

g gate type memory device) (floating trap type memory device) (floatin
 (free carriers)

(reliability) 가 가 가 가
 (deep level trap) 가 , 5 10V
 가

SONOS(Silicon Oxide Nitride Oxide Semiconductor)

1 (20), (22), (24) p- (27) (10) 가
 n+ (28) (22) (20) 가
 2 1 |-' (10), (20), (22), (24) (27) (pote
 2 가 , 가

ntial barrier) (22) 5eV 가 , (20) (22) (conduction band) 가 1eV, 가 (balance band) 2eV 가 (trap level) 가 (dangling bond) 가 (hole) 가 1 (E₁) 가 2 (E₂) 가 3 (E₃) 가

(27) 가 , (20) 가 (22) (program state)가 가 3 (27) (threshold voltage) (22) (10) 가 (20) (10) (22) 1 (E₁) (erase state)가 가 , 가 가

가 가 20 F-N 가 20 가 50 F-N 가 20 가 20

20 (retention)
 F-N (effective mass) 가 F-N F-N

가 1 가

$$E_{ot} = E_{ob} = \frac{Vg - \phi ms - 2\phi b}{X_{ot} + \frac{\epsilon(ot)}{\epsilon(SIN)} + X_{ob}}$$

ot, ob, SIN, ms, b, X, E, Vg

가 가 가 가 가 가 가 가 가

가 F-N (effective mass) 가

2 3 가 Q

$$E_{ot} = \frac{Vg - \phi ms - \phi b - Q \left(\frac{X_{ot}}{\epsilon(ob)} + \frac{X_n}{2\epsilon(n)} \right)}{X_{ot} + X_n \frac{\epsilon(ot)}{\epsilon(n)} + X_{ob}}$$

$$E_{ob} = \left(E_{ot} + \frac{Q}{\epsilon(ot)} \right)$$

ot, ob, n, ms, b, X, E, Vg, Q

가 20 가 F-N

20

NAND

SONOS(Silicon Oxide Nitride Oxide Semicon

4
4
ductor)
(27)

(10), (20), (22), (34),

4 5

$$E_{ot} = \frac{V_g - \phi_{ms} - 2\phi_b}{X_{ot} + X_n \frac{\epsilon(ot)}{\epsilon(n)} + X_{ob} \frac{\epsilon(ot)}{\epsilon(ob)}}$$

$$E_{ob} = E_{ot} \frac{\epsilon(ot)}{\epsilon(ob)}$$

ot, ob, n , ms b , X , E , Vg

가

5

가

SONOS

가

가 가

6

가

가

가

가

6

$$\Delta E_{ot} = \frac{(Vg - \phi_{ms} - 2\phi_b) \left(1 - \frac{\epsilon(ot)}{\epsilon(ob)}\right) X_{ob}}{\left(X_{ot} + X_n \frac{\epsilon(ot)}{\epsilon(n)} + X_{ob}\right) \left(X_{ot} + X_n \frac{\epsilon(ot)}{\epsilon(n)} + X \frac{\epsilon(ot)}{\epsilon(ob)}\right)}$$

(ob)

가

7 8

7

$$E_{ot} = \frac{Vg - \phi_{ms} - \phi_b - Q \left(\frac{X_{ot}}{\epsilon(ob)} + \frac{X_n}{2\epsilon(n)}\right)}{X_{ot} + X_n \frac{\epsilon(ot)}{\epsilon(n)} + X_{ob} \frac{\epsilon(ot)}{\epsilon(ob)}}$$

8

$$E_{ob} = \left(E_{ot} + \frac{Q}{\epsilon(ot)}\right) \frac{\epsilon(ot)}{\epsilon(ob)}$$

, Q
가

(ob)

(ot)

가

가

, ,

6

가

가

가

가

5 7
5
(44), (27)
(27)

(27)

(36)

가

(10), (22)
(44)

(20), (27)
(34)

(22), (34)
(36)

6
(54), (38)
7
(64), (22)
(36)

(27)

(27)

(36,38)

가

(10), (22)
(34)

(10), (34)

(20), (27)
(38)

(27)

(20), (38)

(22), (34)

(22), (34)

(38), (34),

(ob) (ob)

가

가

가

X_{ot}

4

7

5

7

가

X_{ob}

(metallic oxynitride)

B

(metallic oxide)

percent)

(HfO₂),

e; Hf_xSi_{1-x}O₂),
r-Silicate; ZrxSi1-xO₂),

25

8.3eV

(interface state density)

(Hafnium aluminate; Hf_{1-x}AlO_y)

(Hf-Si-oxynitride),

(Zr-Si-oxynitride)

(gap) 8.3eV

(ZrO₂)

0.1%(weight percent)

30%(weight

(ZrO₂),

(Al₂O₃)

(Hafnium silicat

(Z

(Y_2O_3) , (Ta_2O_5) , (TiO_2) , PZT[Pb(Zr,Ti
 $(PbTiO_3)$, $PbZrO_3$, PZT[(Pb,La)(Zr,Ti)O₃], (PbO),
 $(BaTiO_3)$, (V_2O_5) , BST[(Ba,Sr)TiO₃], SBT(SrBi₂Ta₂O₉), Bi₄
 Ti_3O_{12} ,
 (Si_3N_4)
 (ferroelectric layer)
 8
 9 10 8 I-I'
 8 10 (10) (Act) (Act)
 (117g) (117g) 가 (117m) (117s) (Act) (117s)
 (112) (Act) (114) (117m) (110), (112) 가
 (114) (117g) (117m) (117m) (110) (112) (11
 7s), (117g) (117m) (117m) (102)
 (CSL) 가 (CSL) (117g) (117g) (; 102s)
 (Act) (117g, 117m, 117s) (120) (; 102d) (117s)
 (120) (117m) (; 102d) (DC)가
 가 (120) (BL) (DC) (117g, 117m, 117s)
 (117m) (Act) (Act)
 (117s, 117g) (Act) (117g) (117s)
 9 (8 Act) (110), (112) (114) (117s)
 (117s) 가 (117g)
 10 (8 Act) (117g) (116) (117s)
 (116)

20

F-N

(57)

1.

;

;

,

,

;

2.

1

3.

1

(Mendeleef Periodic Table)

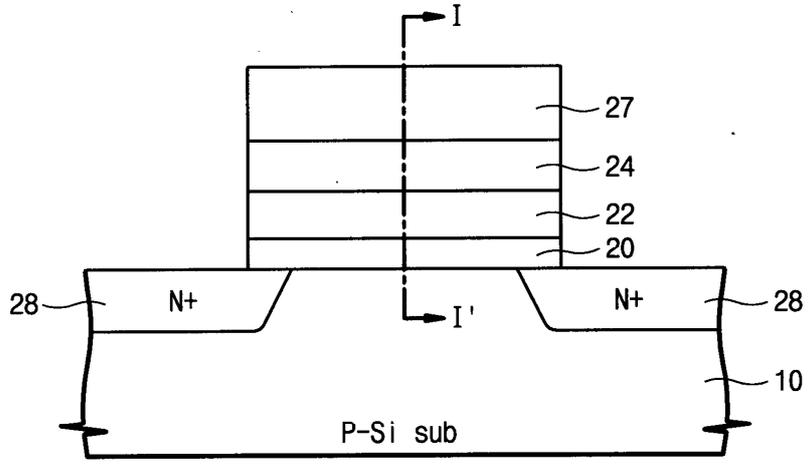
B

(metallic oxide layer)

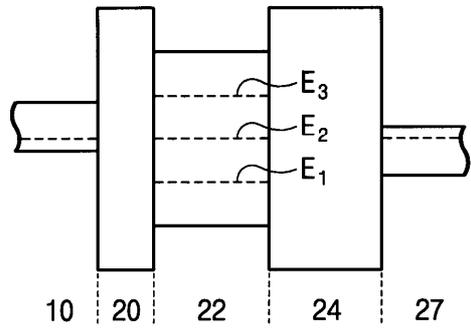
(metallic oxynitride layer)

14. 12 , (Mendeleef Periodic Table) B
15. 12 , B
 가 30%(weight percent) 가 0.1%(weight percent)
16. 15 , Zr, Si, Ti, Hf
17. 12 ,
 (HfO_2) , $(\text{Hf}_{1-x}\text{Al}_x\text{O}_y)$, $(\text{Hf}_x\text{Si}_{1-x}\text{O}_2)$,
 $(\text{Hf-Si-oxynitride})$, (ZrO_2) , $(\text{Zr-Silicate}; \text{ZrxSi}_{1-x}\text{O}_2)$,
 $(\text{Zr-Si-oxynitride})$
18. 12 ,
 (Al_2O_3) , (Ta_2O_5) , (TiO_2) , PZT[Pb(Zi,Ti)
 (PbTiO_3) , PbZrO_3 , PZT[(Pb,La)(Zr,Ti)O₃], (PbO) ,
 (SrTiO_3) , (BaTiO_3) , BST[(Ba,Sr)TiO₃], SBT(SrBi₂Ta₂O₉), Bi₄Ti₃O
19. 12 , ;
20. 12 , ;
21. 12 , ;
22. 12 ,
 (Si_3N_4) , (silic
 on rich SiO₂), (ferroelectric layer) 가
23. 12 ,
24. 12 ,

1
(종래 기술)

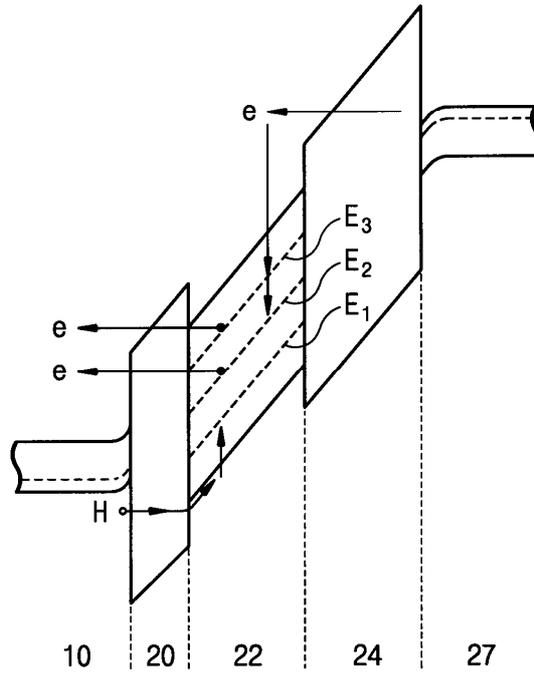


2
(종래 기술)

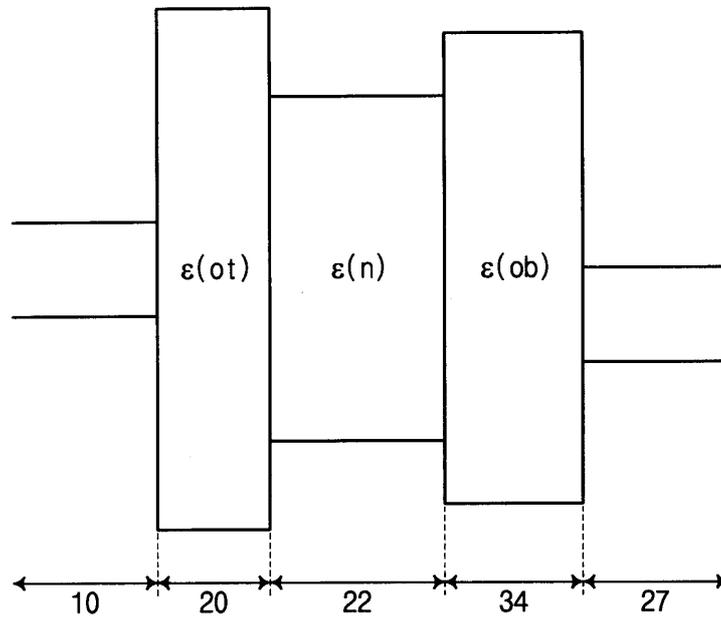


3

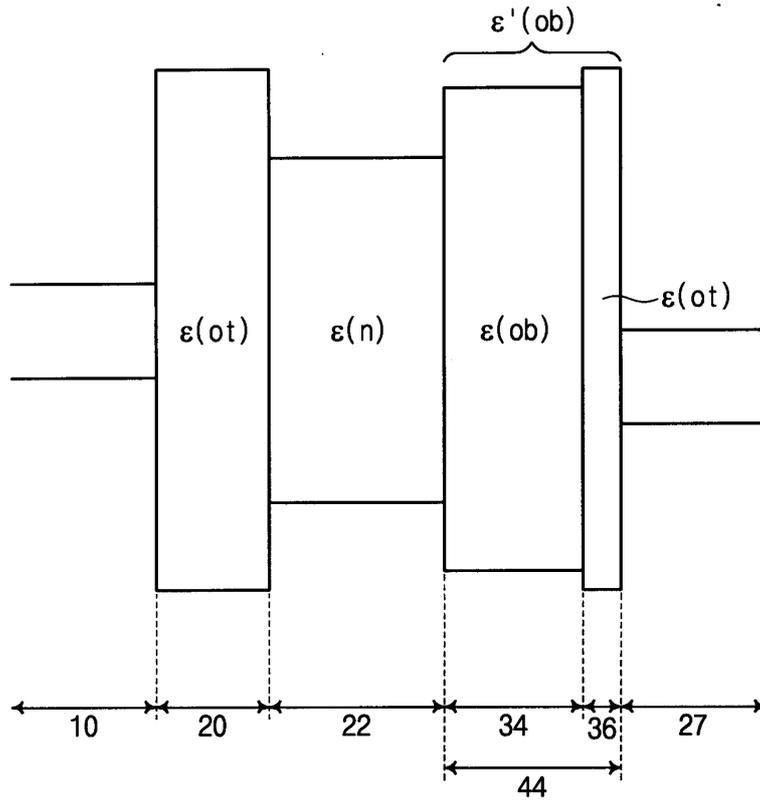
(종래 기술)



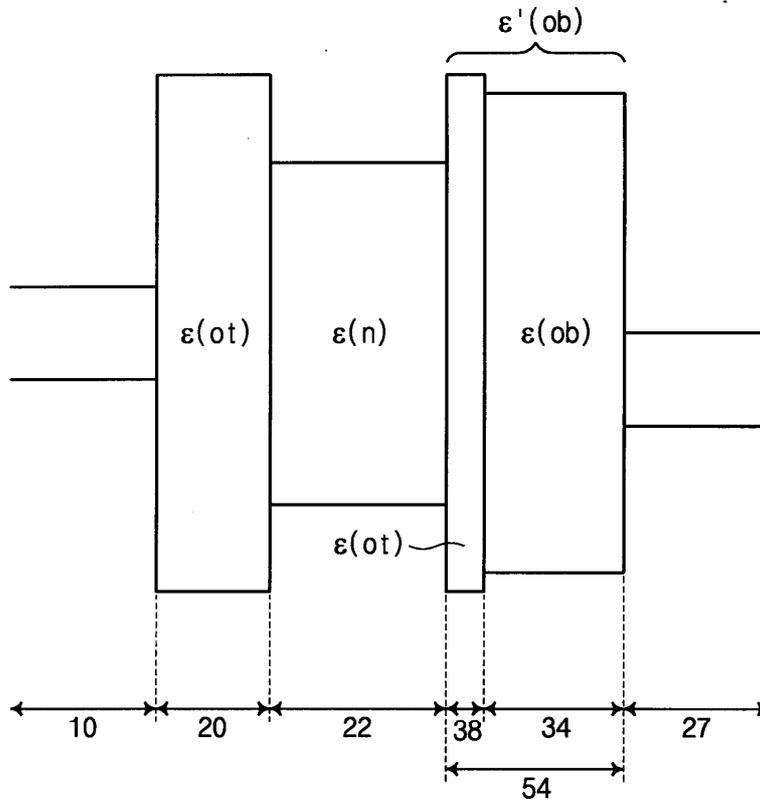
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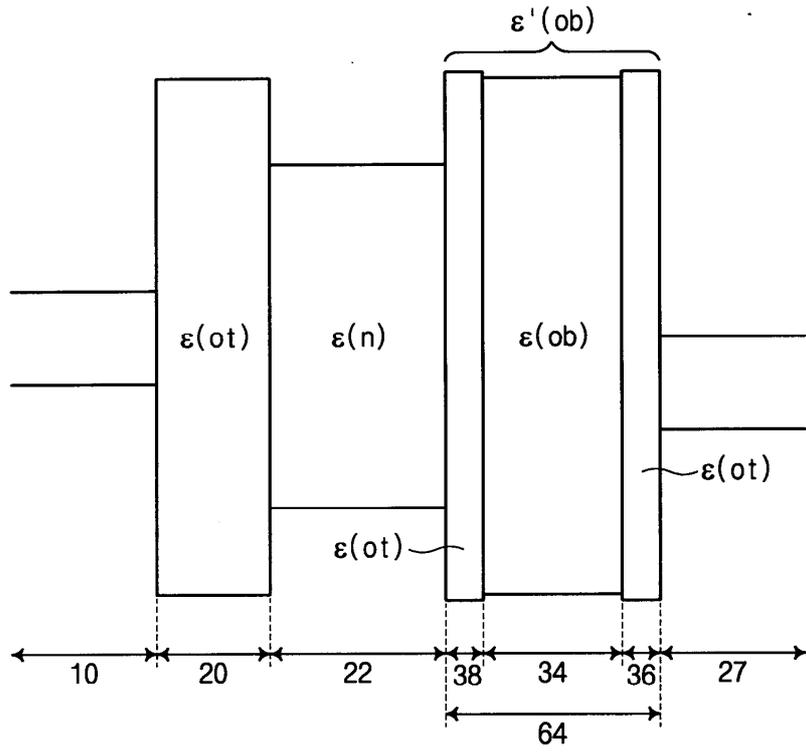
5



6



7



8

