Fig.1

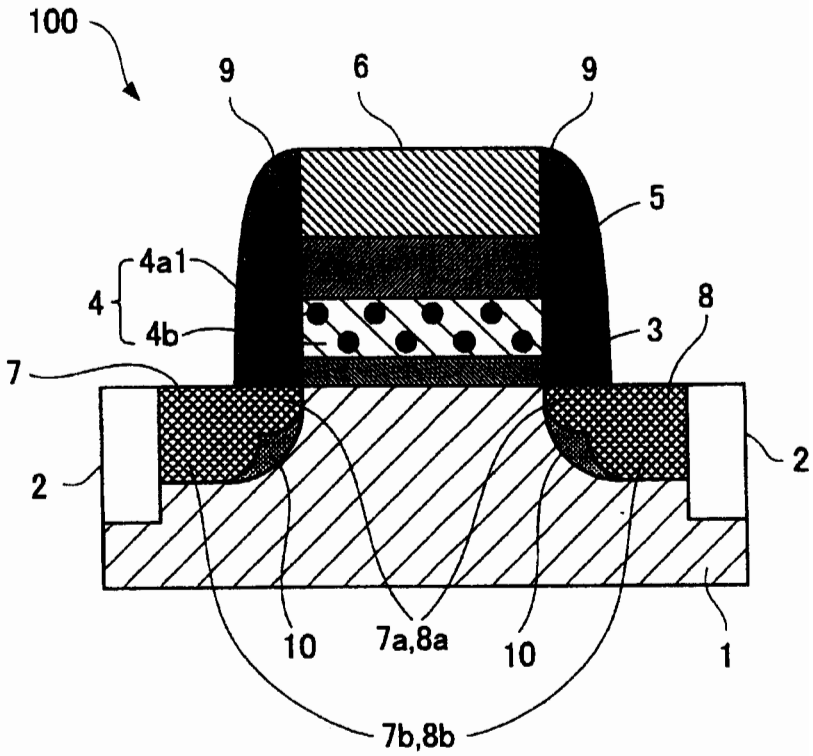

100
9
6
9
5
4a1
4
4b
3
8
7
2
2
10
7a,8a
10
1
7b,8b

Fig.2

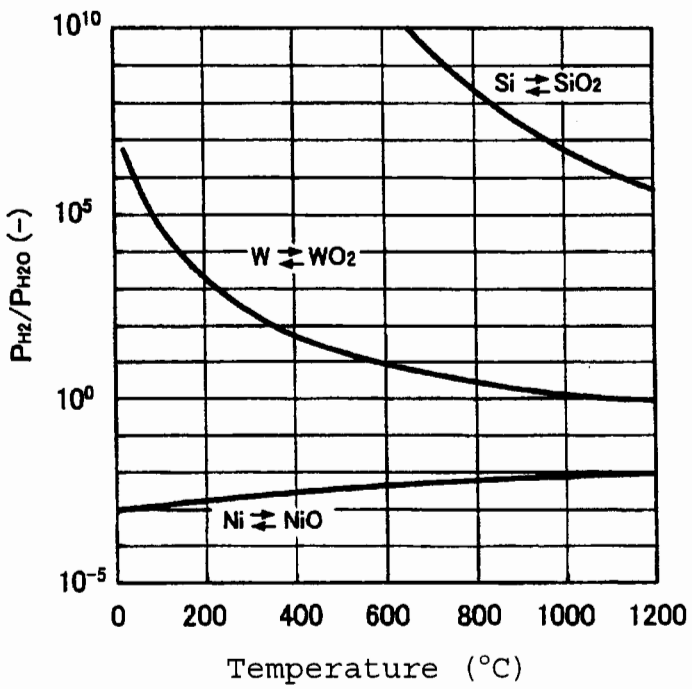

10^{10}
10^{5}
10^{0}
10^{-5}
P_{H2}/P_{H2O} (-)
Si ⇄ SiO2
W ⇄ WO2
Ni ⇄ NiO
0
200
400
600
800
1000
1200
Temperature (°C)

Fig.3

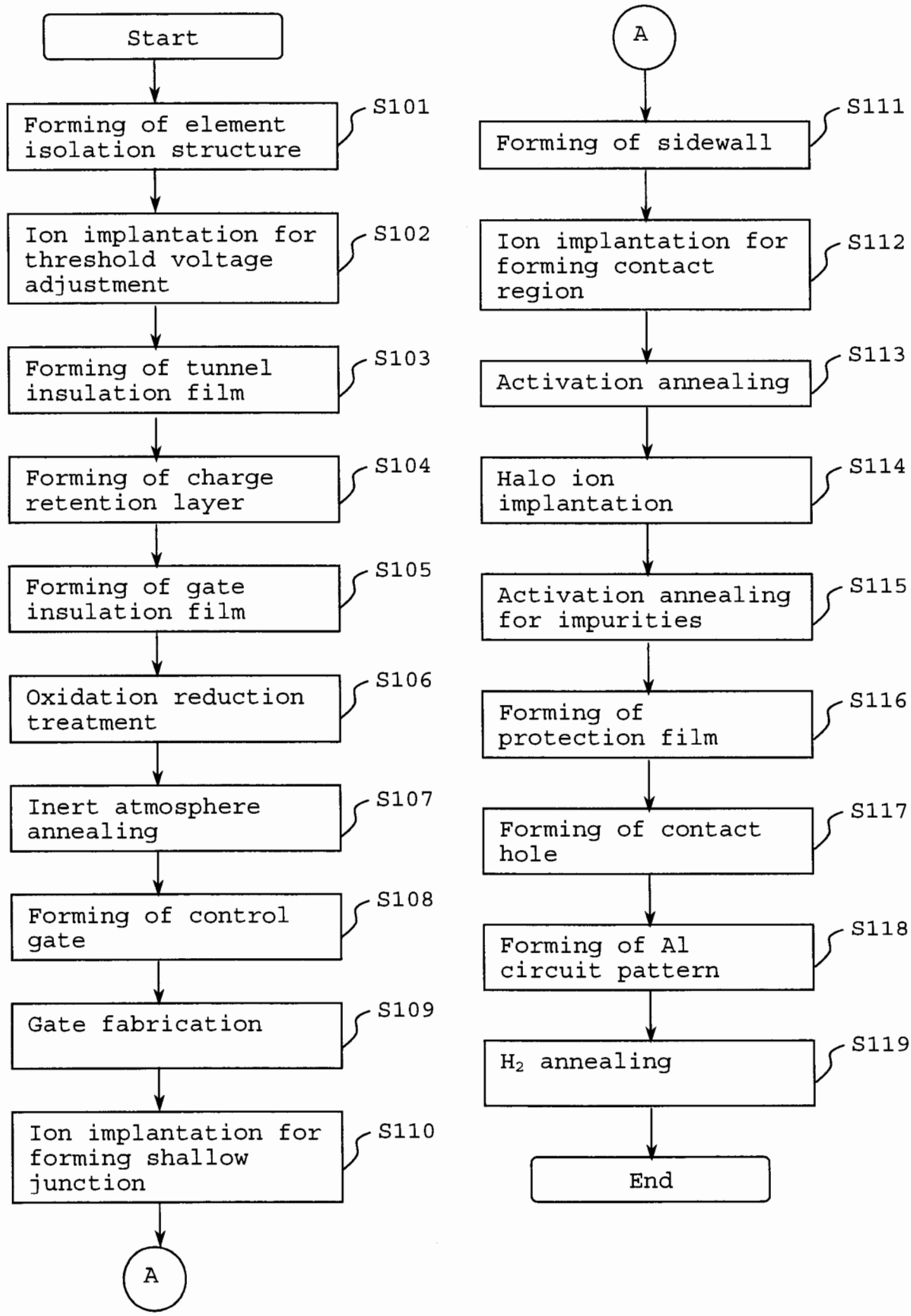

Start
Forming of element isolation structure
S101
Ion implantation for threshold voltage adjustment
S102
Forming of tunnel insulation film
S103
Forming of charge retention layer
S104
Forming of gate insulation film
S105
Oxidation reduction treatment
S106
Inert atmosphere annealing
S107
Forming of control gate
S108
Gate fabrication
S109
Ion implantation for forming shallow junction
S110
A
A
Forming of sidewall
S111
Ion implantation for forming contact region
S112
Activation annealing
S113
Halo ion implantation
S114
Activation annealing for impurities
S115
Forming of protection film
S116
Forming of contact hole
S117
Forming of Al circuit pattern
S118
H_2 annealing
S119
End

Fig4

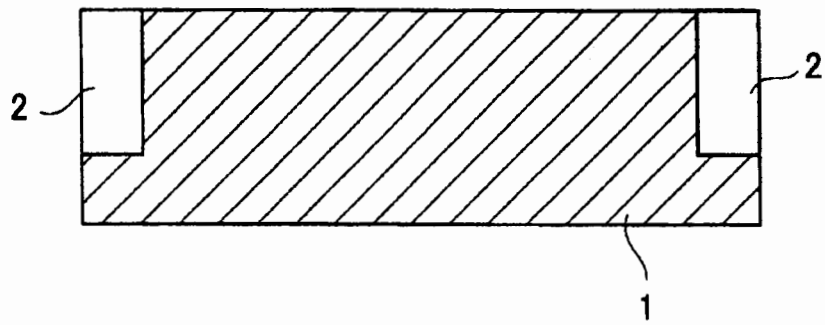


Fig5

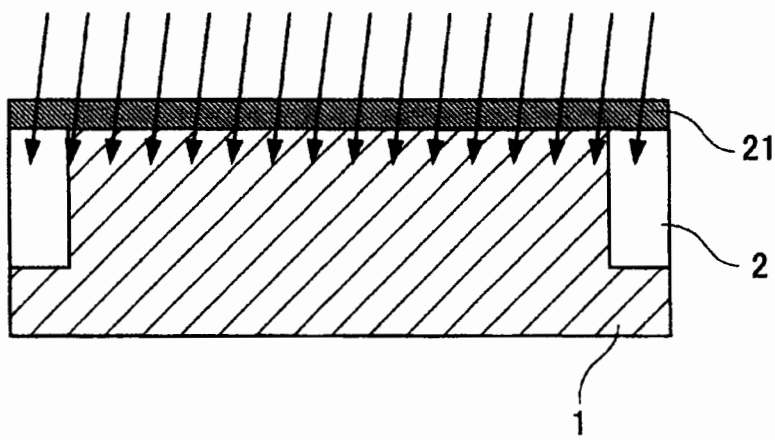


Fig6

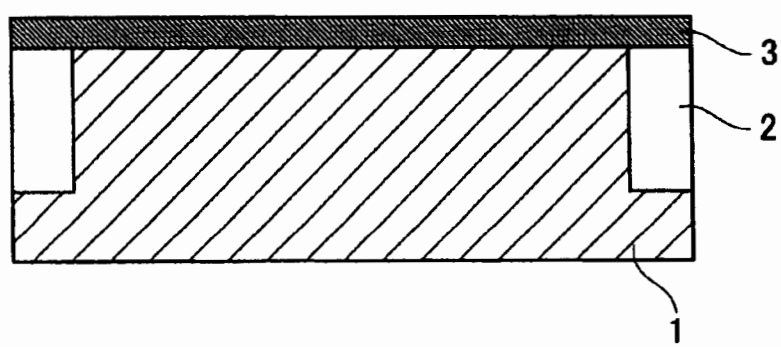


Fig.7

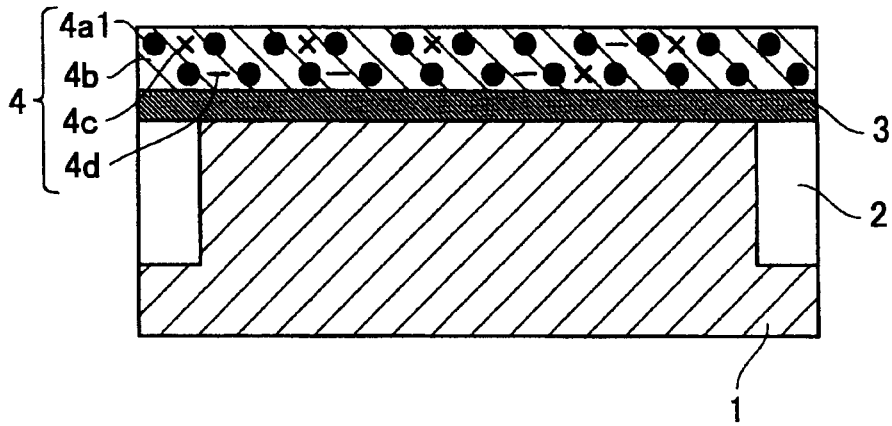


Fig.8

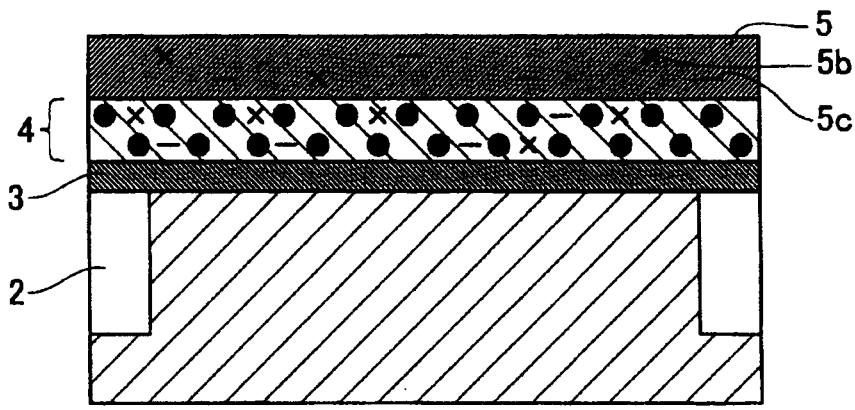


Fig.9

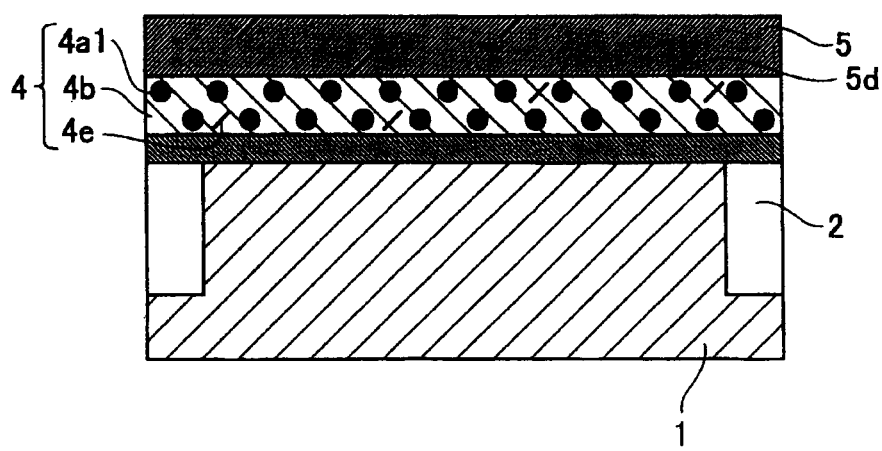


Fig10

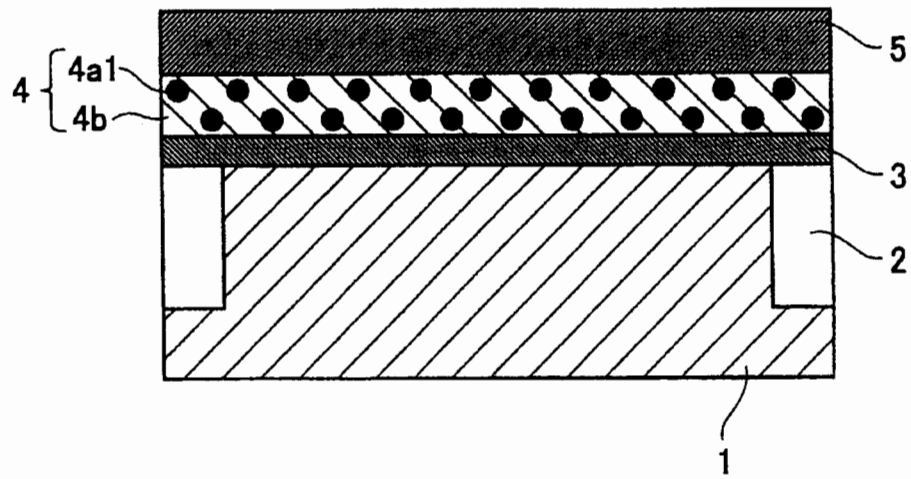


Fig11

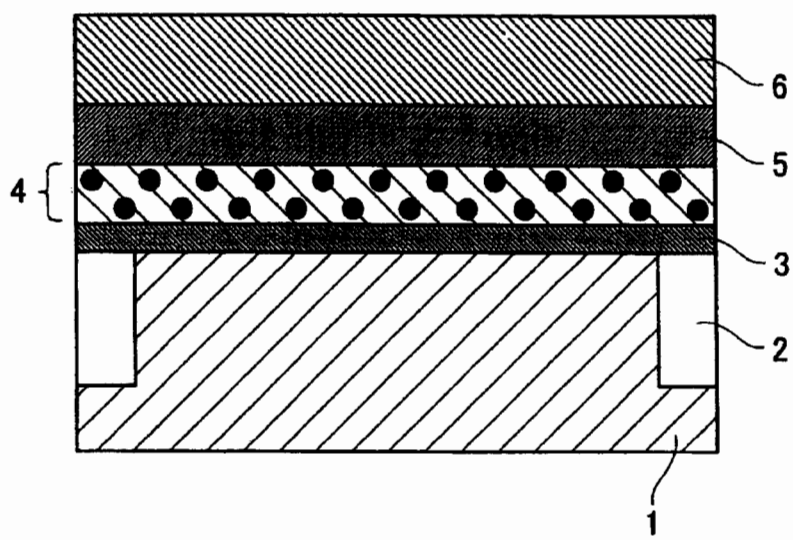


Fig.12

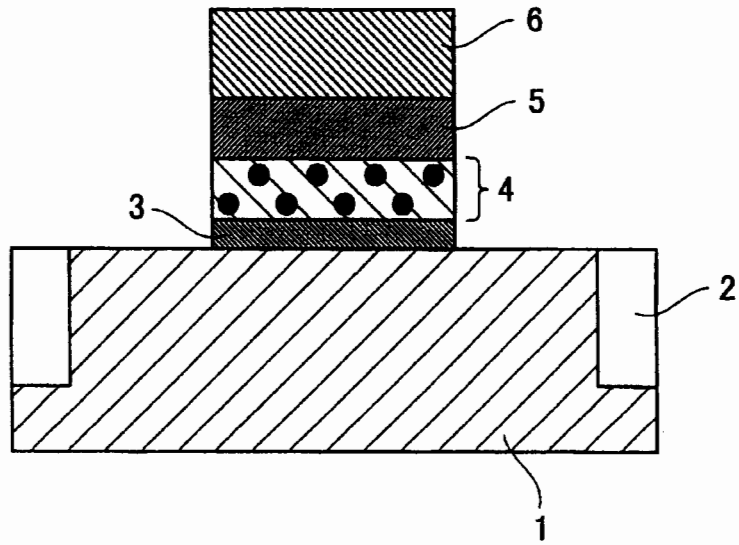


Fig.13

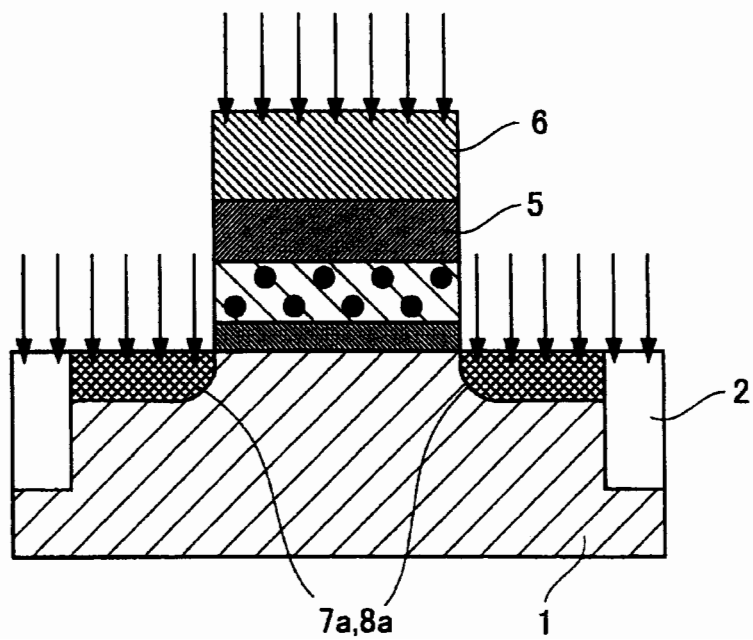


Fig.14

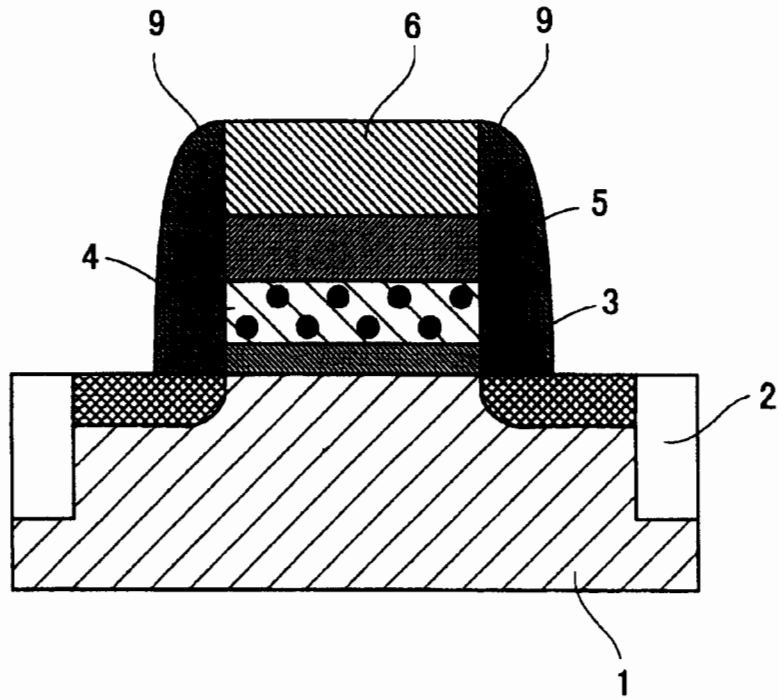


Fig.15

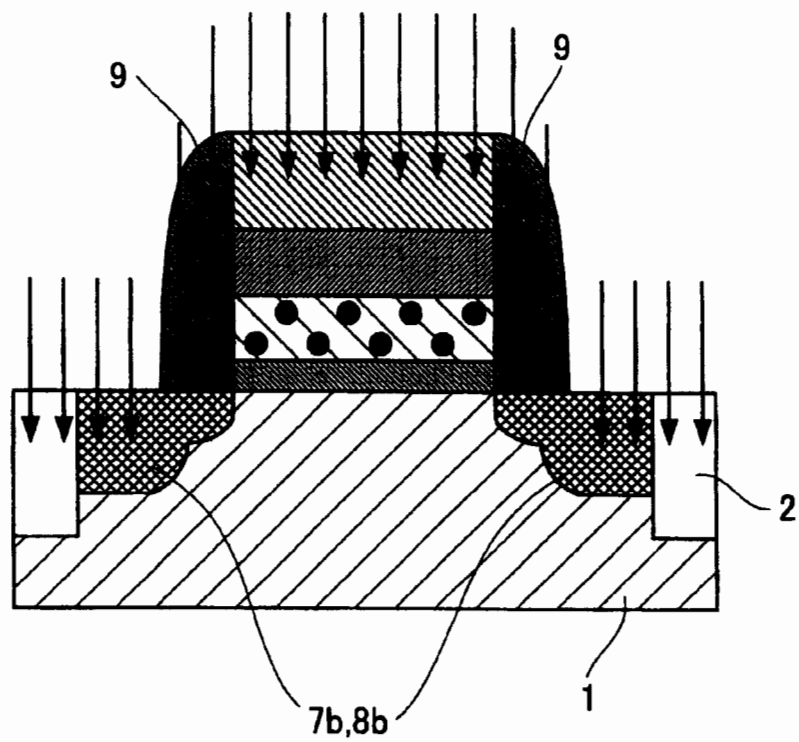


Fig16

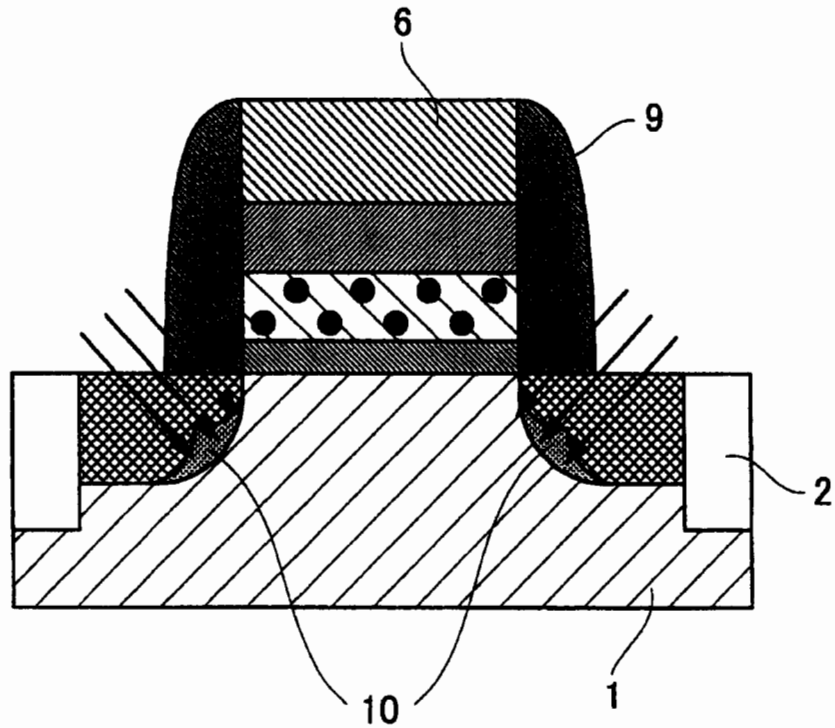


Fig17

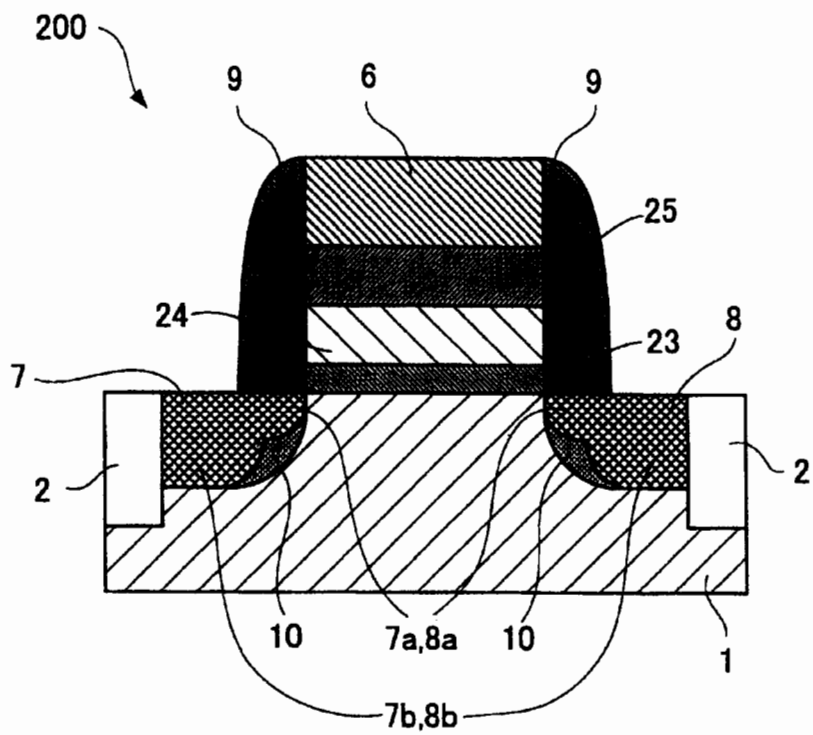


Fig.18

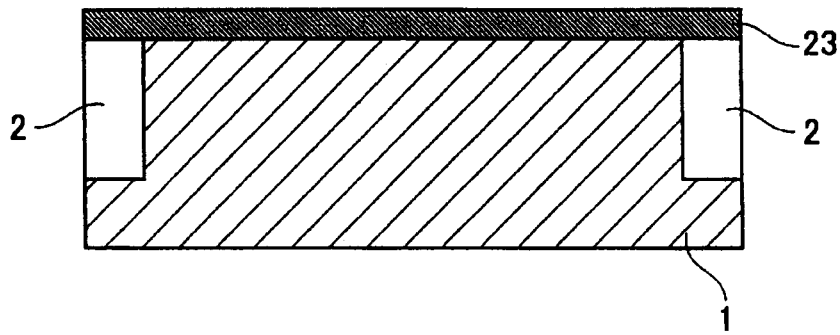


Fig.19

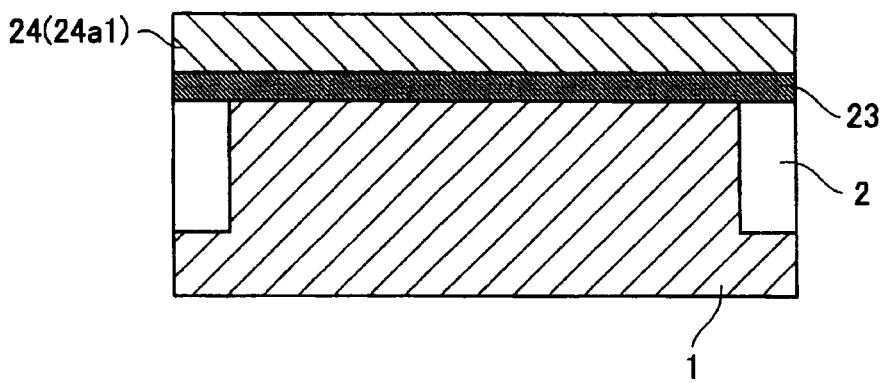


Fig.20

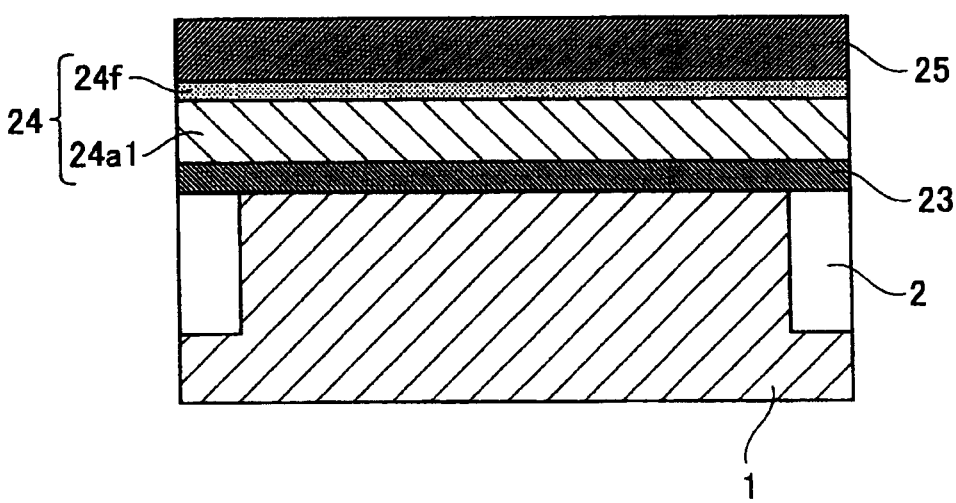


Fig.21

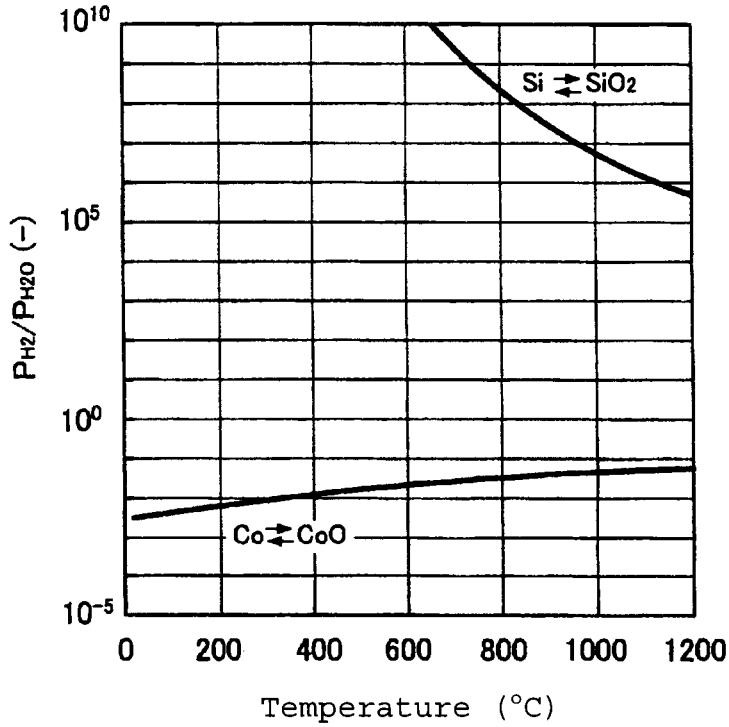

10^{10}
10^{5}
10^{0}
10^{-5}
P_{H2}/P_{H2O} (-)
Si ⇄ SiO_2
Co ⇄ CoO
0
200
400
600
800
1000
1200
Temperature (°C)

Fig.22

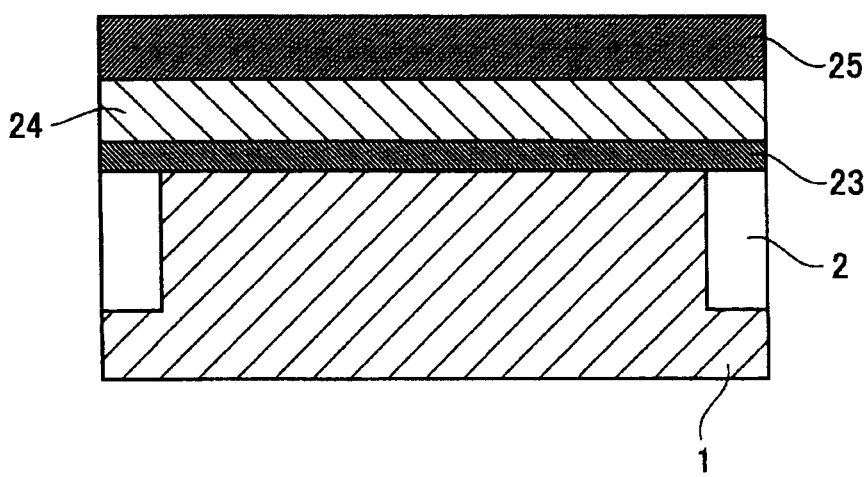

25
24
23
2
1

Fig.23

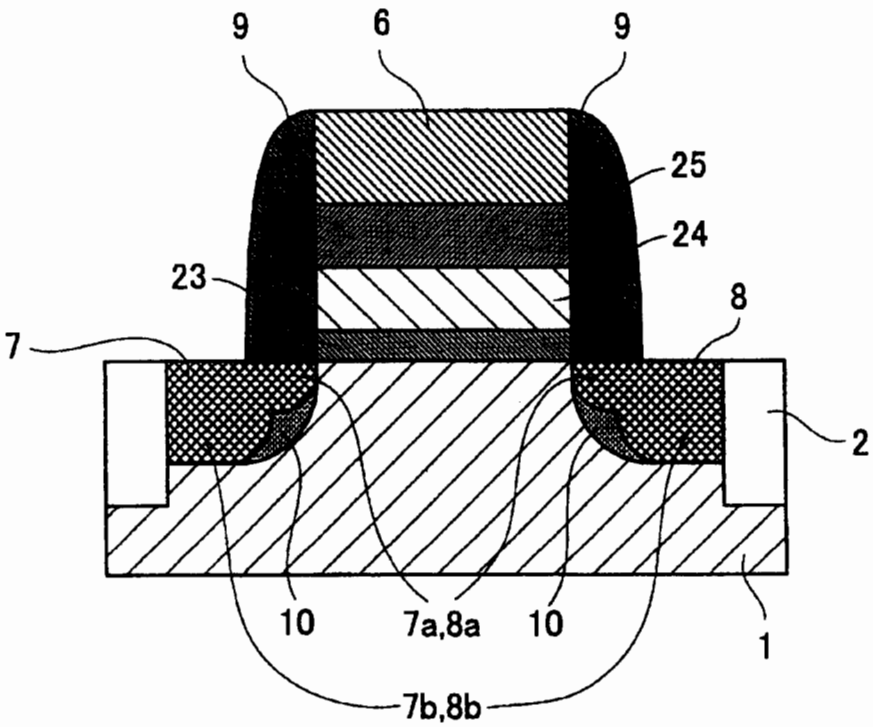

9
6
9
25
24
23
8
7
2
10
7a,8a
10
1
7b,8b

Fig.24

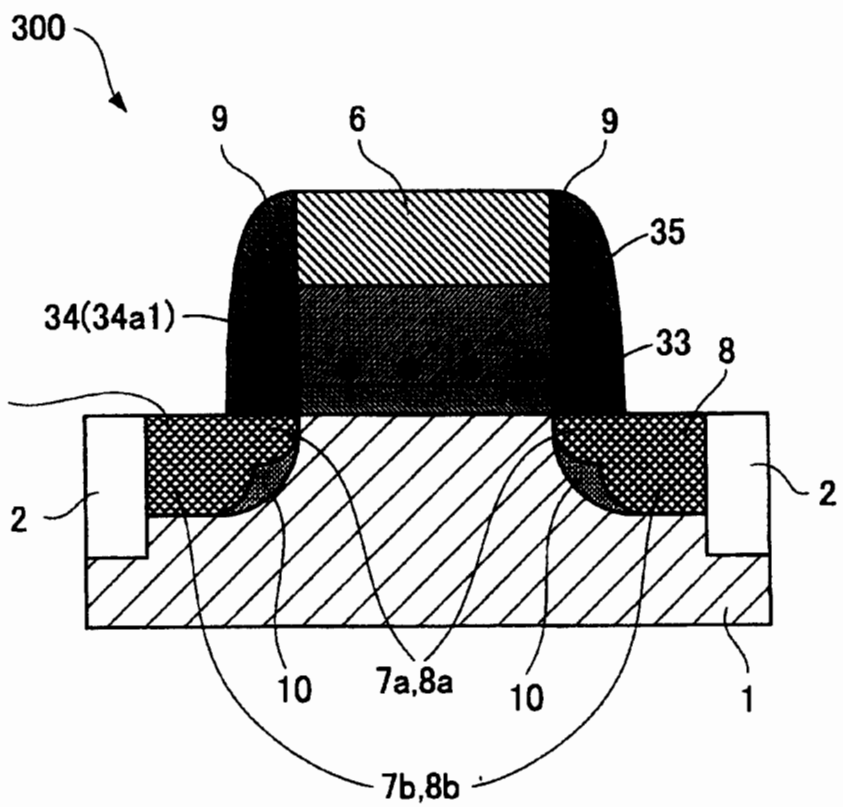

300
9
6
9
35
34(34a1)
33
8
7
2
2
10
7a,8a
10
1
7b,8b

Fig.25

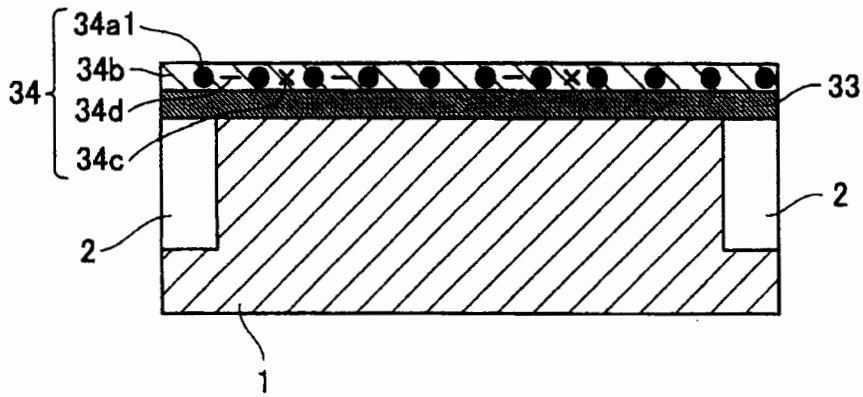


Fig.26

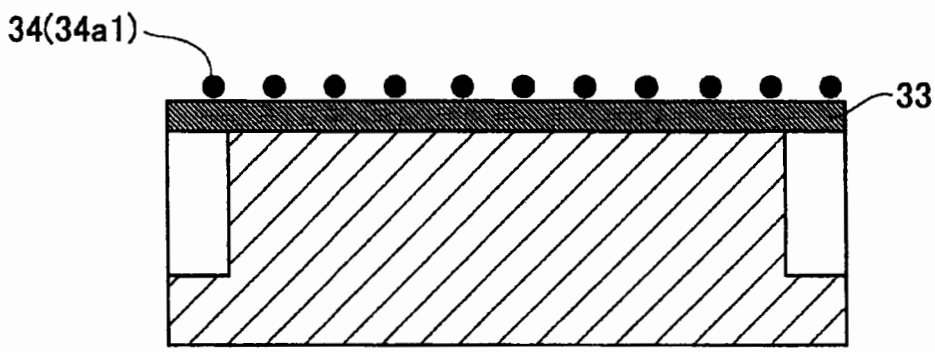


Fig.27

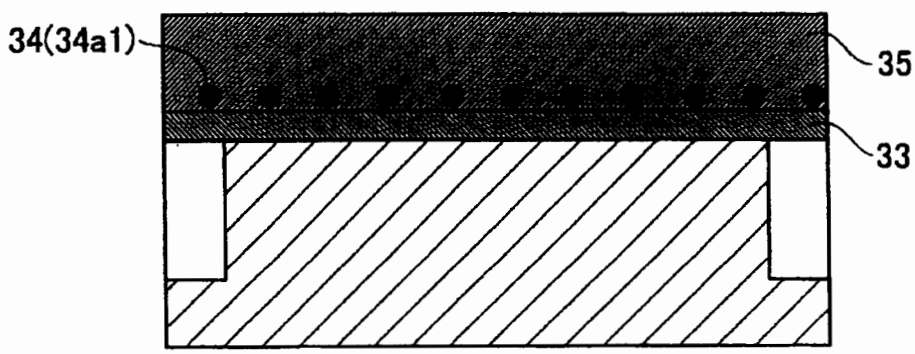


Fig.28

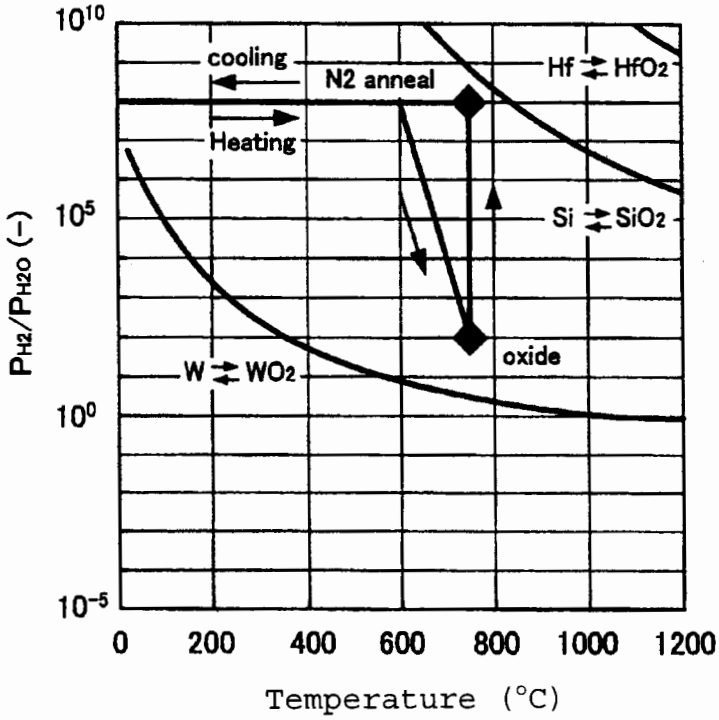
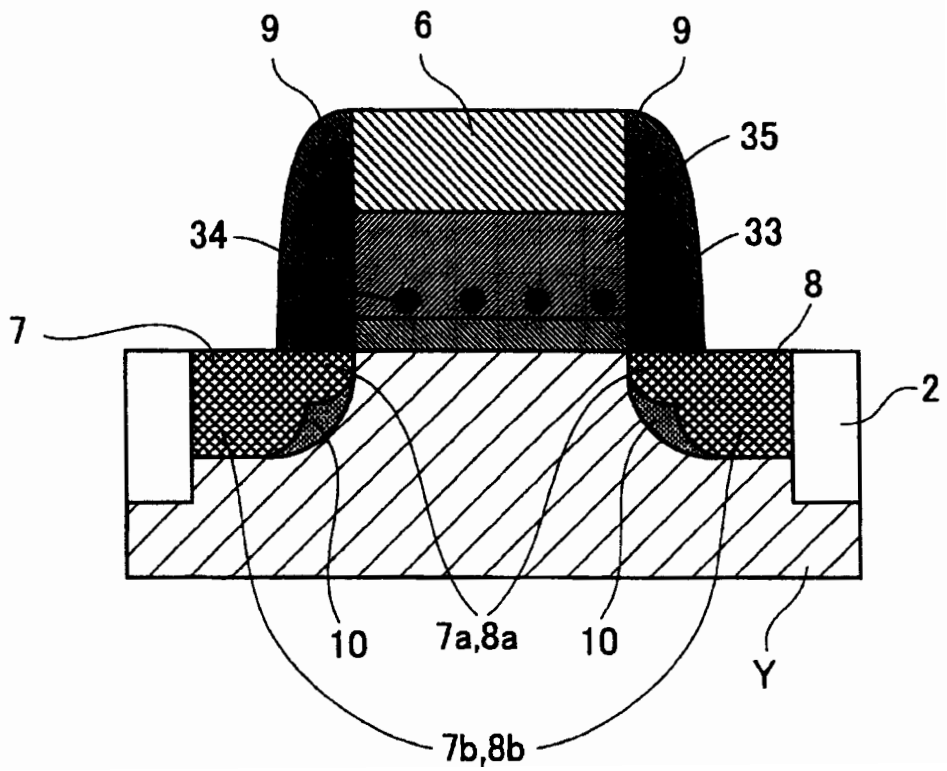

10^{10}
10^{5}
10^{0}
10^{-5}
P_{H2}/P_{H2O} (-)
cooling
N2 anneal
Heating
Hf ⇄ HfO2
Si ⇄ SiO2
W ⇄ WO2
oxide
0
200
400
600
800
1000
1200
Temperature (°C)

Fig.29


9
6
9
35
34
33
8
7
2
10
7a,8a
10
Y
7b,8b