

Claims

1. An optical device comprising:
 - a light emitting structure having substantially vertical sidewalls, the light emitting structure comprising an active layer, the active layer being configured to emit light when an electrical current is applied to the device;
 - an electrically insulating, optically transparent spacer layer having an internal face facing the sidewalls of the light emitting structure and an opposing external face, wherein the spacer layer is configured to enhance light extraction from the active layer; and
 - a reflective, electrically conducting mirror layer disposed on the external face of the spacer layer.
2. The optical device of claim 1 further comprising a passivation layer between the light emitting structure and the spacer layer.
3. The optical device of claim 2, wherein the passivation layer is one of silicon dioxide, aluminium oxide or cubic aluminium nitride.
4. The optical device of any preceding claim wherein the mirror layer has a surface roughness of $R_a = 50 \text{ nm}$.
5. The optical device of any preceding claim wherein the mirror layer has a surface roughness of $R_a = 10 \text{ nm}$.
6. The optical device of any preceding claim wherein the light emitting structure has a first light emitting surface and wherein the optical device further comprises a light extraction feature on the light emitting surface.
7. The optical device of claim 6 wherein the light extraction feature is in the form of a convex lens.
8. The optical device of claim 7 wherein the convex lens has a radius of curvature of one of 2.3 microns or 3 microns.
9. The optical device of any preceding claim wherein the external face of the spacer layer has a pseudo parabolic or parabolic profile.

10. The optical device of claim 9, wherein the profile of the external face of the spacer layer approximates a Bézier curve having two control points with a Bézier coefficient of 0.5.
11. The optical device of any preceding claim wherein the spacer layer is formed of any one of silicon dioxide, silicon nitride or titanium oxide.
12. The optical device of any preceding claim wherein the light emitting structure further comprises an n-cladding layer, and wherein the mirror layer is in electrical contact with the n-cladding layer such that the mirror layer forms a first electrode of the optical device.
13. The optical device of any preceding claim wherein the light emitting structure further comprises a p-cladding layer in electrical contact with a second electrode of the optical device.
14. The optical device of claim 13 wherein the second electrode is formed on a second surface of the light emitting structure opposing the first light emitting surface, and wherein the second electrode is made from a reflective material.
15. The optical device of any preceding claim wherein the light emitting structure further comprises a buffer layer and a super lattice.
16. The optical device of any preceding claim wherein light emitting structure comprises indium gallium nitride.
17. The optical device of any preceding claim wherein the light emitting structure has one of a square, circular, triangular or pentagonal cross-section.
18. The optical device of any preceding claim wherein the light emitting structure has roughened sidewalls.
19. The optical device of any preceding claim wherein the internal face of the spacer layer is formed of a first material and the external face of the spacer layer is formed of a second material.

20. The optical device of claim 19 wherein the first material has a higher index of refraction than the second material.
21. An array of two or more of the optical device of any of claims 1-20.
22. A method of manufacturing the optical device of any of claims 1-20.