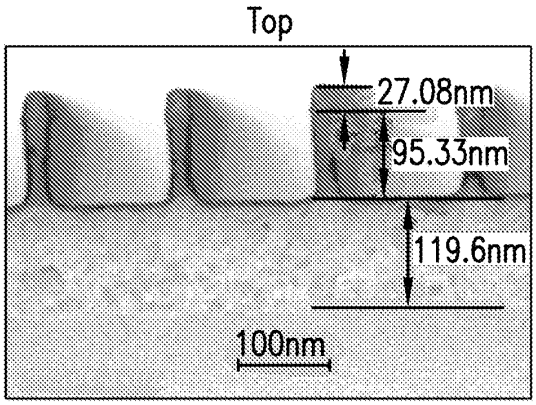


FIG.9C

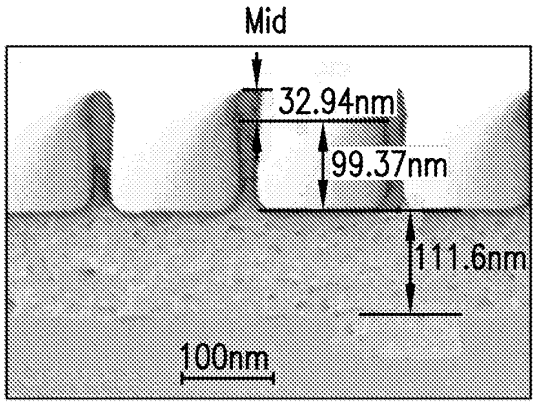


FIG.9D

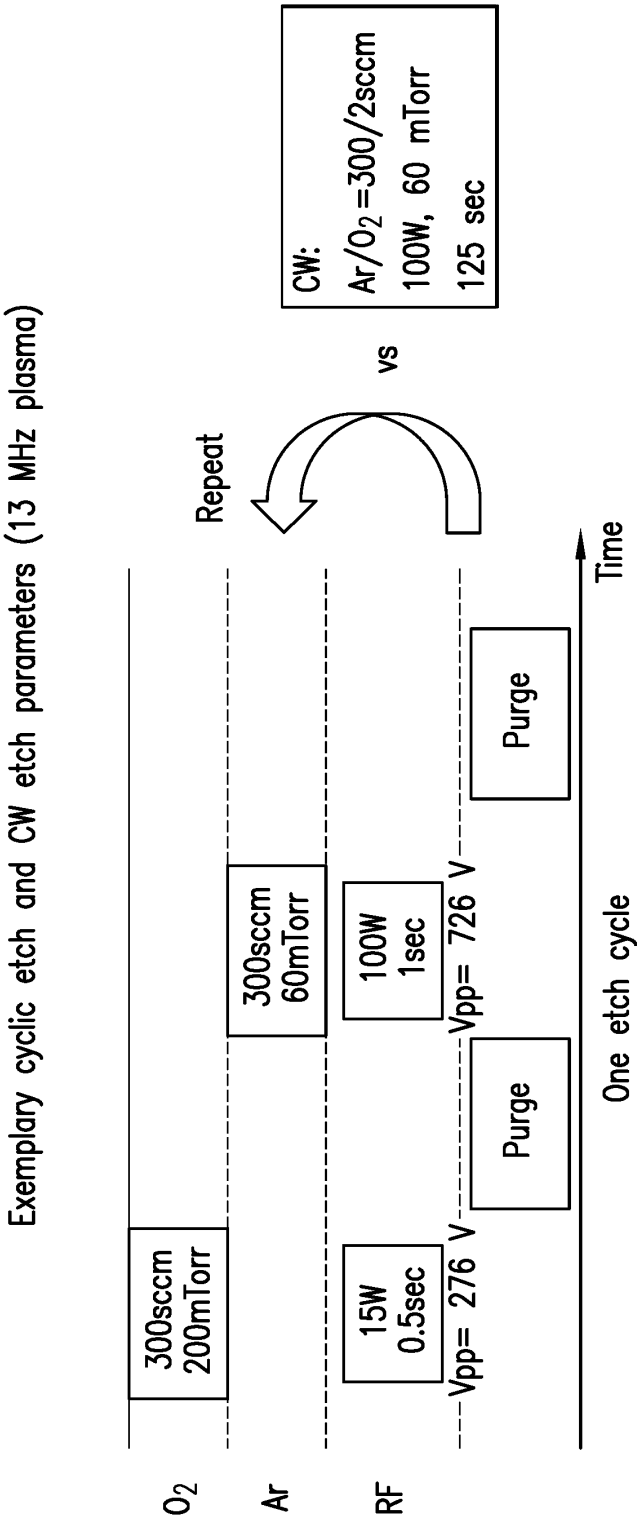

Exemplary cyclic etch and CW etch parameters (13 MHz plasma)
CW:
Ar/O2=300/2sccm
100W, 60 mTorr
125 sec
vs
Repeat
Time
O2
Ar
RF
300sccm
200mTorr
15W
0.5sec
Vpp= 276 V
300sccm
60mTorr
100W
1sec
Vpp= 726 V
Purge
Purge
One etch cycle

FIG.10

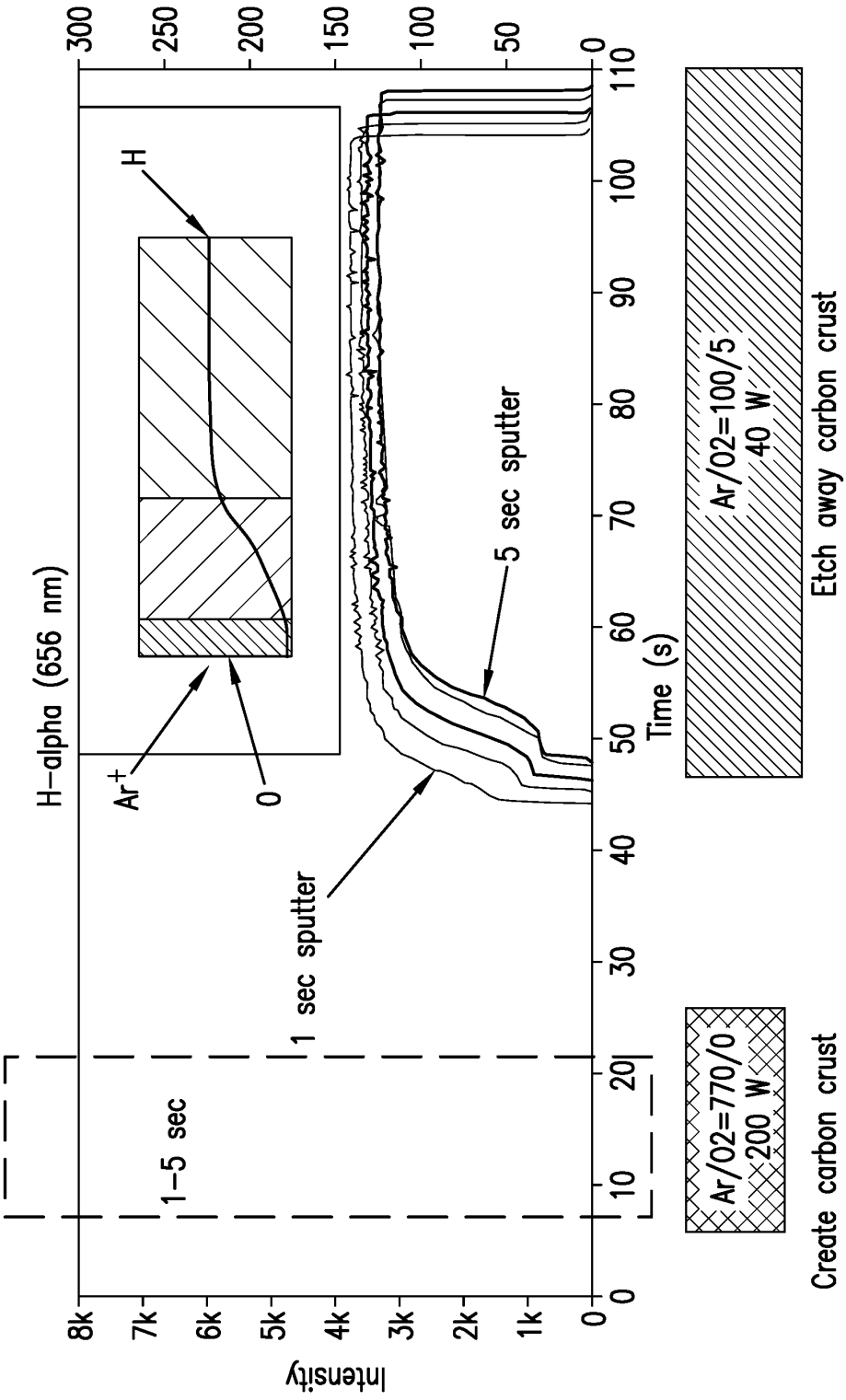

H-alpha (656 nm)
Intensity
Time (s)
H
Ar+
0
1 sec sputter
5 sec sputter
1–5 sec
Ar/02=770/0
200 W
Create carbon crust
Ar/02=100/5
40 W
Etch away carbon crust

FIG.11