Claims

1. An antenna or antenna array for a steerable light beam, the antenna array comprising a plurality of linear antenna arrays (100), each linear antenna array comprising:

a plurality of antenna elements (104);

a waveguide (102) supporting the antenna elements having a length and a thickness;

a transverse phase shifter (200) located at an end of the waveguide; and

a control element (400, 402, 404), adjacent to the waveguide, arranged to induce a change in refractive index along at least a part of the length of the waveguide and in at least a part of the thickness of the waveguide,

wherein the control elements define a longitudinal phase shifter extending along the length of the waveguide, wherein the control elements comprise a pair of doped regions (400, 402) located on either side of the waveguide and separated by the waveguide,

wherein the change in refractive index in the waveguide causes a phase shift in light emitted via each of the plurality of antenna elements.

2. The antenna or antenna array according to claim 1, wherein the change in refractive index is induced in a linear region (108) of the waveguide.

3. The antenna or antenna array according to claim 2, wherein the linear region is located along the length of the waveguide.

4 The antenna or antenna array according to claim 2 or claim 3, the defined linear region is in a lower portion of the waveguide.

5. The antenna or antenna array according to any of claims 1 to 4, wherein the change in refractive index is caused by application of a voltage or heat to the portion of the waveguide from the control element.

6. The antenna or antenna array according to claim 5, wherein heat is applied by a heater element located juxtaposed to the portion of the waveguide.

7. The antenna or antenna array according to claim 6, wherein there is two heating elements positioned on either side of the portion of the waveguide.

8. The antenna or antenna array according to any of the preceding claims, wherein light emitted by the antenna array is steerable by at least one of the first and second phase shifts in one or more directions.

9. The antenna or antenna array according to any of the preceding claims, wherein light emitted by the antenna array is steerable by tuning the phase shift between adjacent antenna elements in the array.

10. The antenna or antenna array according to any of the preceding claims, wherein a single control signal is applied in respective orthogonal directions by inducing the change in the refractive index in corresponding respective orthogonal directions.

11. The antenna or antenna array according to any of the preceding claims, wherein the waveguide is made from a low loss material such as for example Silicon (Si) or Silicon Nitride (SiN).

12. The antenna or antenna array according to any of the preceding claims, wherein the antenna elements are made from one of Silicon Nitride (SiN), Silicon Dioxide (SiO2), and Aluminum Nitride (AlN).

13. The antenna or antenna array according to any of the preceding claims, in combination with an optical power splitter to allow entry of light to the array.

14. A method of fabricating an antenna or antenna array according to claim 1, the method comprising:

forming a first waveguide from a first material (512);

forming a plurality of antenna elements (512) from a second material;

forming a transverse phase shifter at an end of the first waveguide;

forming at least one or more additional control elements (516; 518, 520) i arranged to induce a change in refractive index along at least a part of the length of the waveguide and in at least a part of the thickness of the waveguide, wherein the control elements define a longitudinal phase shifter extending along the length of the first waveguide, wherein the control elements comprise a pair of doped regions located on either side of the first waveguide and separated by the first waveguide,

forming at least one layer of dielectric material (504).

15. The method according to claim 14, further comprises:

forming the additional elements as one of a heating element and a voltage generating element which can cause a change in the refractive index of the defined portion of the waveguide.

16. The method according to claim 14 or claim 15, further comprising forming at least one of a beam coupler, and a beam splitter.