

, , , ,

() (,)

, , .

가 " . , 가 가 가 " " 가 "

가 가 (, " ") 가 가 (5.5eV) 가 , , 가

가

7 - 282715

29

, 29 (1113) (1114) (1112) () (1112) (1111) (1113) (1113) (1114) (1113)

29 (1113) (1113) (1113) (1113) (1112) () 가 (1113)

, , 29 가 가 가

()

(1)

, (2)

, (3)

가

1000

(vapor phase technique)

가

가

600

$1 \times 10^{13} / \text{cm}^3$

DC

가 $1 \text{ k}\Omega \text{cm}$

가 $1 \text{ mV}/\mu\text{m}$

3.5 eV

1mm

1nm

3.5eV

10nm $10 \mu\text{m}$

3.5eV
Ga, Al, In B

500nm

가

가

가

가

가

(blasting)

$1 \times 10^{10} / \text{cm}^2$

C

D

가

가 DC

가

DC

AC

가

가

DC

1a

1

1b

1a

()

1c

1a

()

1d

1

1e

1

2		1	.
3		1	.
4		2	.
5a		3	.
5b		3	.
6a		4	.
6b		4	.
7		5	.
8		6	.
9		7	.
10		8	.
11		9	.
12		9	.
13		9	.
14		10	.
15		11	.
16		12	.
17		10	.
18		11	.
19(a)	(c)	1a	.
20(a)	(d)	4	.
21(a)	(c)	5a	.
22(a)	(d)	6a	.
23(a)	(c)	7	.
24(a)	(d)	8	.

25(a) (c) 9

26(a) (d) 10

27 13

28(a) (d) 27

29

가 , 29 가 (1112) (1113)

(1112) (1113)가 , , (1112) (1113)가 , (1112) 가 (1113) 가 , (1112) 가

가 , 29 (1112) (1113)

가 , (1) 가

1a 1 1a

1a (1) (2) (4) (3) (1) (23) (3) (2)

가 (3) () 가 (1) (3)가 (3) (1) (3) 1c () (3) (3) (2) (3) () (3) (3) (2) (3) () (3) (3) (2) (3) () (3) (1) (3) 가 (2) (3) (2) (1) (3) 가

(2) (2) (3) ()
(2) (2) (3) (1) (3)

가 (3) (1) (3) (1) (2)

(3) () (3)

2 (2) (3) () (3)

(1)

(3) (3) 가 (3) (3) (1)

d (3) () (3) (1) 1
(2) 가

(2) (1) (3) 가 1e (2) (2)

) (2) (2) 1000 ()

1a (1) (4) (3) (3) (1)
(2) (2) (2) (3) (1)
, 2 (2) (3) (3) (1) (2) (1)
, 3 (3) (1) (2)

(3) (4) (3) (4)

가 (3) (3)

(3) 600

(3) , 가 .

(3) (3)가 , 가 가 (3) .

$1 \times 10^{13} / \text{cm}^3$

(4) (3) (1) (1) (11) (1) 가 , (11) (1)

1

, 19(a) , 500 , SiO₂ (2) (3) (1) Si (1) (11) (1) (1) , 19(c) , 19(b) , 10 μm (4)

(3) (3) (3) 가 (3)가 (11) (3) 19(b) (11) (11) (3)

, Si (11) 1mm 가 . $1\mu\text{A}/\text{cm}^2$ 가 3kV

, 2 (2) Cu (3)가 (1)

, 3 (2) (1) (1) (3) (2) 가 , 가 (2) (2) , 가

() , (3) (3) () , (3) (4) (1)

, 가 600 가

가 (3) , 가 ,

가 .

가 (3) $1 \times 10^{13} / \text{cm}^3$

(1) (2) (3)

(3) (1) 가 (3)

(2) 가

4 2

4 () (1) (11) () (2)

(4) () (3) (4) (2)

(5a) (5)

4 e가 (5a) 3 (5) 가 e가 1

(5) 가 () 가 3 e

(5) (4)

e (5) (5a) 4

(5a)가

2

20(a) (1) Si (11) 20(b)

, 500 SiO₂ (2) (1) , 20(c) , 10 μm

(3) SiO₂ (2) (4)

(3) (3) 가 (3)가 (11) (3)

20(b) (11) (11) (3)

() (3) () (3) (4) (1)

() (3)

(5a) (5) (5)가 (4) 20(a) 1mm

(5) 가 , 1 $\mu\text{A}/\text{cm}^2$ 가 3kV

(4) , (3)가 (3) (5a) (5) .
 , e 가 () 가 .
 , 10kV 가 .
 () (2) , (4) () (3)
 3) () (1) 1 , 1 (2), (

(3) (3) (3) (3) (4) (1) (2) (2)
 (1) (3)가 4 , (3) 1 , (1) (2) (3)

(3)

5a 3 .
 5a , () (1) (11) (1) () (3)
 (3) () (2) (4) (2)

5a 5a , (4)
 (3) (2) 1 , (3) (1)
 (2) (1) (3) (3)
 , e (2) 가 (3)

3 .
 , 21(a) , (1) Si .
 (1) (1) .
 () 가 10 μ m (1)

(1) (sand blasting) 가
 (1) .
 (1) 가 ,
 2 μ m (1) (1)

(1) (11) (1) (1)

, 21(b) , 500 SiO₂ (2) (1)
 , 21(c) , 10 μ m (3) SiO₂ (2)
 (4)
 (3) (3)
 21(b) (11) 가 (3)가 (11) (3)
 (11) (3)
 () () , (3) (1)
 () (3) () (4)
 , (5) (11) 1mm (5) 가 . 1 μ A/cm²
 가 2kV
 () (1), () (2), () (3)
 , , 1
 (2) 5a (3) (3)가 (1) (3)
 (1) (1) (2) , (3) , (3)
 (1) (2)
 (3) , (,) (3) (2)
 (1) 가
 5b , (3) (2) 5a
 (1)
 (4)
 6 4
 6a , () (1) (11) (1)
 () () (2) () (3)
 (3) (5a) (4) (4) (2) (4)
 (5) (4)
 6a e가 (5a) 3 (5) 가 , e
 e가 (5) 가 ()가 , 3 , e
 가 (5) (4) ()
 , e
 4

22(a) (1) Si (11) .
 (1) () (1) 10 μ m .
 가 가 (1)
 (1) 가 .
 (1) 가 .
 2 μ m (1) 가 (1)
 (1) (11) (1) (1)
 22(b) , 500 SiO₂ (2) (1)
 22(c) , 10 μ m (3) SiO₂ (2)
 (4)
 22(b) (3) (3) 가 (3)가 (11) (3)
 (11) (3)
 () , (3) () (3) (4) (1)
 () (3)
 (5a) (5) (5) (5a)가 (4) 22(d) (4) 1mm
 (5) 가 , 1 μ A/cm² 가 2kV
 (4) (3)가 (3) (5a) (5)
 e 가 () 가 .
 10kV 가 .
 () (2) () (3)
 () (1) 3 .
 (2), (3) , 1
 (2) 6a (3) (3)가 (1)
 (1) (1) (2) (2) (3) (3)

(1) (3) (3) (1)

(3) (1) (3) (2)

6b (1) (3) (2) 6a

(5)

7 5

7 1a (1) (6) (4) (6) 1a 1a

(1) 가 (6) 가 7

1a

5

23(a) 500 (1) Si (11) 23(b) (1) 가 1mA 가 1.5V , 10μm (3)

(1) (6) (3) SiO₂ (2) (4) 23(c) (4) (3) (11)

1 (3)

2μA/cm² () Si (11) 1mm (5) 가

가 3kV

() (2) (4) () (3)

(1) 1 (2), (

3)

(3) (3)가 (1) (2) 7

(3) (1) (3) (1)

(6)

8 6

8 4 (1) (6) (4) (6) 4

(1) () 가 (6) 가 8 4

1a

6

24(a) (1) Si (11) 24(b) (1) 가 1mA 가 1.5V
 , 500 SiO₂ (2) (1) () 10μm
 (1) (6) 24(c) (4) (3) (3)

11)

(5a) (5) (5) (5a)가 (4) 24(d) (4) 1mm
 (5) 가 , 1μA/cm² 가 2kV
 (4) (3) (5a) (5)
 (3)가 (5)
 e 가 () 가
 10kV 가

() (2) (4) () (3)
 () (1) 2 (2), (3)

3)

(3) (3) (3)가, (1) (2) 8
 (1) (2) (3) (1)

(7)

9 7
 9 5a (1) (6) (4) (6) 5a
 (1) () 가 (6) 가 9 5a
 5a

7

25(a) (1) 25(b) , 500 SiO₂ (2)
 Si (11) (1) (1) 가 1mA 가 1.5V (6)가 (1)
 (6) () 10μm (3)
 (3) SiO₂ (2) 25(c) (4) (3)
 (3) (3) (11)

2μA/cm² , () Si (11) 1mm (5) 가 .
가 2kV .

() (2) (4)
() (3) () (1) 3 .
(2), (3) , ,

(2) 9 (3) (3)가 (1) (2) (3)
(1) (1) , (3) 3 ,

8 3 . ,
(6) 5b .

(8)

10 8 .

10 6a (1) (6) (4) (6) 6a
(1) () 가 (6) 가 10 6a
6a

8 .

26(a) (1) (1) 26(b) , 500 SiO₂ (2)
Si (11) (1) 가 (6)가 ,
() 1mA 가 1.5V (1) (6)
26(c) , 10μm (3) (3) Si
O₂ (2) , (4) (3) (11)
(3)

(5a) (5) (5) (5a)가 (4) , 26(d) (4) 1mm
(5) 가 , 1μA/cm² 가 2kV .

, e 가 () 가 .
, 10kV 가 .

() (2) ()
) (1) , (4) 4 , (2),
(3) , ,

(2) 10 (3) (3)가 (1) (2) (3)
(1) (1) (3) 4 (3)

10 (6) 6b 4

(9)
9

(102) (103) (101) (104)
가 (103) (103) (103)
(101) (105) (104) 가 AC ((106) (107) (103) , AC
(107) (103) 가 (102)
(101), (103), 가

AC 가 (107) 가 가 ,
(107) (103) (101)
(102) (102) 가 가 (101)
(102) (102)
(103) . DC (107) (1)
(103) 가 가 (104)
(103) 가 (103)

12 11 . 11

12 (103) (107) DC (101)
, AC (106) (101) 가 (103)
가 DC (108) . AC (106) DC (108) (102)
가 (103) 가 (101)

(103) DC (101)
(102) DC
가

11 12 (102) 가 가 (101) (103)
 DC 1mV 가 (102) 1kΩcm (102)

11 12 (107), AC (106) DC (108) (103)
 (103)가 (101) 가
 (103)가 (103) (101) 가
 (102)가 (104) 가 DC (101)
 (101) (103) 가

(103) 가 (101) (102)
 가 (103) (103)
 (103) 가
 (103) 가 (103) , AC DC
 13 (103)

(104) (104) 가 DC 가
 (103) (101) 가 (101) (103)
 (103)가 (104) (104)

11 , 9
 11 (101) (Mo)
 0.02μm 가
 2g pH가 3 1 , 2 가 가
 5 x 10¹⁰ /cm⁻² .

900 CVD (1 10%) CO가
 CVD , 0.2μm 25 50 Torr 800
 CVD (102) (103)

가 . Ti Au가 . Ti Au (101) Au .
 , (104) 1mm 10^{-7} Torr .
 Mo (101) , (107) (107)
 AC (106) , AC (106) . (106)
 (103) 가 . 11 $1\mu A/cm^2$, 10 V/60 Hz AC (106)
 DC (108) 12 , 2.5kV DC DC (108) 가 DC
 10V 11 $1\mu A/cm^2$ (104) 가 .
 , AC DC 13 , 7kV DC (104)
 가 . $1\mu A/cm^2$.
 (10)
 14 10 .
) , (103)가 (109) (110)) (109)(, " (109)" , , (110)
 . (103)가 , , c sp2 .
 eV (103) (109)가 3.5eV ,
 (,) (103) 가 , ((103)가
 103)가 Ga, Al, In B .
 (103) (109) 1nm 1mm
 (109) 1nm , (109) 가 (109)가
 1mm , 가 , 가 .

, 1 μ m

(101) , Ni (103) Ni 가 (102) Ni 가

1 5 600 900

14

10⁻⁷ Torr

(104) 1mm

Ni 가 (101) , 7kV DC (104)

1 μ A/cm²

(17) (103) (107) 가 가

, AC (106) DC (108) , 12 9 가

(11)

15 11

15 (102) 3.5eV (101)

(102) (103) (103)

(102) (102)가 3.5eV (102)

가 Ga, Al, In B

(102)가 3.5eV 가 (103)

(102) (103)

1nm 10 μ m (102) (102) (103) 가 10 μ m (103)가 1

nm (102) (103) 가 (102) 가 10 μ m

(101)

(103) (102) 가 (103)

15

, 1 μ m , CVD , CO가 (1 (W) 10%) , 25 40 Torr , 800 900 , CVD , 0.2 μ m , 가 W (101) W 가 (102) , 가 (103) , 가 10⁻⁷ Torr (104) 1mm , W 가 (101) , 7kV DC (104) 1 μ A/cm² , 가 가 (103) (103) (107) 가 , AC (106) DC 18 (108) , 12 9 , (12) 16 12 , 16 (102) (102) (109) (103) (111) , (102) (109) (109) (109) (102) (109) (102) (103) (111) (103) (111) (109) 0.1 μ m 1 μ m 가 (103) (111) 0.01 μ m 0.1 μ m () 가 가 (103) (103) (111) 가 (102) (109) (101) (102) 가 , (101) 가 (102) 500nm 가 1 가

16

, 1 μ m
 CVD (109)
 CVD (109)
 CVD (109) W (109)
 W (109)
 CVD (109)
 (111) W (109)
 (101)
 W (101) W (109) W 가
 (111) (103) CVD (102) CVD 가
 W (101) W (109) W 가
 (111) (103) CVD 가
 (104) 1mm 10⁻⁷ Torr
 W 가 (101) , 7kV DC (104)
 1 μ A/cm²
 (102) (103)
 1 x 10¹⁰ /cm²
 500nm
 CVD
 (13)
 27 13
 (211) (212) (212a)
 (220) 213 (22)
 (211)) 가 , (212) (212b)
 (213b) (213a) (213) ((213b)가

(220) (211) , 가 .
 28(a) 28(d) .
 , 28(a) (211)
 (212) (212a) , (220)
 (213a) (28(b)). (213b) .
 (212b) (28(c)). , 27 (2
 12) 가 (28(d)).

가

, , , () ()
 () , () () ()
 , () .

, DC 가 가 , (1) ()
), (2) , (3) ,

(57)

1.

2.

1 , .

3.

4.

5.

6.

7.

1 , , .

8.

1 , .

9.

1 , .

10.

1 , , .

11.

1 , 1000 .

12.

1 , .

- 13.
1 , .
- 14.
13 , .
- 15.
14 , .
- 16.
14 , (vapor phase technique)
- 17.
13 , .
- 18.
14 , 가 (termination structure)
- 19.
17 , 가 .
- 20.
14 , 600 .
- 21.
17 , 600 .
- 22.
14 , .
- 23.
17 , .
- 24.

- 22 , .
- 25.
- 22 , $1 \times 10^{13} / \text{cm}^3$.
- 26.
- 23 , .
- 27.
- 23 , $1 \times 10^{13} / \text{cm}^3$.
- 28.
- 1 , .
- 29.
- 30.
- 31.
- 32.
- 33.
- 34.
- 35.
- 36.

37.

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61.

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‘
(thermal spraying technique)
‘

62.

63.

64.

65.

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66.

67.

68.

69.

70.

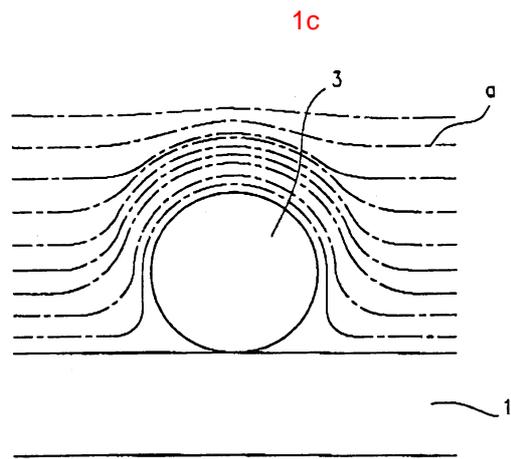
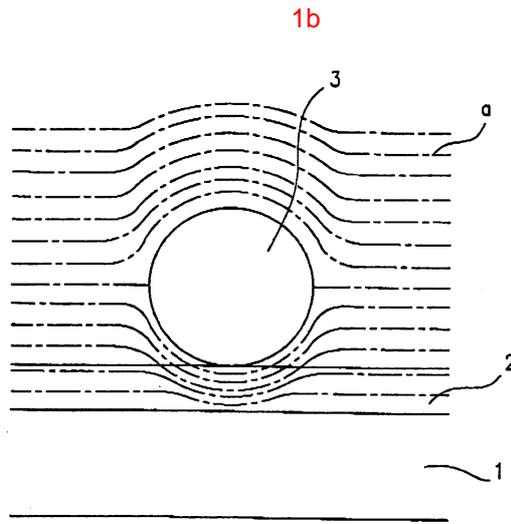
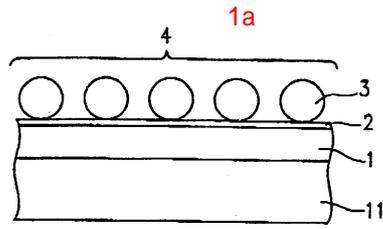
71.

72.

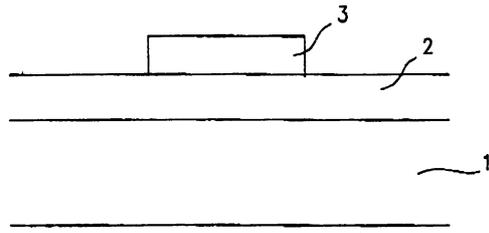
73.

74.

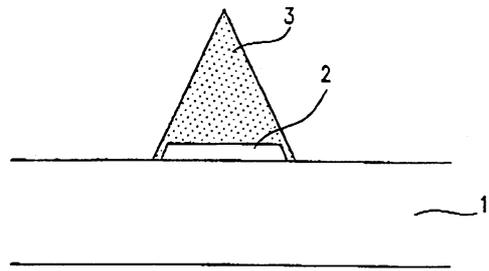
1 , 가 , 가 ,
가 , , .



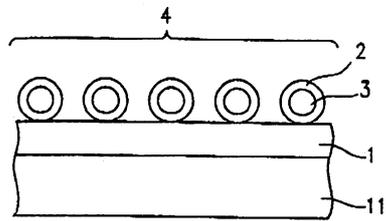
1d



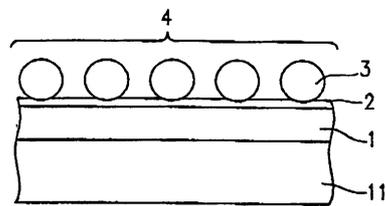
1e



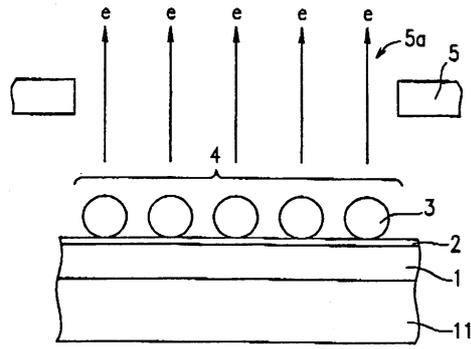
2



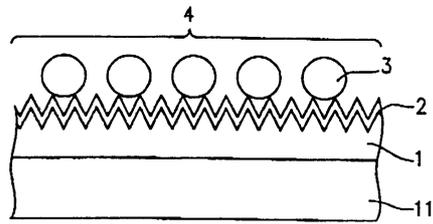
3



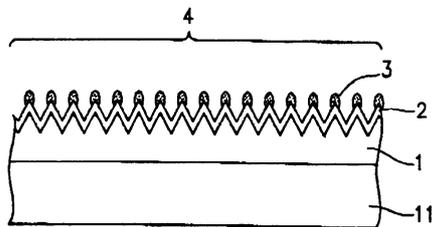
4



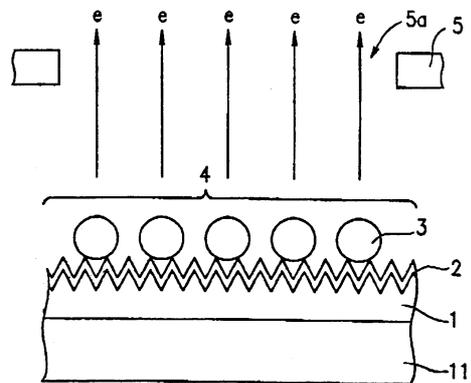
5a



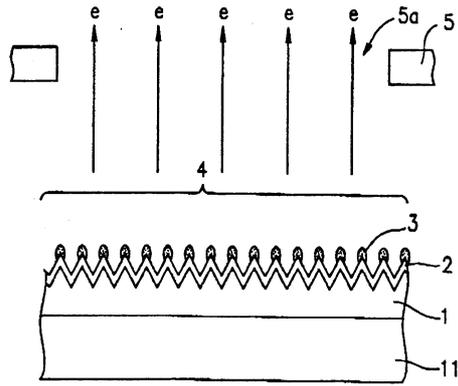
5b



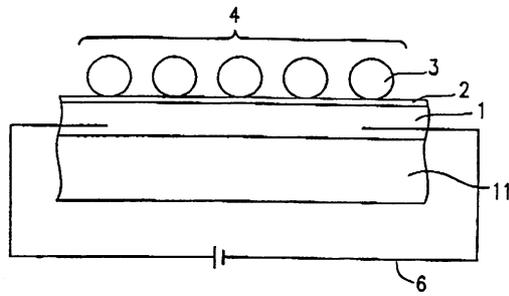
6a



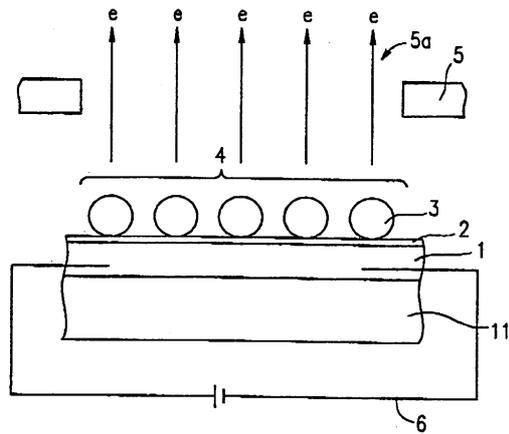
6b



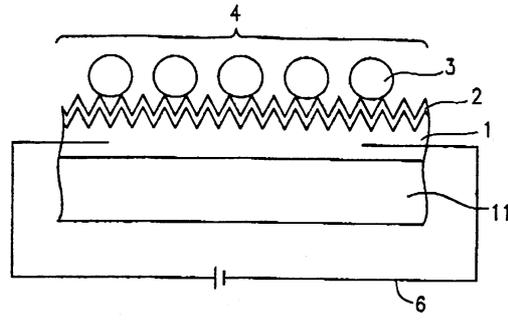
7



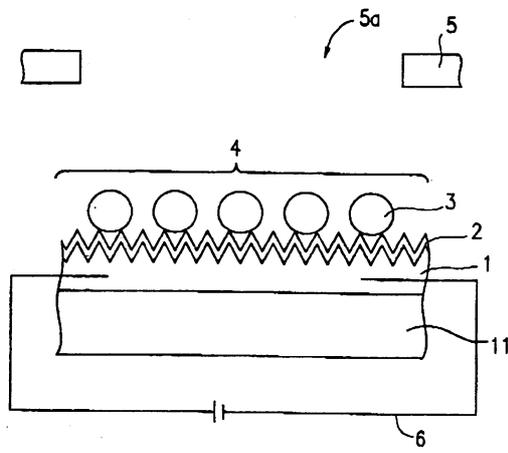
8



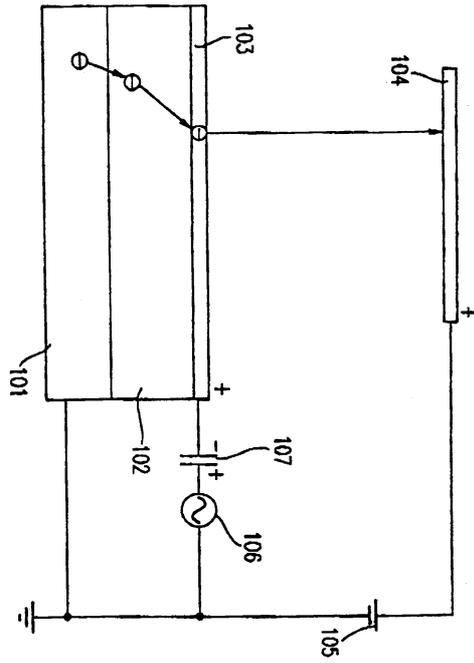
9



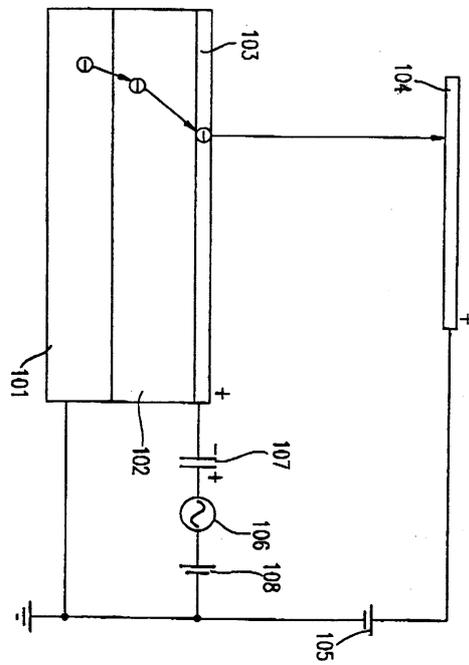
10



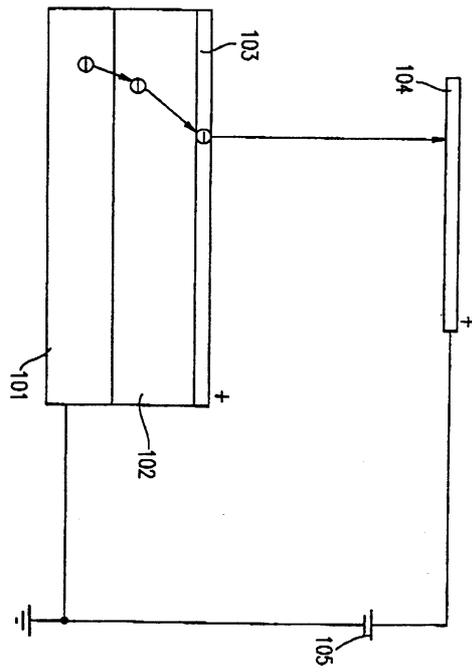
11



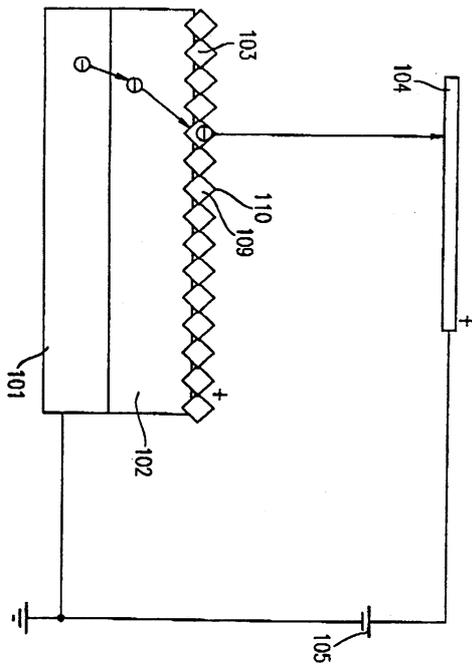
12



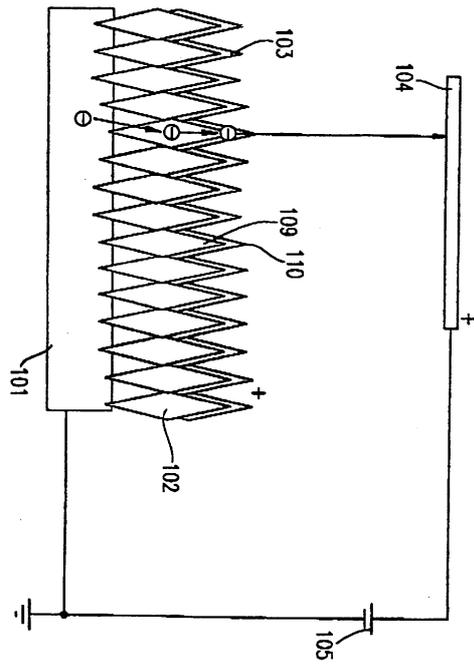
13



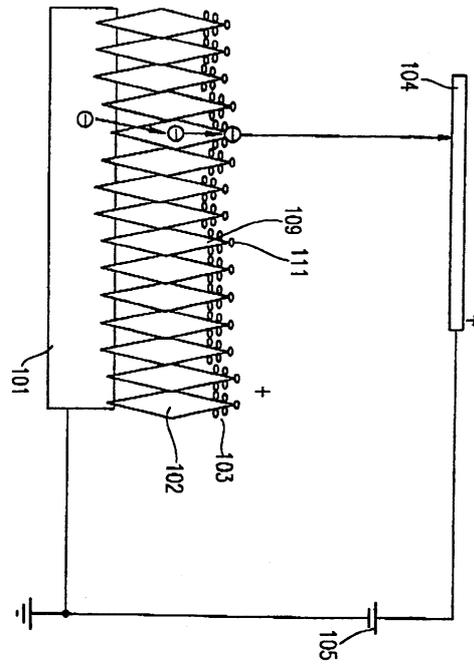
14



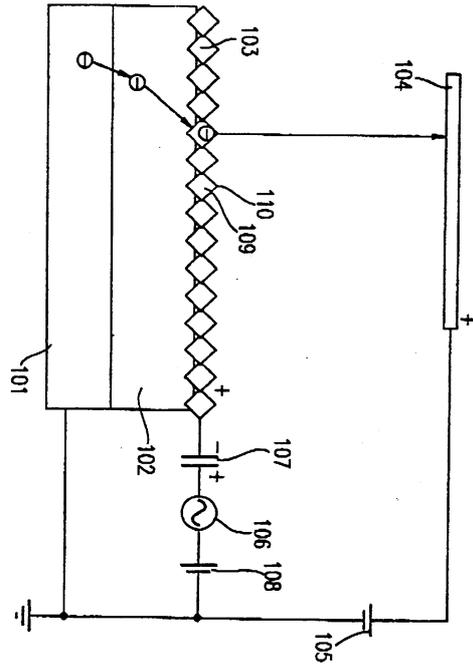
15



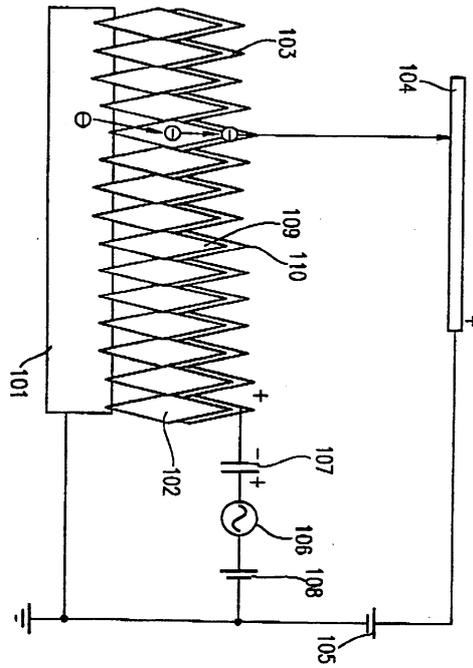
16



17

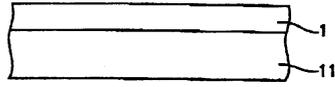


18

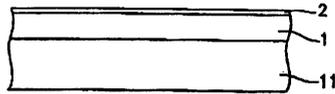


19

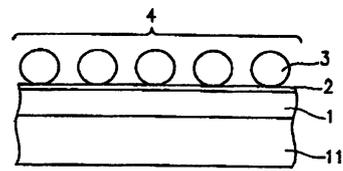
(a)



(b)

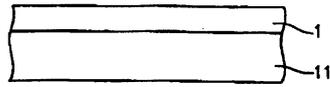


(c)

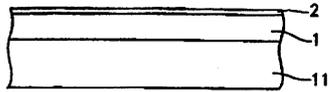


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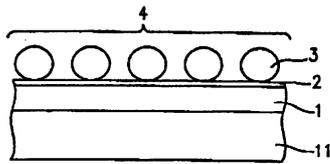
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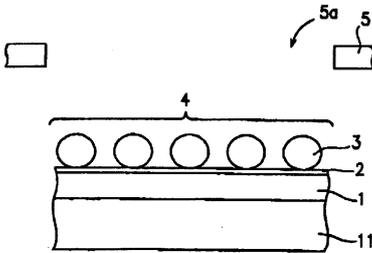
(b)



(c)

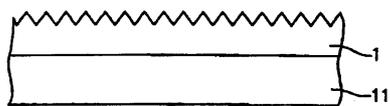


(d)

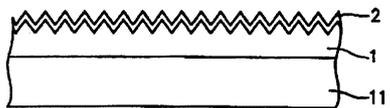


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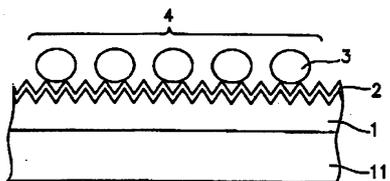
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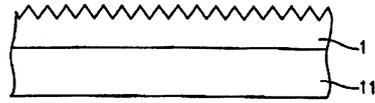
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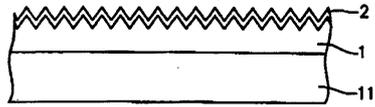
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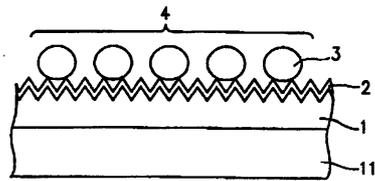
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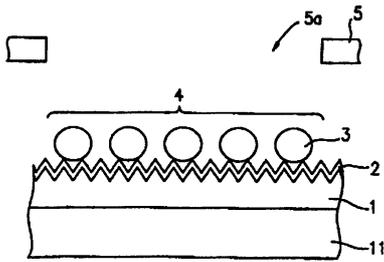
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(c)

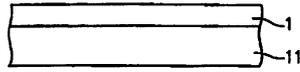


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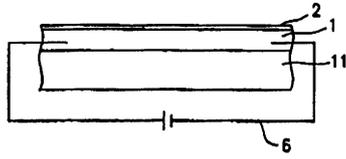


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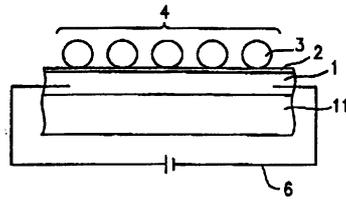
(a)



(b)

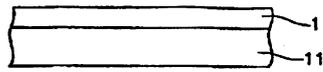


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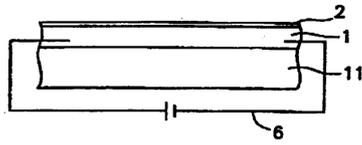


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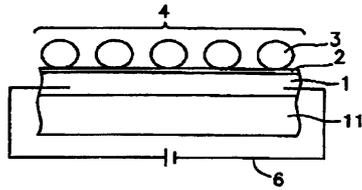
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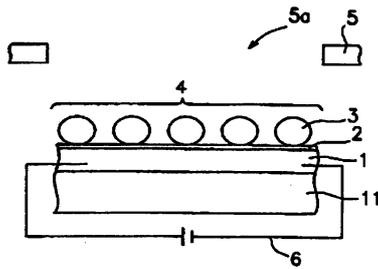
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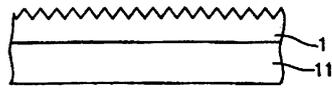


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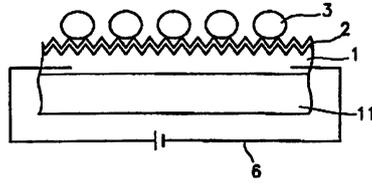


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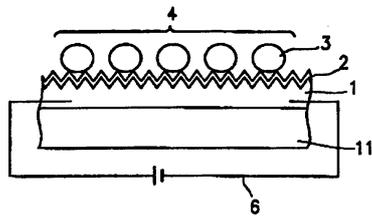
(a)



(b)

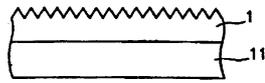


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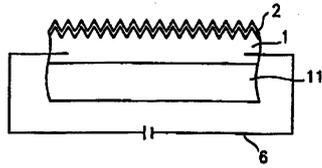


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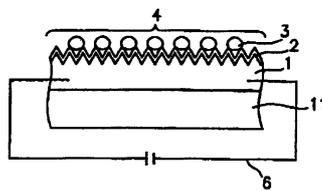
(a)



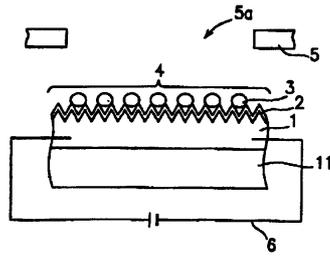
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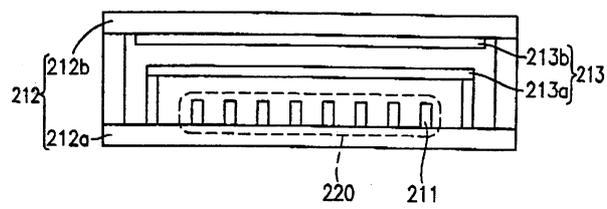
(c)



(d)



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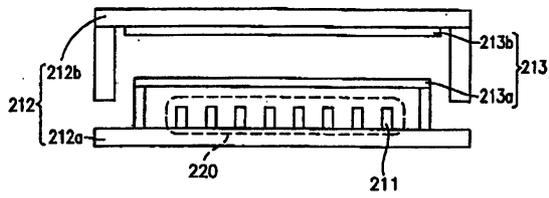
(a)



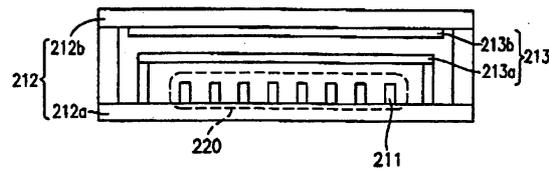
(b)



(c)



(d)



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