CLAIMS

1. A method of manufacturing a light emitting diode (LED) device comprising:

forming an LED structure by depositing a plurality of semiconductor layers on a transparent substrate;

placing trenched metal in the plurality of semiconductor layers, with the trenched metal contacting the transparent substrate, the trenched metal is arranged to define a trenched grid;

attaching the LED structure to a CMOS structure with electrical interconnects that define a cavity therebetween;

directing laser light to provide laser lift-off of the transparent substrate from the plurality of semiconductor layers.

2. The method of manufacturing a light emitting diode (LED) device of claim 1, further comprising depositing an underfill material in the cavity.

3. The method of manufacturing a light emitting diode (LED) device of claim 1, wherein the transparent substrate is sapphire.

4. The method of manufacturing a light emitting diode (LED) device of claim 1, wherein the electrical interconnects are electrically conductive pillars.

5. The method of manufacturing a light emitting diode (LED) device of claim 1, further comprising coating a sidewall of the transparent substrate with anti-stick coating.

6. The method of manufacturing a light emitting diode (LED) device of claim 5, wherein the transparent substrate is dipped into anti-stick material to coat the sidewall.

7. A method of manufacturing a light emitting diode (LED) device comprising:

attaching an LED structure including trenched metal within a plurality of semiconductor layers to a CMOS structure with electrical interconnects that define a cavity therebetween, the plurality of semiconductor layers and trenched metal arranged into a grid that defines pixels; and

directing laser light to provide laser lift-off of the transparent substrate from the plurality of semiconductor layers.

8. The method of manufacturing a light emitting diode (LED) device of claim 7, wherein the substrate is sapphire.

9. The method of manufacturing a light emitting diode (LED) device of claim 7, wherein the plurality of semiconductor layers are GaN.

10. The method of manufacturing a light emitting diode (LED) device of claim 7, wherein the electrical interconnects are electrically conductive pillars.

11. A method of manufacturing a micro light emitting diode (μLED) device comprising:

depositing a plurality of semiconductor layers on a transparent substrate to form a μLED structure, the transparent substrate having a lateral dimension of less than 100 μm x 100 μm;

placing trenched metal in the plurality of semiconductor layers, with the trenched metal contacting the transparent substrate, the trenched metal arranged to define a trenched grid and defining a plurality of spaced mesas;

attaching the μLED structure to a wafer with electrical interconnects that define a cavity therebetween;

directing laser light to provide laser lift-off of the transparent substrate from the plurality of semiconductor layers.

12. The method of manufacturing a micro light emitting diode (μLED) of claim 11, further comprising depositing an underfill material in the cavity.

13. The method of manufacturing a micro light emitting diode (μLED) of claim 11, wherein the transparent substrate is sapphire.

14. The method of manufacturing a micro light emitting diode (μLED) of claim 11, wherein the electrical interconnects are electrically conductive pillars.

15. The method of manufacturing a micro light emitting diode (μLED) of claim 11, further comprising coating a sidewall of the transparent substrate with anti-stick coating.

16. The method of manufacturing a micro light emitting diode (μLED) of claim 15, wherein the transparent substrate is dipped into anti-stick material to coat the sidewall.

17. The method of manufacturing a micro light emitting diode (μLED) of claim 11, wherein the trenched metal comprises a reflective metal.

18. The method of manufacturing a micro light emitting diode (μLED) of claim 11, wherein the plurality of spaced mesas is arranged into pixels with a pixel pitch in a range of from 1 μm to 100 μm.

19. The method of manufacturing a micro light emitting diode (μLED) of claim 11, wherein the pixel pitch is in a range of from 30 μm to 50 μm.

20. The method of manufacturing a micro light emitting diode (μLED) of claim 11, wherein the semiconductor layers comprise one or more of an N-type layer, an active layer, and a P-type layer.