Claims

1. A method of forming an optical device, the method comprising the steps of:

(a) forming spacers on a sacrificial mesa, the mesa having substantially vertical sidewalls, the spacers being formed from a first electrically insulating, optically transparent material, and having an internal face facing the mesa sidewalls, and an opposing external face;

(b) depositing a reflective, electrically conducting material so as to form a mirror layer on the external face of the spacers;

(c) removing the sacrificial mesa so as to form a pocket between the internal faces of the spacers; and

(d) installing a die having substantially vertical sidewalls into the pocket between the internal faces of the spacers.

2. The method of any preceding claim wherein the external faces of the spacers are angled relative to the internal faces.

3. The method of claim 2 wherein the external faces of the spacers have a pseudo-parabolic profile.

4. The method of claim 2 wherein the external faces of the spacers have a profile that approximates a Bézier curve having two control points with a Bézier coefficient of 0.5.

5. The method of any preceding claim wherein the spacers are formed of silicon nitride, silicon oxide or tin oxide.

6. The method of any preceding claim further comprising depositing a transparent conducting oxide over the die and spacers.

7. The method of claim 6 wherein the transparent conducting oxide is indium tin oxide.

8. The method of any of claims 6 and 7 wherein the transparent conducting oxide forms an electrical contact to the die, and a second electrical contact is formed on an opposing surface of the die.

9. The method of any preceding claim further comprising the step of forming a light extraction feature on the transparent conducting oxide above the underlying die.

10. The method of claim 9 wherein the light extraction feature is in the form of convex lens.

11. The method of any preceding claim further comprising the step of depositing a second electrically insulating, optically transparent material on the external face of each of the spacers, the second electrically insulating, optically transparent material having a different refractive index to that of the first electrically insulating, optically transparent material.

12. The method of claim 11 wherein the refractive index of the first material is greater than that of the second material.

13. The method of any preceding claim further comprising the step of applying index-matching material filler between the die and the internal faces of the spacers.

14. The method of any preceding claim wherein the sacrificial mesa is first created by forming two trenches either side of a designated region in a layer of sacrificial material.

15. The method of claim 14 wherein the reflective, electrically conductive material is further deposited along an exposed bottom portion of each of the trenches.

16. The method of claim 15 further comprising the step of filling the trenches with an insulating material.

17. The method of any preceding claim wherein the die comprises an n-doped layer, a p-doped layer, and an active region configured to emit light when electrical current is applied to the die.

18. The method of any preceding claim wherein the sidewalls of the die are coated in an optically transparent, electrically insulating material.

~~19. An optical device manufactured according to steps (a)-(c) of method claim 1.~~

~~20. The optical device of claim 19 manufactured according to the method of any of claims 2-18.~~