CLAIMS

1. A device which detects and/or emits infrared radiation in the mid-infrared region, the device comprising:

a first layer comprising a first transition metal dichalcogenide; and

a second layer comprising a second transition metal dichalcogenide, wherein the second layer is deposited adjacent to the first layer to form a first interface which interlayer excitons are producible from for rendering the device operable to detect and/or emit infrared radiation in the mid-infrared region.

2. The device of claim 1,

wherein the first transition metal dichalcogenide comprises a conduction band having a minimum energy value and the second transition metal dichalcogenide comprises a valence band having a maximum energy value, and wherein the minimum energy value of the conduction band of the first transition metal dichalcogenide and the maximum energy value of the valence band of the second transition metal dichalcogenide render a first difference in energy value for the interlayer excitons to be producible from the first interface; or

wherein the first transition metal dichalcogenide comprises a valence band having a maximum energy value and the second transition metal dichalcogenide comprises a conduction band having a minimum energy value, and wherein the maximum energy value of the valence band of the first transition metal dichalcogenide and the minimum energy value of the conduction band of the second transition metal dichalcogenide render a first difference in energy value for the interlayer excitons to be producible from the first interface.

3. The device of claim 1 or 2, further comprising a third layer deposited adjacent to the second layer to form a second interface which interlayer excitons are producible from for rendering the device operable to detect and/or emit infrared radiation in the mid-infrared region, wherein the third layer comprises a third transition metal dichalcogenide.

4. The device of claim 3, wherein the third transition metal dichalcogenide is identical to the first transition metal dichalcogenide.

5. The device of claim 3,

wherein the third transition metal dichalcogenide comprises a valence band having a maximum energy value, and

wherein the maximum energy value of the valence band of the third transition metal dichalcogenide and the minimum energy value of the conduction band of the second transition metal dichalcogenide render a second difference in energy value for the interlayer excitons to be producible from the second interface.

6. The device of claim 3,

wherein the third transition metal dichalcogenide comprises a conduction band having a minimum energy value, and

wherein the minimum energy value of the conduction band of the third transition metal dichalcogenide and the maximum energy value of the valence band of the second transition metal dichalcogenide render a second difference in energy value for the interlayer excitons to be producible from the second interface.

7. The device of any one of claims 1 to 6, wherein the first transition metal dichalcogenide comprises hafnium disulfide, molybdenum disulfide, molybdenum diselenide, titanium disulfide, tin diselenide, titanium diselenide, tungsten disulfide, tungsten diselenide, zirconium disulfide, or zirconium diselenide.

8. The device of any one of claims 1 to 7, wherein the second transition metal dichalcogenide comprises hafnium disulfide, molybdenum disulfide, molybdenum diselenide, titanium disulfide, tin diselenide, titanium diselenide, tungsten disulfide, tungsten diselenide, zirconium disulfide, or zirconium diselenide.

9. The device of any one of claims 3 to 6, wherein the third transition metal dichalcogenide comprises hafnium disulfide, molybdenum disulfide, molybdenum

diselenide, titanium disulfide, tin diselenide, titanium diselenide, tungsten disulfide, tungsten diselenide, zirconium disulfide, or zirconium diselenide.

10. The device of any one of claims 3 to 6, wherein the device comprises more than one of the first layer, more than one of the second layer, and/or more than one of the third layer.

11. The device of any one of claims 3 to 6, wherein each of the first layer, the second layer and the third layer comprises a thickness ranging from 5 Å to 10 Å.

12. The device of any one of claims 1 to 11, wherein the interlayer excitons are producible at a room temperature ranging from 293 K to 303 K.

13. The device of any one of claims 1 to 12, further comprising a substrate which the first layer and the second layer are deposited on, wherein the substrate comprises silicon.

14. The device of any one of claims 1 to 13, further comprising a power source connectable thereto, wherein the power source is operable to render a voltage applied to have the device detects and/or emits infrared radiation in the mid-infrared region.

15. The device of any one of claims 1 to 14, wherein the device is an infrared photo-detector, an infrared photo-emitter, or a combination thereof, operable in the mid-infrared region.