Claims:

1. A method of forming a monolithic LED array precursor, the method comprising:

(i) providing a substrate having a surface;

(ii) forming a continuous first semiconductor layer on the surface of the substrate;

(iii) selectively masking the first semiconductor layer, by depositing a masking layer, which comprises a plurality of apertures, on the first semiconductor layer;

(iv) growing a second semiconductor layer on unmasked portions of the first semiconductor layer, through the apertures of the masking layer to form a plurality of columns each having a regular trapezoidal cross-section normal to the substrate, a substantially flat upper surface portion, and sloped facets;

(v) forming a third semiconductor layer covering the second semiconductor layer, wherein the third semiconductor layer comprises a plurality of quantum well sub-layers, has a substantially flat upper surface portion, and has sloped side portions provided on the sloped facets of the second semiconductor layer having a thickness which is less than the thickness of the substantially flat upper surface portion;

(vi) forming a fourth semiconductor layer covering the third semiconductor layer, whereby the fourth semiconductor layer has a substantially flat upper surface portion and sloped side portions;

(vii) forming primary electrical contacts only on the substantially flat upper surface portion of the fourth semiconductor layer; and

wherein the first to fourth semiconductor layers comprise Group III-nitrides.

2. The method according to claim 1, wherein the second, third, and fourth semiconductor layers are discontinuous.

3. The method according to claim 1 or claim 2, wherein step (iii) comprises:

(a) depositing a continuous masking layer, and

(b) selectively removing a plurality of portions of said masking layer to provide a plurality of apertures.

4. The method according to claim 3, wherein selectively removing a plurality of portions of said masking layer includes selectively removing a plurality of corresponding portions of the first semiconductor layer.

5. A method of forming a monolithic LED array precursor, the method comprising:

(i) providing a substrate having a surface;

(ii) forming a continuous first semiconductor layer on the surface of the substrate;

(iii) selectively treating the first semiconductor layer to form an amorphous surface pattern, wherein the amorphous surface pattern defines a plurality of untreated portions of the first semiconductor layer;

(iv) growing a second semiconductor layer on the untreated portions of the first semiconductor layer to form a plurality of columns each having a regular trapezoidal cross-section normal to the substrate and a substantially flat upper surface portion, and sloped facets;

(v) forming a third semiconductor layer covering the second semiconductor layer, wherein the third semiconductor layer comprises one or more quantum well sub-layers and has a substantially flat upper surface portion and has sloped side portions provided on the sloped facets of the second semiconductor layer having a thickness which is less than the thickness of the substantially flat upper surface portion;

(vi) forming a fourth semiconductor layer covering the third semiconductor layer, whereby the fourth semiconductor layer has a substantially flat upper surface portion; and

(vii) forming primary electrical contacts only on the substantially flat upper surface portion of the fourth semiconductor layer

wherein the first to fourth semiconductor layers comprise Group III-nitrides.

6. A method according to any of claims 1 to 4, wherein the plurality of apertures form a regularly spaced array, or

a method according to claim 5 wherein the plurality of untreated portions of the first semiconductor layer form a regularly spaced array.

7. A method according to any of the preceding claims, wherein the first semiconductor layer has a wurtzite crystal structure with a (0001) plane, and the substantially flat upper surface portion of the fourth semiconductor layer is parallel to the (0001) plane of the first semiconductor layer

8. A method according to any of the preceding claims, the method further comprising forming one or more secondary electrical contacts in electrical communication with the primary electrical contacts across the quantum well sub-layers to form a monolithic LED array, preferably wherein the one or more secondary electrical contacts are formed on the first semiconductor layer.

9. A method according to any of the preceding claims, wherein the monolithic LED array precursor comprising at least first and second sub-arrays of LED structures, each sub-array capable of emitting light at a different dominant wavelength.

10. A method according to any of the preceding claims, further comprising a step of at least partially removing the substrate, and at least partially removing the first semiconductor layer to form a plurality of dome or lens structures corresponding to and aligned with each of the plurality of columns of the second semiconductor layer.

11. A method according to any of the preceding claims, wherein the substrate is selectively removed to form a plurality of collimating channels, each of the collimating channels aligned with a primary contact formed on the substantially flat upper surface portion of the fourth semiconductor layer.

12. A monolithic LED array precursor comprising:

a plurality of LED structures sharing a first semiconductor layer, wherein the first semiconductor layer defines a plane of the LED array precursor, each LED structure comprising:

(i) a second semiconductor layer on the first semiconductor layer, having an upper surface portion parallel to the plane of the LED array precursor, the second semiconductor layer having a regular trapezoidal cross-section normal to the upper surface portion, such that the second semiconductor layer has sloped sides;

(ii) a third semiconductor layer on the second semiconductor layer, having an upper surface portion parallel to the plane of the LED array precursor, the third semiconductor layer and the second semiconductor layer forming a structure having a regular trapezoidal cross-section normal to the upper surface portion, such that the third semiconductor layer has sloped sides parallel to the sloped sides of the second semiconductor layer;

(iii) a fourth semiconductor layer on the third semiconductor layer, having an upper surface portion parallel to the plane of the LED array precursor, the fourth semiconductor layer, the third semiconductor layer, and the second semiconductor layer forming a structure having a regular trapezoidal cross-section normal to the upper surface portion, such that the fourth semiconductor layer has sloped sides parallel to the sloped sides of the third semiconductor layer; and

(iv) a primary electrical contact on the fourth semiconductor layer, wherein the primary electrical contact is only on the upper surface portion of the fourth semiconductor layer which is parallel to the plane of the LED array precursor;

wherein the third semiconductor layer comprises a plurality of quantum well sub-layers, the quantum well sub-layers having a greater thickness on a portion parallel to the plane of the LED array precursor and a reduced thickness on a portion which is not parallel to the plane of the LED array precursor.

13. The monolithic LED array precursor of claim 12, wherein a spacing of the sloped sides of the third semiconductor layer from the sloped sides of the second semiconductor layer is less than a spacing of the upper surface portion of the third semiconductor layer from the upper surface portion of the second semiconductor layer.

14. The monolithic LED array precursor of claim 12 or claim 13, wherein a spacing of the sloped sides of the fourth semiconductor layer from the sloped sides of the third semiconductor layer is less than a spacing of the upper surface portion of the fourth semiconductor layer from the upper surface portion of the third semiconductor layer.

15. The monolithic LED array precursor of claim 12 or claim 13 or claim 14, wherein the sloped faces of each layer form a plurality of planar facets.

16. The monolithic LED array precursor of any of claims 12 to 15, wherein the second, third and fourth semiconductor layers are shared between LED structures

17. The monolithic LED array precursor of any of claims 12 to 16, wherein the first semiconductor layer has a wurtzite crystal structure with a (0001) plane, and the substantially flat upper surface portion of the fourth semiconductor layer is parallel to the (0001) plane of the first semiconductor layer

18. The monolithic LED array precursor of any of claims 12 to 16, wherein the first semiconductor layer comprises a plurality of lens structures corresponding to and aligned with the plurality of LED structures.

19. A monolithic LED array comprising the monolithic LED array precursor of any of claims 12 to 18 and further comprising one or more secondary electrical contacts in electrical communication with the primary electrical contacts across the quantum well sub-layers.

20. The monolithic LED array of claim 19, wherein the monolithic LED array comprising at least first and second sub-arrays of LED structures, each sub-array capable of emitting light at a different dominant wave-length.

21. A display device comprising the monolithic LED array according to any of claims 19 or 20