

Claims

1. A method of forming a light emitting structure comprising:
forming a first light emitting region configured to emit light having a first
5 primary peak wavelength;
forming a second light emitting region configured to emit light having a second
primary peak wavelength, wherein the first primary peak wavelength is different to
the second primary peak wavelength; and
forming a partially reflective layer positioned at least partially between the first
10 light emitting region and the second light emitting region, wherein the partially
reflective layer is configured to reflect light having the first primary peak wavelength
emitted by the first light emitting region and allow light having the second primary
peak wavelength emitted by the second light emitting region to pass through the
partially reflective layer, wherein the partially reflective layer comprises a Distributed
15 Bragg Reflector comprising alternating epitaxial crystalline layers with different
porosities.
2. The method according to claim 1, wherein the second primary peak wavelength is
longer than the first primary peak wavelength.
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3. The method according to any preceding claim, wherein forming the light emitting
structure comprises forming a primary light emitting surface area wherein the light
having the first primary peak wavelength and the second primary peak wavelength
are emitted from the light emitting structure via the primary light emitting surface
25 area.
4. The method according to any preceding claim, wherein the method comprises
bonding a first light emitting device comprising the first light emitting region
configured to emit light having the first primary peak wavelength, to a second light
30 emitting device comprising the second light emitting region configured to emit light
having the second primary peak wavelength, preferably wherein the first light
emitting device and the second light emitting device are light emitting diode devices

each comprising a light emitting region, an n-type region and a p-type region, preferably wherein the first light emitting region and the second light emitting region comprise at least one epitaxial quantum well, preferably wherein at least one of the first light emitting device and the second light emitting device comprises the partially reflective layer.

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5. The method according to any preceding claim, wherein the light emitting structure comprises a third light emitting region configured to emit light having a third primary peak wavelength, wherein the third primary peak wavelength is different to the first and second primary peak wavelengths, preferably wherein the method comprises bonding a third light emitting device comprising the third light emitting region configured to emit light having the third primary peak wavelength to the first light emitting device comprising the first light emitting region configured to emit light having the first primary peak wavelength and/or the second light emitting device comprising the second light emitting region configured to emit light having the second primary peak wavelength, preferably wherein the third light emitting device is a light emitting diode device comprising a light emitting region, an n-type region and a p-type region, preferably wherein the third light emitting region comprises at least one epitaxial quantum well, preferably comprising a second partially reflective layer positioned at least partially between the second light emitting region and the third light emitting region, wherein the partially reflective layer is configured to reflect light having the first primary peak wavelength emitted by the first light emitting region and light having the second primary peak wavelength emitted by the second light emitting region and allow light having the third primary peak wavelength emitted by the third light emitting region to pass through.

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6. The method according to any of claims 4 or 5, wherein bonding comprises using a handling device to facilitate positioning of the first light emitting device in relation to the second light emitting device, preferably comprising bonding the handling device to the first light emitting device.

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7. The method according to any preceding claim, wherein the first light emitting device and/or the second light emitting device comprises a substrate, preferably when dependent on claim 4, comprising removing the substrate of the first light emitting device and/or the second light emitting device, preferably using a wet etch, thereby to provide a surface for bonding the first light emitting device and second light emitting device, preferably comprising removing the substrate of the first light emitting device prior to bonding the first light emitting device and the second light emitting device.
8. The method according to any of claim 6 or 7, comprising removing the handling device after the first light emitting device and the second light emitting device have been bonded together.
9. The method of any preceding claim, comprising disposing a transparent conductive layer on the first light emitting device, preferably comprising bonding a further handling device to the transparent conductive layer thereby to facilitate formation of electrodes in the light emitting structure.
10. The method of any preceding claim, comprising forming one or more electrodes, preferably comprising forming at least one of one or more electrodes by etching a via, more preferably comprising forming an insulating surface on at least part of the inner wall of the via, yet more preferably comprising forming a conductor at least partially within the via thereby to enable formation of a contact.
11. The method of any of claims 6 to 10, when dependent on claim 5, wherein the handling device is bonded on the opposite side of the light emitting structure to a substrate.
12. The method according to any of claims 4 to , comprising bonding the partially reflective layer to a second light emitting device formed on a second substrate, preferably comprising bonding the partially reflective layer to a transparent conductive layer of the second light emitting device.

13. The method according to any preceding claim, wherein the light emitting structure comprises a Gallium Nitride based structure.
- 5 14. The method according to any preceding claim, wherein the light emitting structure is at least partially grown by metalorganic chemical vapour deposition. and/or wherein the first light emitting region and/or second light emitting region comprises one or more epitaxial quantum well layers, and/or wherein the light emitting structure comprises one or more crystalline epitaxial compound semiconductor layers.
- 10 15. The method according to any preceding claim wherein the alternating epitaxial crystalline layers with different porosities comprise epitaxial Gallium Nitride layers with different porosities.
- 15 16. The method according to claim 16 wherein the alternating epitaxial crystalline layers are formed as part of a continuous growth process with at least one of the first and second light emitting regions.
17. A light emitting structure comprising:
- 20 a first light emitting region configured to emit light having a first primary peak wavelength;
- a second light emitting region configured to emit light having a second primary peak wavelength, wherein the first primary peak wavelength is different to the second primary peak wavelength; and
- 25 a partially reflective layer positioned at least partially between the first light emitting region and the second light emitting region, wherein the partially reflective layer is configured to reflect light having the first primary peak wavelength emitted by the first light emitting region (thereby to reduce illumination of the second light emitting region by the first light emitting region) and allow light having the second
- 30 primary peak wavelength emitted by the second light emitting region to pass through the partially reflective layer, wherein the partially reflective layer comprises a

Distributed Bragg Reflector comprising alternating epitaxial crystalline layers with different porosities.

5 18. The light emitting structure according to claim 17, wherein the second primary peak wavelength is longer than the primary peak wavelength.

10 19. The light emitting structure according to any of claim 17 and 18, wherein the light emitting structure comprises a primary light emitting surface area wherein the light having the first primary peak wavelength and the second primary peak wavelength are emitted from the light emitting structure by the primary light emitting surface area.

15 20. The light emitting structure according to any of claim 17 to 19, wherein the light emitting structure comprises a first light emitting device comprising the first light emitting region configured to emit light having the first primary peak wavelength that is bonded to a second light emitting device comprising the second light emitting region configured to emit light having the second primary peak wavelength, preferably wherein the first light emitting device and the second light emitting device are light emitting diode devices each comprising a light emitting region, an n-type region and
20 a p-type region, preferably wherein the first light emitting region and the second light emitting region comprise at least one epitaxial quantum well, preferably wherein at least one of the first light emitting device and the second light emitting device comprises the partially reflective layer.

25 21. The light emitting structure according to any of claim 17 to 20, wherein the light emitting structure comprises a third light emitting region configured to emit light having a third primary peak wavelength, wherein the third primary peak wavelength is different to the first and second primary peak wavelengths, preferably wherein the third light emitting device comprising the third light emitting region configured to emit
30 light having the third primary peak wavelength is bonded to the first light emitting device comprising the first light emitting region configured to emit light having the first primary peak wavelength and/or the second light emitting device comprising the

second light emitting region configured to emit light having the second primary peak wavelength, preferably wherein the third light emitting device is a light emitting diode device comprising a light emitting region, an n-type region and a p-type region, preferably wherein the third light emitting region comprises at least one epitaxial quantum well.

22. The light emitting structure according to claim 21, comprising a second partially reflective layer positioned at least partially between the second light emitting region and the third light emitting region, wherein the partially reflective layer is configured to reflect light having the first primary peak wavelength emitted by the first light emitting region and light having the second primary peak wavelength emitted by the second light emitting region and allow light having the third primary peak wavelength emitted by the third light emitting region to pass through.

23. The light emitting structure according to any of claim 17 to 22, wherein the first light emitting device and/or the second light emitting device comprise a substrate, and/or wherein the first light emitting device comprises a transparent conductive layer.

24. The light emitting structure of any of claims 17 to 23, comprising one or more electrodes, preferably wherein the one or more electrodes comprise a via hole, more preferably wherein the via hole comprise an insulating surface on at least part of the inner wall of the via hole, yet more preferably wherein the via hole comprises a conductor at least partially within the via hole thereby to enable formation of a contact.

25. The light emitting structure according to any of claims 17 to 24, comprising bonding the partially reflective layer to a second light emitting device formed on a second substrate.

26. The light emitting structure according to any of claim 17 to 25, wherein the light emitting structure comprises a Gallium Nitride based structure, and/or wherein the first light emitting region and/or second light emitting region comprises one or more

epitaxial quantum well layers, and/or wherein the light emitting structure comprises one or more crystalline epitaxial compound semiconductor layers.

- 5 27. The light emitting structure according to any of claims 17 to 26 wherein the alternating epitaxial crystalline layers with different porosities comprise epitaxial Gallium Nitride layers with different porosities.

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