CLAIMS

1. An apparatus comprising an illumination system for illuminating an object, said illumination system comprising:

an illumination source,

a coupler,

a light bar, and

a plurality of patterned metasurfaces, each of which defines a diffraction site which is spaced apart from adjacent diffraction sites,

wherein said coupler couples light from said illumination source into said light bar, and

wherein, after having undergone total internal reflection within said light bar, said light exits said light bar through each of the diffraction sites and travels toward said object.

2. The apparatus of claim 1, wherein said plurality of patterned metasurfaces is patterned on a surface of said light bar.

3. The apparatus of claim 1, wherein said plurality of patterned metasurfaces is patterned on a top surface of said light bar, said top surface being a surface that is closest to said object.

4. The apparatus of claim 1, wherein said plurality of patterned metasurfaces is patterned on a bottom surface of said light bar, said bottom surface being a surface that is furthest from said object.

5. The apparatus of claim 1, wherein said light has a wavelength, wherein said plurality of patterned metasurfaces comprises nanostructures of uniform height, wherein said nanostructures are embedded in a medium, and wherein, said nanostructures have a higher refractive index than said medium at said wavelength.

6. The apparatus of claim 3, wherein said light has a wavelength, wherein said plurality of patterned metasurfaces comprises nanostructures of uniform height, wherein said nanostructures are embedded in a medium, and wherein, at said nanostructures have a refractive index greater than two at said wavelength.

7. The apparatus of claim 6, wherein said medium is air.

8. The apparatus of claim 6, wherein said light has a wavelength and wherein said medium is a medium having an index of refraction that is less than two at said wavelength.

9. The apparatus of claim 1, wherein said light bar is configured to cause light from said illumination source to be replicated at each of the diffraction sites.

10. The apparatus of claim 1, wherein said light bar is configured to cause light from said illumination source to form replicas at each of the diffraction sites, diffraction sites being separated by distances greater than a coherence length of said illumination source which produces replicas separated by distances greater than the coherence length of said illumination source.

11. The apparatus of claim 1, wherein light from said illumination source forms incoherent replicas at each of the diffraction sites.

12. The apparatus of claim 1, wherein the diffraction sites are positioned on the top surface of the light bar such that light from said illumination source forms replicas that are on a top surface of said light bar, as a result of which light is diffracted upon incidence and redirected into free space.

13. The apparatus of claim 1, wherein light from said illumination source forms replicas that are on a bottom surface of said light bar, wherein light incident on said bottom surface becomes diffracted as a result of interaction with said plurality of patterned metasurfaces, wherein, as a result of such interaction said light is no longer totally internally reflected within said light bar and is thus redirected into free space.

14. The apparatus of claim 1, wherein when light directly illuminates said object, a first angular diversity of illumination results, wherein when said light illuminates said object through said light bar, a second angular diversity of illumination results, and wherein said second angular diversity of illumination exceeds said first angular diversity of illumination.

15. The apparatus of claim 1, wherein when light illuminates said object directly, a first speckle results, wherein when said light illuminates said object through said light bar, a second

speckle results, and wherein said first speckle has a first contrast, wherein said second speckle has a second contrast, and wherein said first contrast exceeds said second contrast.

16. The apparatus of claim 1, wherein said plurality of patterned metasurfaces is partially reflective and wherein said plurality of patterned metasurfaces is partially transmissive.

17. The apparatus of claim 1, wherein said plurality of patterned metasurfaces has a non-zero reflection coefficient and a non-unity diffraction into a desired order.

18. The apparatus of claim 1, further comprising an air gap, wherein said air gap separates said plurality of patterned metasurfaces from said light bar.

19. The apparatus of claim 1, further comprising a linearly decreasing air gap, wherein said air gap separates said plurality of patterned metasurfaces from said light bar by a distance that varies linearly with position along said light bar.