CLAIMS

WHAT IS CLAIMED IS:

1. A folded circularly symmetric illumination optic comprising:

a first light transfer mode having a first central refractive surface and a second central refractive surface, wherein one of the first and second central refractive surfaces has at least one peened feature;

a second light transfer mode having a first refractive surface, a first Total Internal Reflection ("TIR") surface, a second TIR surface and a second refractive surface;

a third light transfer mode having a first refractive surface, a first TIR surface and a second refractive surface, wherein the first TIR surface has at least one peening feature, and wherein the second refractive surface is conical;

wherein the first TIR surface and second refractive surface of the second light transfer mode is coincident at least one point, wherein the second refractive surface of the third light transfer mode is coincident with the first TIR surface and second refractive surface of the second light transfer mode.

2. A folded circularly symmetric illumination optic comprising:

a first light transfer mode comprising a first central refractive surface and a second central refractive surface, wherein one of the first and second central refractive surfaces has at least one peened feature;

a second light transfer mode having a ~~third~~ first refractive surface, a first Total Internal Reflection ("TIR") surface, a second TIR surface and a ~~fourth~~ second refractive surface, wherein the first TIR surface and ~~fourth~~ second refractive surface are coincident at least one point; and

a third light transfer mode which has a ~~fifth~~ third refractive surface, the second TIR surface, and a ~~sixth~~ fourth refractive surface, wherein the second TIR surface has at least one peening feature; and

wherein the ~~sixth~~ fourth refractive surface is coincident with the first TIR surface and ~~fourth~~ second refractive surface at least one point.

3. The folded circularly symmetric illumination optic of claim 2, wherein the ~~sixth~~ fourth refractive surface is conical.

4. The folded circularly symmetric illumination optic of claim 2, wherein the second TIR surface of the second light transfer mode and the third light transfer mode is conical.

5. The folded circularly symmetric illumination optic of claim 1, wherein the first central refractive surface of the first light transfer mode is planar, and the second central refractive surface of the first light transfer mode is curved.

6. The folded circularly symmetric illumination optic of claim 2, wherein the first central refractive surface is planar, and the second central refractive surface is curved.

7. The folded circularly symmetric illumination optic of claim 1 or 2, wherein the at least one peened feature is a bump or a plurality of bumps.

8. The folded circularly symmetric illumination optic of claim 7, wherein the bump allows a spread beam angle range from 15 degrees to 60 degrees.

9. The folded circularly symmetric illumination optic of claim 7, wherein the plurality of bumps comprises at least one bump which allows a spread beam angle range from 15 degrees to 60 degrees.

10. The folded circularly symmetric illumination optic of claim 7, wherein the bump has a lens size with a diameter range from 20mm to 50mm.

11. The folded circularly symmetric illumination optic of claim 7, wherein the plurality of bumps comprises at least one bump which has a lens size with a diameter range from 20mm to 50mm.

12. A lighting apparatus comprising the folded circularly symmetric illumination optic of

claim 1 or 2.

CLAIMS

WHAT IS CLAIMED IS:

1. A folded circularly symmetric illumination optic comprising:

a first light transfer mode having a first central refractive surface and a second central refractive surface, wherein one of the first and second central refractive surfaces has at least one peened feature;

a second light transfer mode having a first refractive surface, a first Total Internal Reflection ("TIR") surface, a second TIR surface and a second refractive surface;

a third light transfer mode having a first refractive surface, a first TIR surface and a second refractive surface, wherein the first TIR surface has at least one peening feature, and wherein the second refractive surface is conical;

wherein the first TIR surface and second refractive surface of the second light transfer mode is coincident at least one point, wherein the second refractive surface of the third light transfer mode is coincident with the first TIR surface and second refractive surface of the second light transfer mode.

2. A folded circularly symmetric illumination optic comprising:

a first light transfer mode comprising a first central refractive surface and a second central refractive surface, wherein one of the first and second central refractive surfaces has at least one peened feature;

a second light transfer mode having a first refractive surface, a first Total Internal Reflection ("TIR") surface, a second TIR surface and a second refractive surface, wherein the first TIR surface and second refractive surface are coincident at least one point; and

a third light transfer mode which has a third refractive surface, the second TIR surface, and a fourth refractive surface, wherein the second TIR surface has at least one peening feature; and

wherein the fourth refractive surface is coincident with the first TIR surface and second refractive surface at least one point.

3. The folded circularly symmetric illumination optic of claim 2, wherein the fourth

refractive surface is conical.

4. The folded circularly symmetric illumination optic of claim 2, wherein the second TIR surface of the second light transfer mode and the third light transfer mode is conical.

5. The folded circularly symmetric illumination optic of claim 1, wherein the first central refractive surface of the first light transfer mode is planar, and the second central refractive surface of the first light transfer mode is curved.

6. The folded circularly symmetric illumination optic of claim 2, wherein the first central refractive surface is planar, and the second central refractive surface is curved.

7. The folded circularly symmetric illumination optic of claim 1 or 2, wherein the at least one peened feature is a bump or a plurality of bumps.

8. The folded circularly symmetric illumination optic of claim 7, wherein the bump allows a spread beam angle range from 15 degrees to 60 degrees.

9. The folded circularly symmetric illumination optic of claim 7, wherein the plurality of bumps comprises at least one bump which allows a spread beam angle range from 15 degrees to 60 degrees.

10. The folded circularly symmetric illumination optic of claim 7, wherein the bump has a lens size with a diameter range from 20mm to 50mm.

11. The folded circularly symmetric illumination optic of claim 7, wherein the plurality of bumps comprises at least one bump which has a lens size with a diameter range from 20mm to 50mm.

12. A lighting apparatus comprising the folded circularly symmetric illumination optic of claim 1 or 2.