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2 10-1
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3 1
7 35
3 1
7 35
3 1
7 35
(74)

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(54)

(57)

, (, GaN) , , 1 (GaN) , 2 (GaN) 3 (GaN) . 3 .

1

( ) , 1 2 13(3B)
(perovskite) GaN ,

, 570 670 1 GaN ;

1 GaN , 750 850 2 GaN
; ,

2 GaN , 950 1050 3 GaN
,

, 3 GaN , GaN
, 1 GaN
2 GaN ,
.

2

3

1 , 2 3 GaN ,
.

4

1 , 1 GaN 5nm 300nm
.

5

3 , 1 GaN 5nm 300nm
.

6

1 , 2 GaN 0.5 50
.

7

3 , 2 GaN 0.5 50
.

8

4 , 2 GaN 0.5 50
.

9

5 , 2 GaN 0.5 50
.

10

1 3 9 , 3 GaN
, 2 GaN , 2 GaN
20 4 , 3 GaN
.

11

12

13

[0001] , , , GaN
.

[0002] GaN, InGaN, AlGaN, InGaAlN GaN ($In_xGa_yAl_{1-x-y}N$, , 0 ≤ x,y ; x+y ≤ 1) ,
, , ,
.

[0003] , GaN , ,
GaN
.

[0004] , GaN (lattice mismatching) ,
GaN (dislocation density) , ,
. , ,
GaN
.

[0005] , (Hydride Vapor Phase Epitaxial Growth: , HVPE)
ELO (Epitaxial Lateral Overgrowth) GaN .
ELO , ,
, (seed)
GaN .

[0006] , GaN
,
, GaN .

[0007] , ELO GaN (heat distortion) , ELO
GaN (polishing) GaN
( ) GaN ,
.

[0008] , , , 13 (3B) (perovskite)
, 011 101 , GaN
(WO95/27815). , 011 101 ,

(011) , (101) .

[0009] , 13 (3B) NdGaO$_3$ (, NGO
) , 011 101 GaN ,
1.2% , SiC ,
. , GaN
.

[0010] , (2000-4045).
, NGO (400 750) GaN , (N$_2$)
GaN , , GaN (800 1200
) GaN (thick film layer) . , GaN
GaN , GaN (800 1200
) NH$_3$ NGO . , GaN
NGO .

[0011] , (2000-4045) , NGO GaN
GaN (800 1200) (400 750) ,
. , GaN , NGO
, GaN ( ) , ,
.

[0012] , , NGO GaN , GaN
, GaN , GaN
.

[0013] , GaN ,
(, NGO , 13(3B)) GaN
, GaN GaN GaN
.

[0014] , , , 1
, 2 , 3 ,
. , GaN
, .

[0015] , 3 (GaN) , 1 (GaN)
2 (GaN) , . ,
, . , 1 (GaN
) 2 (GaN) , 3 (GaN)
.

[0016] , 1, 2, 3 , . , GaN
,
, 1 (GaN) 2 (GaN
) 3 (GaN) .

[0017] , 1 (GaN) , 5nm 300nm .
, 10nm 100 nm .

[0018] , 2 (GaN) . ,
, 3 (GaN) , 1
(GaN) .

[0019] , 1 (GaN) 570 670

.

[0020] , 2 (GaN) , 0.5 50 .
, 3 (GaN) . ,
, 3 (GaN) , 2 (GaN)
.

[0021] , 2 (GaN) 750 850 ,
.

[0022] , 3 (GaN) , 950 1050 .

[0023] , 3 (GaN) , 2 (GaN)
, 2 (GaN) (, 3) 20
4 3 (GaN) .

[0024] , 3 (GaN) , 3
, 1 2 (GaN : ,)
, 3 (GaN) .

[0025] , , , l, 2 3
. , , NGO 1
13 (3B) .

[0026] ______________________________

[0027] , , NGO GaN
. , NGO (ingot) . , NGO
, 50mm , 0.5mm .

[0028] ______

[0029] NGO GaN , GaN
.

[0030] , (mirror-polished) NGO 5 , 5
. , N_2 (blow) . ,
NGO (etchant) (: = 1:3, 80) 5 .

[0031] , NGO HVPE , N_2 620
, Ga HCl GaCl NH_3 , N_2 NGO ,
1 40nm GaN . , GaCl 8×10^{-3} atm, NH_3 0.15 atm
. , .

[0032] , , N_2 800 ,
GaCl NH_3 , N_2 NGO , 2 10 GaN
.

[0033] , , N_2 1000 . ,
60 GaN . , GaN
, GaN .

[0034] , GaCl NH_3 , N_2 NGO 3
GaN . , 50 /h , 480
.

[0035] , 5 /min 400 GaN .

[0036] GaN , GaN , X (X-ray locking curve) (FWHM: Full-Width Half Maximum) 180 300 , .

[0037] ______

[0038] , NGO GaN , GaN .

[0039] , GaN , NGO GaN .

[0040] , NGO 5 , 5 . , N_2 . , NGO (: = 1:3, 80) 5 .

[0041] , NGO HVPE , N_2 620 , Ga HCl GaCl NH_3 , N_2 NGO , 100nm GaN . , GaCl 5.0×10^{-3} atm, NH_3 3.0×10^{-1} atm . , .

[0042] , , N_2 1000 , GaCl NH_3 , N_2 NGO GaN . , 40 /h , 300 .

[0043] , 5.3 /min 90 200 GaN .

[0044] GaN , GaN , X- (FWHM) 1000 , GaN .

[0045] , .

[0046] , GaN , GaN 570 670 , GaN 750 850 , GaN 950 l050 .

[0047] , GaN 5nm 300nm , GaN 0.5 50 . GaN (,) , NGO NH_3 , GaN .

[0048] , GaN , 20 4 .

[0049] , GaN , GaCl $1.0\times l0^{-3}$ $1.0\times l0^{-2}$ atm, NH_3 1.0×10^{-1} 4.0×10^{-1} atm, 30 100 /h, 930 1050 , 4 10 /min .

[0050] , , , , (, GaN) , 1 (GaN) ; 2 (GaN) ; , 3 (GaN) , 3 , 1 (GaN) 2 (GaN) , 3 (GaN) ,

. , 1 2 (GaN) , 3 (GaN)
NGO NH_3 .

[0051] , GaN ,
.