Semiconductor light emitting device and its manufacturing method

Patent family list

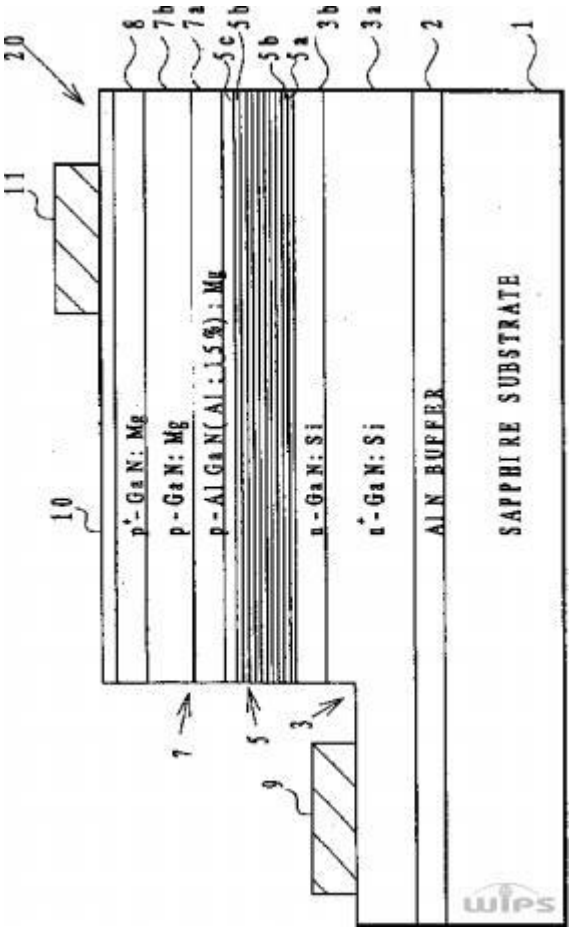
Number of countries : **4** Number of patents : **12**

Patent Number	Application Number	Priority Number
JP 1998-135514 A (1998.05.22)	1996-299404 (1996.10.22)	JP 1996-002578 (1996.09.08)
		JP 1996-257819 (1996.09.08)
JP 3304787 B2 (2002.05.10)	1996-299404 (1996.10.22)	JP 1996-257819 (1996.09.08)
JP 2002-158374 A (2002.05.31)	2001-273690 (2001.09.10)	JP 1996-002578 (1996.09.08)
		JP 1996-257819 (1996.09.08)
JP 3780887 B2 (2006.03.17)	2001-273690 (2001.09.10)	JP 1996-257819 (1996.09.08)
		JP 1996-299404 (1996.10.22)
KR 0458145 B1 (2004.11.12)	1997-0046749 (1997.09.08)	JP 1996-257819 (1996.09.08)
		JP 1996-299404 (1996.10.22)
TW 575971 B (2004.02.11)	86112932 (1997.09.08)	JP 1996-299404 (1996.10.22)
		JP 1996-257819 (1996.09.08)
US 6040588 A1 (2000.03.21)	1997-925325 (1997.09.08)	JP 1996-257819 (1996.09.08)
		JP 1996-299404 (1996.10.22)
US 6326236 B1 (2001.12.04)	2000-497814 (2000.02.03)	JP 1996-257819 (1996.09.08)
		JP 1996-299404 (1996.10.22)
		US 1997-925325 (1997.09.08)
US 6420733 B2 (2002.07.16)	2001-922687 (2001.08.07)	JP 1996-257819 (1996.09.08)
		JP 1996-299404 (1996.10.22)
		US 1997-925325 (1997.09.08)
		US 2000-497814 (2000.02.03)
		JP 1996-002578 (1996.09.08)
		US 1997-925325 (1997.09.08)
		JP 1996-299404 (1996.10.22)
		US 2000-497814 (2000.02.03)
US 6541293 B2	2002-158830	JP 1996-257819

	(2003.04.01)	(2002.06.03)	(1996.09.08) JP 1996-299404 (1996.10.22) US 1997-925325 (1997.09.08) US 2001-922687 (2001.08.07) US 2000-497814 (2000.02.03) JP 1996-299404 (1996.10.22) US 2001-922687 (2001.08.07) JP 1996-002578 (1996.09.08) US 1997-925325 (1997.09.08) US 2000-497814 (2000.02.03)
	US 6821800 BB (2004.11.23)	2002-326398 (2002.12.23)	US 2000-497814 (2000.02.03) JP 1996-299404 (1996.10.22) US 2001-922687 (2001.08.07) US 1997-925325 (1997.09.08) JP 1996-257819 (1996.09.08) US 2002-158830 (2002.06.03)
	US 6821800 B2 (2004.11.23)	2002-326398 (2002.12.23)	JP 1996-257819 (1996.09.08) JP 1996-299404 (1996.10.22) US 2001-922687 (2001.08.07) US 1997-925325 (1997.09.08) US 2000-497814 (2000.02.03) JP 1996-002578 (1996.09.08) US 2002-158830 (2002.06.03)

1. JP3304787 :

- **Title** :-
- **Country** : JP (Japan)
- **Patent Number** : 3304787 (2002.05.10)
- **Kind of Document** : B2 (April 1986 ~ March 1996 for examined publications May 1996 onwards for granted patents)
- **Assignee** : -
- **Application Number** : 1996-299404 (1996.10.22)
- **IPC Code** : H01L-033/00 ; H01S-005/343
- **Priority Number** : JP 1996-257819 (1996.09.08)
- **Abstract** :
- **Drawing** :



2. JP3780887 :

- **Title** :-
- **Country** : JP (Japan)
- **Patent Number** : 3780887 (2006.03.17)
- **Kind of Document** : B2 (April 1986 ~ March 1996 for examined publications
  May 1996 onwards for granted patents)
- **Assignee** : -
- **Application Number** : 2001-273690 (2001.09.10)
- **IPC Code** : H01L-033/00 ; H01L-021/205
- **Priority Number** : JP 1996-257819 (1996.09.08); JP 1996-299404 (1996.10.22)
- **Abstract** :

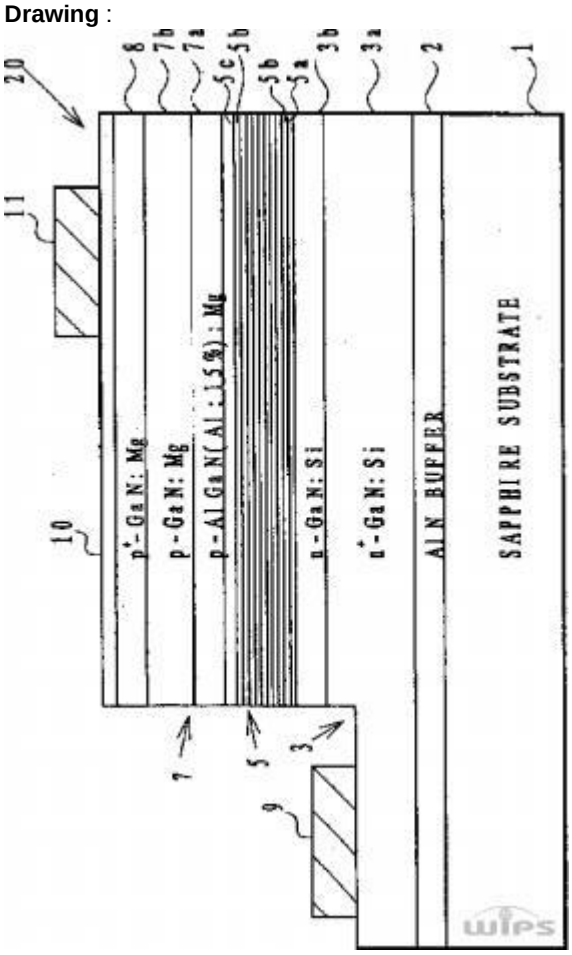
3. JP1998-135514 :

- **Title** : **SEMICONDUCTOR LIGHT EMITTING ELEMENT AND ITS MANUFACTURING METHOD**
- **Country** : JP (JAPAN)
- **Patent Number** : 1998-135514 (1998.05.22)
- **Kind of Document** : A (DOC. LAID OPEN TO PUBL. INSPEC. [PUBLISHED FROM 1971 ONWARDS])
- **Assignee** : TOYODA GOSEI KK
- **Application Number** : 1996-299404 (1996.10.22)
- **IPC Code** : H01L-029/02; H01L-029/15; H01L-033/00; H01S-005/00; H01S-005/323; H01S-005/343
- **Priority Number** : JP 1996-002578 (1996.09.08)
- **Abstract** : A semiconductor light-emitting device involving the steps of: forming a first semiconductor layer; forming a light-emitting layer of superlattice structure by laminating a barrier layer being made of InY1Ga1-Y1N (Y1>/=0) and a quantum well layer being made of InY2Ga1-Y1N (Y2>Y1 and Y2>0) on the first semiconductor layer; and forming a second semiconductor layer on the light-emitting layer, an uppermost barrier layer, which will become an uppermost layer of the light-emitting layer, is made thicker than the other barrier layers. Further, at the time of forming the second semiconductor layer, an upper surface of such uppermost barrier layer is caused to disappear so that the thickness of the uppermost barrier layer becomes substantially equal to those of the other barrier layers.

4. JP1998-135514 :

- **Title** :-
- **Country** : JP (Japan)
- **Patent Number** : 1998-135514 (1998.05.22)
- **Kind of Document** : A (Patents - unexamined publications)
- **Assignee** : -
- **Application Number** : 1996-299404 (1996.10.22)
- **IPC Code** : H01L-033/00 ; H01S-003/18
- **Priority Number** : JP 1996-257819 (1996.09.08)
- **Abstract** : -

- **Drawing** :



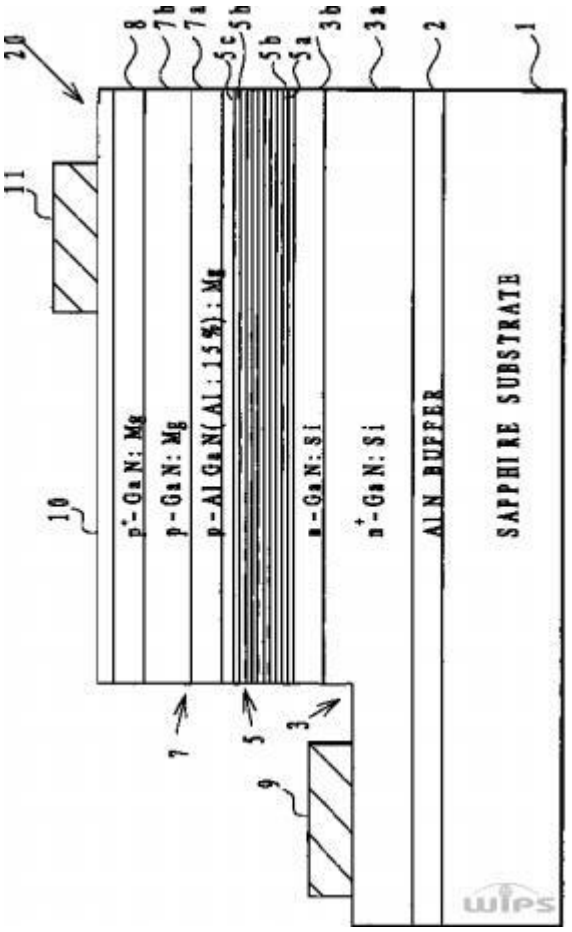
5. JP2002-158374 :

- **Title** : **SEMICONDUCTOR LIGHT EMITTING ELEMENT AND METHOD OF MANUFACTURING THE SAME**
- **Country** : JP (JAPAN)
- **Patent Number** : 2002-158374 (2002.05.31)
- **Kind of Document** : A (DOC. LAID OPEN TO PUBL. INSPEC. [PUBLISHED FROM 1971 ONWARDS])
- **Assignee** : TOYODA GOSEI KK
- **Application Number** : 2001-273690 (2001.09.10)
- **IPC Code** : H01L-033/00; H01L-021/02; H01L-021/205; H01L-033/06; H01L-033/32
- **Priority Number** : JP 1996-002578 (1996.09.08)
- **Abstract** :

6. JP2002-158374 :

- **Title** :-
- **Country** : JP (Japan)
- **Patent Number** : 2002-158374 (2002.05.31)
- **Kind of Document** : A (Patents - unexamined publications)
- **Assignee** : -
- **Application Number** : 2001-273690 (1996.10.22)
- **IPC Code** : H01L-033/00 ; H01L-021/205
- **Priority Number** : JP 1996-257819 (1996.09.08)
- **Abstract** : -

- **Drawing** :



7. KR0458145 :

- **Title** : **-**
- **Country** : KR (Republic of Korea)
- **Patent Number** : 0458145 (2004.11.12)
- **Kind of Document** : B1 (EXAMINED PATENT APPLICATION, SECOND PUBLICATION; SINCE 970930 GRANTED PATENT)
- **Assignee** : -
- **Application Number** : 1997-0046749 (1997.09.08)
- **IPC Code** : H01L-033/00
- **Priority Number** : JP 1996-257819 (1996.09.08); JP 1996-299404 (1996.10.22)
- **Abstract** : -

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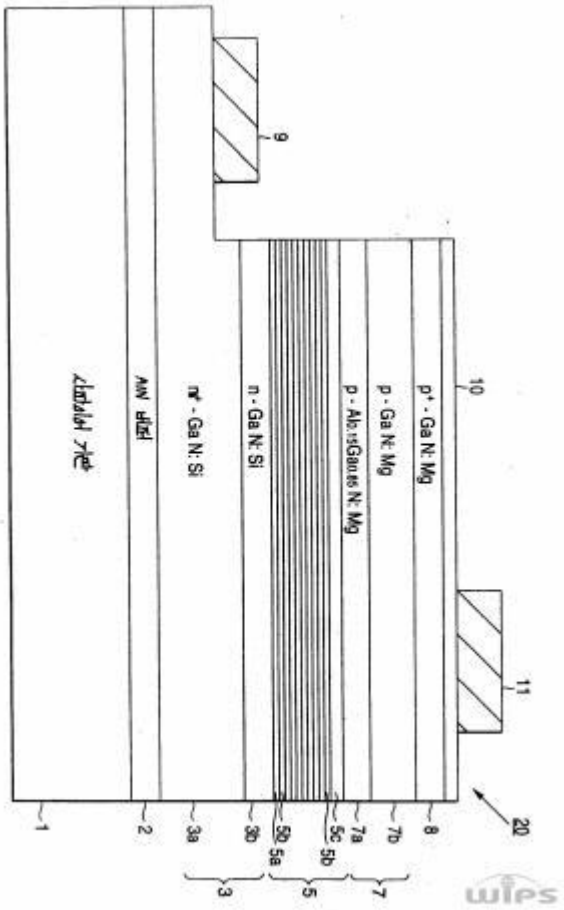


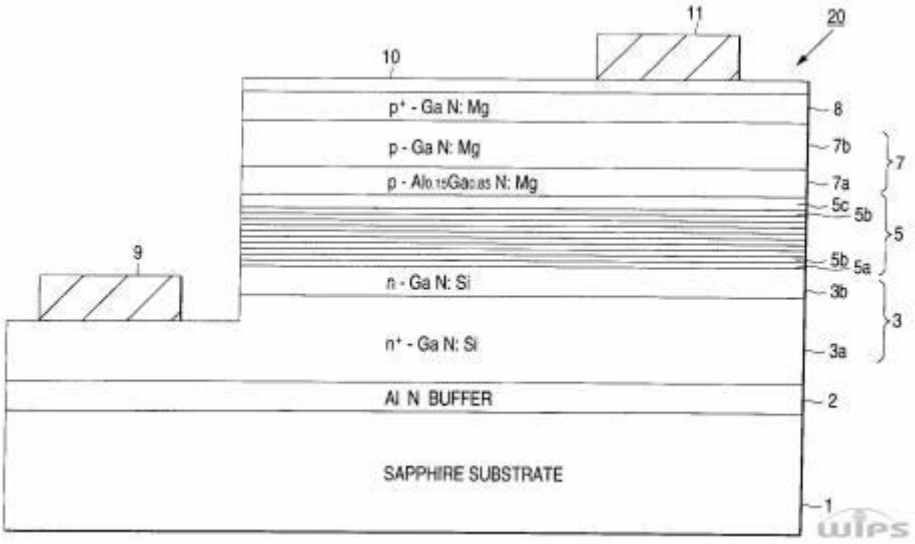
8. TW575971 :

- **Title** : **Semiconductor light emitting device and its manufacturing method**
- **Country** : TW (TAIWAN)
- **Patent Number** : 575971 (2004.02.11)
- **Kind of Document** : B (PATENT)
- **Assignee** : TOYODA GOSEI KK
- **Application Number** : 86112932 (1997.09.08)
- **IPC Code** : H01L-033/00
- **Priority Number** : JP 1996-299404 (1996.10.22); JP 1996-257819 (1996.09.08)
- **Abstract** :

9. US6040588 :

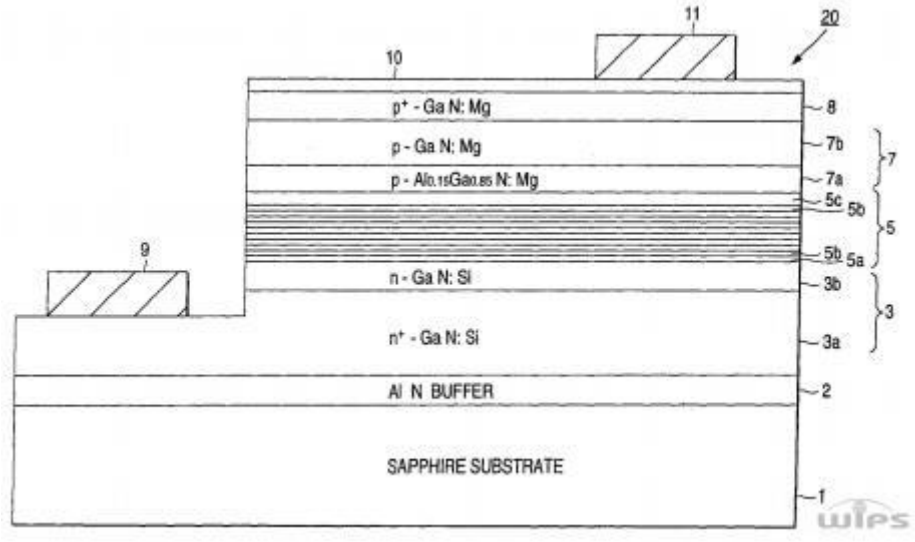
- **Title** : **Semiconductor light-emitting device**
- **Country** : US (United States of America)
- **Patent Number** : 6040588 (2000.03.21)
- **Kind of Document** : A1 (Utility Patent Application published on or after January 2, 2001)
- **Assignee** : Toyoda Gosei Co., Ltd.
- **Application Number** : 1997-925325 (1997.09.08)
- **IPC Code** : H01L-029/06 ; H01L-033/00
- **Priority Number** : JP 1996-257819 (1996.09.08); JP 1996-299404 (1996.10.22)
- **Abstract** : A semiconductor light-emitting device involving the steps of: forming a first semiconductor layer; forming a light-emitting layer of superlattice structure by laminating a barrier layer being made of $In_{Y1}Ga_{1-Y1}N$ (Y1≥0) and a quantum well layer being made of $In_{Y2}Ga_{1-Y1}N$ (Y2>Y1 and Y2>0) on the first semiconductor layer; and forming a second semiconductor layer on the light-emitting layer, an uppermost barrier layer, which will become an uppermost layer of the light-emitting layer, is made thicker than the other barrier layers. Further, at the time of forming the second semiconductor layer, an upper surface of such uppermost barrier layer is caused to disappear so that the thickness of the uppermost barrier layer becomes substantially equal to those of the other barrier layers.

Drawing :



10. US6326236 :

- **Title** : **Semiconductor light-emitting device and manufacturing method thereof**
- **Country** : US (United States of America)
- **Patent Number** : 6326236 (2001.12.04)
- **Kind of Document** : B1 (Utility Patent Grant (no pre-grant publication) issued on or after January 2, 2001)
- **Assignee** : Toyoda Gosei Co., Ltd.
- **Application Number** : 2000-497814 (2000.02.03)
- **IPC Code** : H01L-021/44 ; H01L-021/00
- **Priority Number** : JP 1996-257819 (1996.09.08); JP 1996-299404 (1996.10.22); US 1997-925325 (1997.09.08)
- **Abstract** : In a method of manufacturing a semiconductor light-emitting device involving the steps of: forming a first semiconductor layer; forming a light-emitting layer of superlattice structure by laminating a barrier layer being made of $In_{Y1}Ga_{1-Y1}N$ (Y1≥0) and a quantum well layer being made of $In_{Y2}Ga_{1-Y2}N$ (Y2>Y1 and Y2>0) on the first semiconductor layer; and forming a second semiconductor layer on the light-emitting layer, an uppermost barrier layer, which will become an uppermost layer of the light-emitting layer, is made thicker than the other barrier layers. Further, at the time of forming the second semiconductor layer, an upper surface of such uppermost barrier layer is caused to disappear so that the thickness of the uppermost barrier layer becomes substantially equal to those of the other barrier layers.
- **Drawing** :

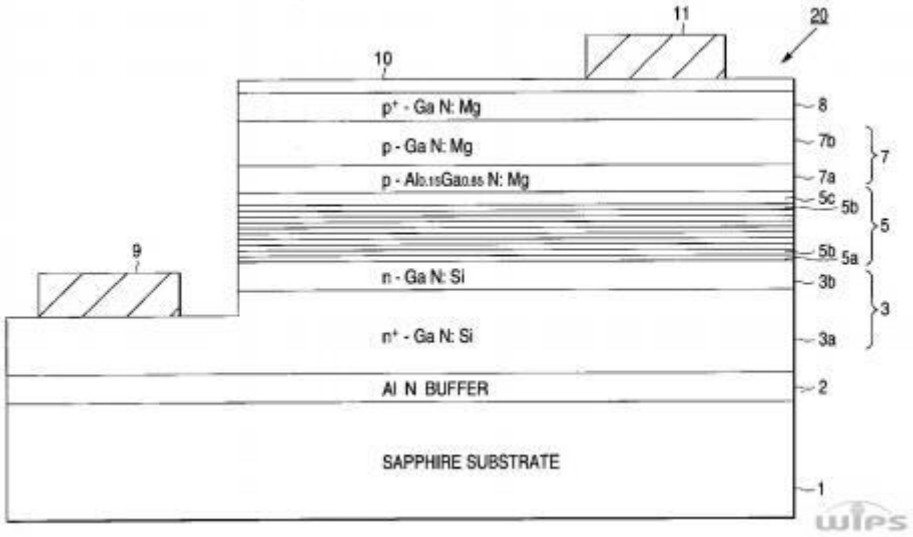


11. US6420733 :

- **Title** : **Semiconductor light-emitting device and manufacturing method thereof**
- **Country** : US (United States of America)
- **Patent Number** : 6420733 (2002.07.16)
- **Kind of Document** : B2 (Utility Patent Grant (with pre-grant publication) issued on or after January 2, 2001)
- **Assignee** : Toyoda Gosei Co., Ltd.
- **Application Number** : 2001-922687 (2001.08.07)
- **IPC Code** : H01L-033/00
- **Priority Number** : JP 1996-257819 (1996.09.08); JP 1996-299404 (1996.10.22); US 1997-925325 (1997.09.08); US 2000-497814 (2000.02.03)
- **Abstract** : In a method of manufacturing a semiconductor light-emitting device involving the steps of: forming a first semiconductor layer; forming a light-emitting layer of superlattice structure by laminating a barrier layer being made of $In_{Y1}Ga_{1-Y1}N$ (Y1≥0) and a quantum well layer being made of $In_{Y2}Ga_{1-Y2}N$ (Y2>Y1 and Y2>0)

on the first semiconductor layer; and forming a second semiconductor layer on the light- emitting layer, an uppermost barrier layer, which will become an uppermost layer of the light-emitting layer, is made thicker than the other barrier layers. Further, at the time of forming the second semiconductor layer, an upper surface of such uppermost barrier layer is caused to disappear so that the thickness of the uppermost barrier layer becomes substantially equal to those of the other barrier layers.

- **Drawing** :

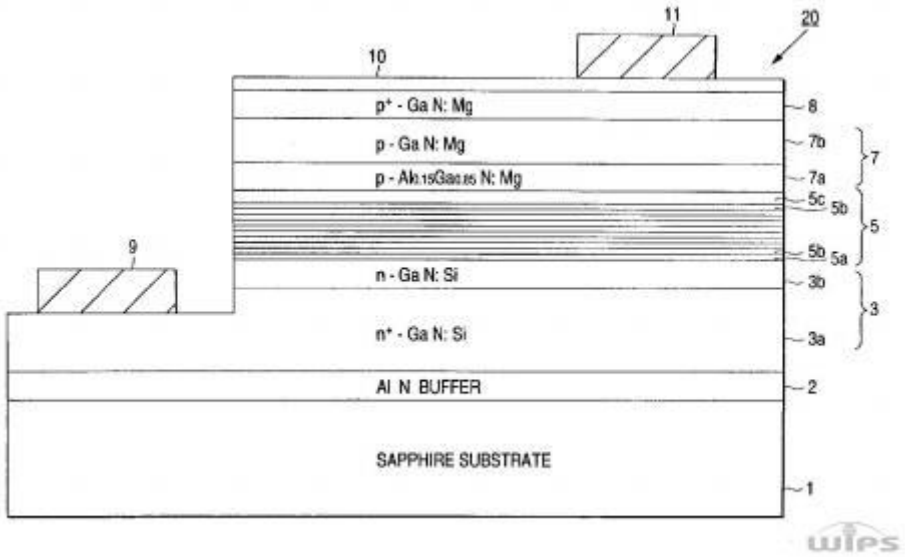


12. US6420733 :

- **Title** : **Semiconductor light-emitting device and manufacturing method thereof**
- **Country** : US (USA)
- **Patent Number** : 6420733 (2002.07.16)
- **Kind of Document** : B2 (REEXAM. CERTIF., N-ND REEXAM. or GRANTED PATENT AS SECOND PUBLICATION [FROM 2001 ONWARDS])
- **Assignee** : TOYODA GOSEI KK
- **Application Number** : 2001-922687 (2001.08.07)
- **IPC Code** : H01L-029/02; H01L-029/15; H01L-033/00
- **Priority Number** : JP 1996-002578 (1996.09.08); US 1997-925325 (1997.09.08); JP 1996-299404 (1996.10.22); US 2000-497814 (2000.02.03)
- **Abstract** : In a method of manufacturing a semiconductor light-emitting device involving the steps of: forming a first semiconductor layer; forming a light-emitting layer of superlattice structure by laminating a barrier layer being made of InY1Ga1-Y1N (Y1>=0) and a quantum well layer being made of InY2Ga1-Y2N (Y2>Y1 and Y2>0) on the first semiconductor layer; and forming a second semiconductor layer on the light- emitting layer, an uppermost barrier layer, which will become an uppermost layer of the light-emitting layer, is made thicker than the other barrier layers. Further, at the time of forming the second semiconductor layer, an upper surface of such uppermost barrier layer is caused to disappear so that the thickness of the uppermost barrier layer becomes substantially equal to those of the other barrier layers.

13. US6541293 :

- **Title** : **Semiconductor light-emitting device and manufacturing method thereof**
- **Country** : US (United States of America)
- **Patent Number** : 6541293 (2003.04.01)
- **Kind of Document** : B2 (Utility Patent Grant (with pre-grant publication) issued on or after January 2, 2001)
- **Assignee** : Toyoda Gosei Co., Ltd.
- **Application Number** : 2002-158830 (2002.06.03)
- **IPC Code** : H01L-021/00
- **Priority Number** : JP 1996-257819 (1996.09.08); JP 1996-299404 (1996.10.22); US 1997-925325 (1997.09.08); US 2001-922687 (2001.08.07); US 2000-497814 (2000.02.03)
- **Abstract** : In a method of manufacturing a semiconductor light-emitting device involving the steps of: forming a first semiconductor layer; forming a light-emitting layer of superlattice structure by laminating a barrier layer being made of $In_{Y1}Ga_{1-Y1}N$ (Y1≥0) and a quantum well layer being made of $In_{Y2}Ga_{1-Y2}N$ (Y2>Y1 and Y2 >0) on the first semiconductor layer; and forming a second semiconductor layer on the light-emitting layer, an uppermost barrier layer, which will become an uppermost layer of the light-emitting layer, is made thicker than the other barrier layers. Further, at the time of forming the second semiconductor layer, an upper surface of such uppermost barrier layer is caused to disappear so that the thickness of the uppermost barrier layer becomes substantially equal to those of the other barrier layers.
- **Drawing** :



14. US6541293 :

- **Title** : **Semiconductor light-emitting device and manufacturing method thereof**
- **Country** : US (USA)
- **Patent Number** : 6541293 (2003.04.01)
- **Kind of Document** : B2 (REEXAM. CERTIF., N-ND REEXAM. or GRANTED PATENT AS SECOND PUBLICATION [FROM 2001 ONWARDS])
- **Assignee** : TOYODA GOSEI KK
- **Application Number** : 2002-158830 (2002.06.03)
- **IPC Code** : H01L-029/02; H01L-029/15; H01L-033/00
- **Priority Number** : JP 1996-299404 (1996.10.22); US 2001-922687 (2001.08.07); JP 1996-002578 (1996.09.08); US 1997-925325 (1997.09.08); US 2000-497814 (2000.02.03)
- **Abstract** : In a method of manufacturing a semiconductor light-emitting device involving the steps of: forming a first semiconductor layer; forming a light-emitting layer of superlattice structure by laminating a barrier layer being made of InY1Ga1-Y1N (Y1>=0) and a quantum well layer being made of InY2Ga1-Y2N (Y2>Y1 and Y2 >0) on the first semiconductor layer; and forming a second semiconductor layer on the light-emitting layer, an uppermost barrier layer, which will become an uppermost layer of the light-emitting layer, is made thicker than the other barrier layers. Further, at the time of forming the second semiconductor layer, an upper surface of such uppermost barrier layer is caused to disappear so that the thickness of the uppermost barrier layer becomes substantially equal to those of the other barrier layers.

15. US6821800 :

- **Title** : **Semiconductor light-emitting device and manufacturing method thereof**
- **Country** : US (USA)
- **Patent Number** : 6821800 (2004.11.23)
- **Kind of Document** : BB ()
- **Assignee** : TOYODA GOSEI KK
- **Application Number** : 2002-326398 (2002.12.23)
- **IPC Code** : H01L-021/00
- **Priority Number** : US 2000-497814 (2000.02.03); JP 1996-299404 (1996.10.22); US 2001-922687 (2001.08.07); US 1997-925325 (1997.09.08); JP 1996-257819 (1996.09.08); US 2002-158830 (2002.06.03)
- **Abstract** : In a method of manufacturing a semiconductor light-emitting device involving the steps of: forming a first semiconductor layer; forming a light-emitting layer of superlattice structure by laminating a barrier layer being made of InY1Ga1-Y1N (Y1>=0) and a quantum well layer being made of InY2Ga1-Y2N (Y2>Y1 and Y2>0) on the first semiconductor layer; and forming a second semiconductor layer on the light-emitting layer, an uppermost barrier layer, which will become an uppermost layer of the light-emitting layer, is made thicker than the other barrier layers. Further, at the time of forming the second semiconductor layer, an upper surface of such uppermost barrier layer is caused to disappear so that the thickness of the uppermost barrier layer becomes substantially equal to those of the other barrier layers.

16. US6821800 :

- **Title** : **Semiconductor light-emitting device and manufacturing method thereof**
- **Country** : US (United States of America)
- **Patent Number** : 6821800 (2004.11.23)
- **Kind of Document** : B2 (Utility Patent Grant (with pre-grant publication) issued on or after January 2, 2001)
- **Assignee** : Toyoda Gosei Co., Ltd.
- **Application Number** : 2002-326398 (2002.12.23)
- **IPC Code** : H01L-021/00
- **Priority Number** : JP 1996-257819 (1996.09.08); JP 1996-299404 (1996.10.22); US 2001-922687 (2001.08.07); US 1997-925325 (1997.09.08); US 2000-497814 (2000.02.03); JP 1996-002578 (1996.09.08); US 2002-158830 (2002.06.03)
- **Abstract** : In a method of manufacturing a semiconductor light-emitting device involving the steps of: forming

a first semiconductor layer; forming a light-emitting layer of superlattice structure by laminating a barrier layer being made of $In_{Y1}Ga_{1-Y1}N$ ($Y1 \geqq 0$) and a quantum well layer being made of $In_{Y2}Ga_{1-Y2}N$ ($Y2>Y1$ and $Y2>0$) on the first semiconductor layer; and forming a second semiconductor layer on the light-emitting layer, an uppermost barrier layer, which will become an uppermost layer of the light-emitting layer, is made thicker than the other barrier layers. Further, at the time of forming the second semiconductor layer, an upper surface of such uppermost barrier layer is caused to disappear so that the thickness of the uppermost barrier layer becomes substantially equal to those of the other barrier layers.

- **Drawing** :