Claims

1. A semiconductor device comprising: a semiconductor substrate having a metasurface layer configured with a plurality of pairs of finger portions in a repeating arrangement, and are electrically configurable to modulate a radiation signal received by the semiconductor device; wherein each pair of finger portions comprises first and second members, the first member doped with a first dopant and the second member doped with a second dopant being different to the first dopant; and wherein two adjacent first members form a unit with a length of the unit no greater than at least one of Terahertz wavelength, near-infrared wavelength and mid-infrared wavelength to enable the repeating arrangement.

2. The semiconductor device according to claim 1, wherein the repeating arrangement is periodic.

3. The semiconductor device according to claim 1, wherein the repeating arrangement is aperiodic.

4. The semiconductor device according to claim 1, wherein the semiconductor substrate includes being formed from a silicon-based material.

5. The semiconductor device according to claim 4, wherein the silicon-based material is undoped.

6. The semiconductor device according to claim 1, wherein the radiation signal includes a Terahertz (THz) radiation signal, a near-infrared signal, or a mid-infrared signal.

7. The semiconductor device according to claim 1, wherein the first dopant is a p-type dopant and the second dopant is an n-type dopant.

8. The semiconductor device according to claim 1, wherein the first and second members are each configured to have a maximum width of half of at least one of Terahertz wavelength, near-infrared wavelength and mid-infrared wavelength.

9. The semiconductor device according to claim 1, wherein; the first members of the plurality of pairs of finger portions are arranged to be coupled to a first ohmic contact which is doped with the first dopant, and the second members of the plurality of pairs of finger portions are arranged to be coupled to a second ohmic contact which is doped with the second dopant; and the first and second ohmic contacts further coupled to respective electrodes, which are electrically connectable to a voltage source to operate the device.

10. The semiconductor device according to claim 9, wherein the first ohmic contact is P++ and the second ohmic contact is N++.

11. The semiconductor device according to claim 9, wherein the electrodes are made of aluminium with titanium acting as an adhesion layer between the electrodes and the ohmic contacts.

12. The semiconductor device according to claim 1, wherein the first and second members of each pair of finger portions are arranged to be coupled to respective ohmic contacts, the respective ohmic contacts of the plurality of pairs of finger portions further coupled to respective electrodes, which are electrically connectable to respective voltage sources to operate the device.

13. The semiconductor device according to claim 1, wherein the metasurface layer includes being arranged to have a substantially flat surface.

14. The semiconductor device according to claim 1, wherein an undoped intrinsic region is formed between the first and second members of each pair of finger portions.

15. A method of modulating a radiation signal using a semiconductor device, the semiconductor device comprising a semiconductor substrate having a metasurface layer configured with a plurality of pairs of finger portions in a periodic or aperiodic repeating arrangement, each pair of finger portions comprises first and second members, the first member doped with a first dopant and the second member doped with a second dopant being different to the first dopant, and any two adjacent first members form a unit with a length of the unit no greater than at least one of Terahertz wavelength, near-infrared wavelength and

mid-infrared wavelength to enable the periodic or aperiodic repeating arrangement, the method comprising: receiving the signal by the device; and electrically configuring the plurality of pairs of finger portions to modulate the received signal.