Claims

The invention claimed is:

1. A light extraction film laminated to a glass substrate for organic light emitting diode devices, comprising: a flexible transparent film; a nanostructured layer having a first surface applied to the flexible transparent film and having a second surface opposite the first surface; a planarizing backfill layer applied over the second surface of the nanostructured layer, wherein the backfill layer has a higher index of refraction than the nanostructured layer; a glass substrate laminated to the flexible transparent film on a side opposite the nanostructured layer; and a region between the flexible transparent film and the glass substrate, wherein the region comprises one or more air gaps enclosed by an adhesive between the flexible transparent film and the glass substrate.

2. The light extraction film of claim 1, wherein the adhesive is patterned in stripes or a square pattern to provide the air gaps.

3. The light extraction film of claim 1, further comprising a protective layer applied over the backfill layer.

4. A method of making a light extraction film laminated to a glass substrate for organic light emitting diode devices, comprising: providing a flexible transparent film; applying a nanostructured layer to the flexible transparent film, wherein the nanostructured layer has a first surface applied to the flexible transparent film and a second surface opposite the first surface; applying a planarizing backfill layer over the second surface of the nanostructured layer, wherein the backfill layer has a higher index of refraction than the nanostructured layer; and laminating a glass substrate to the flexible transparent film on a side opposite the nanostructured layer, wherein the laminating step includes providing a region between the flexible transparent film and the glass substrate, wherein the region comprises one or more air gaps enclosed by an adhesive between the flexible transparent film and the glass substrate.

5. The method of claim 4, further comprising patterning the adhesive in stripes or a square pattern to provide the air gaps.

6. The method of claim 4, further comprising applying a protective layer over the backfill layer.

CLAIMS

1. A light extraction film laminated to a glass substrate for organic light emitting diode devices, comprising:

a flexible substantially transparent film;

a low index nanostructured layer applied to the flexible substantially transparent film;

a high index planarizing backfill layer applied over the nanostructured layer;

a glass substrate laminated to the flexible substantially transparent film on a side opposite the nanostructured layer; and

an ultra-low index region between the flexible substantially transparent film and the glass substrate.

2. The light extraction film of claim 1, wherein the ultra-low index region comprises one or more air gaps.

3. The light extraction film of claim 1, wherein the ultra-low index region comprises argon or nitrogen.

4. The light extraction film of claim 1, wherein the ultra-low index region comprises a structured adhesive.

5. The light extraction film of claim 1, wherein the ultra-low index region comprises an antireflective structured surface.

6. The light extraction film of claim 1, wherein the ultra-low index region comprises an ultra-low index material.

7. The light extraction film of claim 1, wherein the low index nanostructured layer comprises nanoparticles applied in a surface layer manner to the flexible substantially transparent film.

8. The light extraction film of claim 1, wherein the low index nanostructured layer comprises photonic crystal structures or linear gratings.

9. The light extraction film of claim 1, further comprising a protective layer applied over the backfill layer.

10. A method of making a light extraction film laminated to a glass substrate for organic light emitting diode devices, comprising:

providing a flexible substantially transparent film;

applying a low index nanostructured layer to the flexible substantially transparent film;

applying a high index planarizing backfill layer over the nanostructured layer; and

laminating a glass substrate to the flexible substantially transparent film on a side opposite the nanostructured layer, wherein the laminating step includes providing an ultra-low index region between the flexible substantially transparent film and the glass substrate.

11. The method of claim 10, wherein the ultra-low index region comprises one or more air gaps.

12. The method of claim 10, wherein the ultra-low index region comprises argon or nitrogen.

13. The method of claim 10, wherein the ultra-low index region comprises a structured adhesive.

14. The method of claim 10, wherein the ultra-low index region comprises an antireflective structured surface.

15. The method of claim 10, wherein the ultra-low index region comprises an ultra-low index material.

16. The method of claim 10, wherein the low index nanostructured layer comprises nanoparticles applied in a surface layer manner to the flexible substantially transparent film.

17. The method of claim 10, wherein the low index nanostructured layer comprises photonic crystal structures or linear gratings.

18. The method of claim 10, further comprising applying a protective layer over the backfill layer.