

CLAIMS:

1. A method for fabricating a frusto-conical micro-lightguide for collimation of light emitted from micro-LEDs, comprising:
 - 5 depositing a layer of UV-curable material onto a substrate;
 - selectively curing a first part of the layer using UV light having a conical irradiation profile to define a shape of the frusto-conical micro-lightguide;
 - developing the UV-curable material to remove one of the first part of the layer and a second part of the layer, wherein the second part of the layer is uncured.
- 10 2. The method of claim 1, wherein the second part of the layer is removed and the first part of the layer comprises the frusto-conical micro-lightguide.
3. The method of claim 1, wherein the first part of the layer is removed and the
15 second part of the layer comprises a frusto-conical recess that defines the shape of the frusto-conical micro-lightguide.
4. The method of claim 3, wherein the method further comprises depositing a
20 lightguide material in the frusto-conical recess and removing the second part of the layer, such that the lightguide material comprises the frusto-conical micro-lightguide.
5. The method of any preceding claim, wherein the frusto-conical micro-lightguide
25 comprises a first planar surface and a second planar surface, wherein the first planar surface has a smaller area than the second planar surface.
6. The method of any preceding claim wherein the method further comprises fabricating an array of micro-lightguides.
- 30 7. The method of any preceding claim, wherein the conical irradiation profile takes a form of a substantially inverted cone and is achieved by transmitting the UV light through a mask that is moving in a circular trajectory, such that the first planar surface of the frusto-conical micro-lightguide is proximate the substrate.

8. The method of claim 7, wherein the substrate is a processed wafer comprising a plurality of micro-LEDs.
- 5 9. The method of claim 7 or 8, wherein the mask comprises one or more circular apertures.
- 10 10. The method of any of claims 1 to 6, wherein the conical irradiation profile is achieved by collimation of the UV light such that the second planar surface of the frusto-conical micro-lightguide is proximate the substrate.
- 11 11. The method of claim 10, wherein the collimation is achieved using one or more micro-lenses.
- 15 12. The method of claim 10 or 11, wherein the substrate is a transparent material such as glass or sapphire.
13. The method of any of claims 10 to 12, wherein the micro-lightguides are coupled to an array of micro-LEDs.
- 20 14. The method of any preceding claim, wherein the angle of a sidewall of the frusto-conical micro-lightguide to a central axis of the frusto-conical micro-lightguide is preferably between 10° and 18° , wherein the central axis of the frusto-conical micro-lightguide passes through a central point of the first planar surface and a central point of the second planar surface.
- 25 15. The method of claim any preceding claim, wherein the central axis of the frusto-conical micro-lightguide is aligned with a central axis of a micro-LED.
- 30 16. The method of any preceding claim, wherein the micro-lightguide further comprises a reflective coating.
17. The method of claim any preceding claim, wherein the UV-curable resist material is deposited by spin coating.

18. The method of any of claims 5 to 17, wherein the first planar surface has a characteristic dimension that is 50 % of a characteristic dimension of the second planar surface.
- 5 19. The method of any of claims 5 to 18, wherein the characteristic dimension of the second planar surface is equal to a characteristic dimension of the frusto-conical micro-lightguide that is parallel to the central axis of the frusto-conical micro-lightguide.
- 10 20. The method of any of claims 5 to 19, wherein the characteristic dimension of the first planar surface is 60 % larger than a characteristic dimension of the micro-LED.
- 15 21. The method of claim 20, wherein the characteristic dimension of the first planar surface is preferably 70 % larger than the characteristic dimension of the micro-LED.