

CLAIMS

1. A solar cell comprising:
 - (a) a first junction layer;
 - (b) a second junction layer; and
 - 5 (c) an active region between the first and second junction layers, the active region comprising a plurality of quantum well layers each of which is sandwiched between barrier layers and the material forming each quantum well layer is independently a group III nitride,
- 10 wherein, consecutive quantum well layers have different bandgap values due to variations in the thickness of the layers and/or their having differing compositions of at least one of their constituent elements.
- 15 2. The solar cell of claim 1 wherein the bandgap of consecutive quantum well layers decreases on moving away from a surface of the solar cell upon which, in use, sunlight will be incident.
3. The solar cell of claim 1 wherein the constituent elements are selected from the group consisting of aluminium, gallium, indium and nitrogen.
- 20 4. The solar cell of claim 3 wherein the content of at least one of the constituent elements in consecutive quantum well layers increases on moving further away from an extent of the solar cell upon which, in use, sunlight is incident.
- 25 5. The solar cell of claim 1 wherein the thickness of consecutive quantum well layers decreases on moving further away from an extent of the solar cell upon which, in use, sunlight is incident.
6. The solar cell of claim 1 wherein the composition of individual quantum well layers is substantially constant throughout their extent.

7. The solar cell of claim 1 wherein the composition of individual quantum well layers varies in a continuous fashion on proceeding through the quantum well layer from a region contacting one adjacent barrier layer to a region contacting the next adjacent barrier layer.
- 5 8. The solar cell of claim 7 wherein it is the relative content of at least two group III elements selected from the group consisting of indium, aluminium and gallium which varies.
9. The solar cell of claim 1 wherein the group III nitride material forming the quantum well layers is selected from the group consisting of
10 indium gallium nitride, aluminium indium gallium nitride, indium aluminium nitride and aluminium gallium nitride.
10. The solar cell of claim 9 wherein the quantum well layers comprise indium gallium nitride and the indium and gallium contents vary between consecutive quantum well layers.
- 15 11. The solar cell of claim 10 wherein the quantum well layer having the highest bandgap and being located at the end of the solar cell closest to the surface adapted to receive sunlight will be the quantum well layer with the lowest indium content.
12. The solar cell of claim 1 wherein each quantum well layer is between
20 about 1 to about 5 nm thick.
13. The solar cell of claim 1 wherein the barrier layers comprise material selected from the group consisting of gallium nitride, aluminium nitride, indium gallium nitride, indium aluminium nitride and aluminium indium gallium nitride.
- 25 14. The solar cell of claim 1 wherein the barrier layers are selected such that the bandgaps of the barrier layers are higher than the bandgap of the sandwiched quantum well layer.

15. The solar cell of claim 1 wherein the solar cell further comprises one or more blocking layers.
16. The solar cell of claim 15 wherein the cell is a p-i-n structure and is grown to have at least one blocking layer present before the p-layer and after the n-layer.
17. The solar cell of claim 1 wherein the junction layer closest to the sunlit surface has a higher bandgap than the subsequent quantum well or barrier layers.
18. A method of forming a solar cell comprising a multiple quantum well structure, the method including the steps of:
- (a) forming a barrier layer;
 - (b) forming a desired thickness of a quantum well layer former from a group III nitride on top of the barrier layer;
 - (c) forming a further barrier layer on top of the exposed quantum well layer such that the quantum well layer is sandwiched between the two barrier layers;
 - (d) forming a desired thickness of a further quantum well layer formed from a group III nitride on top of the exposed further barrier layer; and
 - (e) repeating steps (c) to (d) to form a desired number of quantum wells wherein consecutive quantum well layers have different bandgap values due to variations in the thickness of the layers and/or their having differing contents of the at least one group III nitride,
- to thereby form a solar cell comprising a multiple quantum well structure.
19. The method of claim 18 wherein the quantum well layers are indium gallium nitride layers and the indium and gallium content vary in consecutive layers.

20. The method of claim 18 including the step of increasing the content of the at least one group III nitride in consecutive quantum well layers on moving further away from an extent of the solar cell upon which, in use, sunlight is incident.
- 5 21. The method of claim 18 including the step of maintaining the content of the at least one group III nitride substantially constant within individual quantum well layers.
22. The method of claim 18 including the step of forming a junction layer on a substrate and subsequently forming the first barrier layer or quantum well layer upon the junction layer.
- 10 23. The method of claim 22 including the step of forming a further junction layer on top of the final quantum well layer to be formed.
24. The method of claim 18 including the step of forming the multiple quantum well structure such that the content of the at least one group III nitride in consecutive quantum well layers decreases on moving further away from an extent of the solar cell upon which, in use, sunlight is incident.
- 15 25. The method of claim 18 including the step of separating the multiple quantum well structure from an underlying substrate and reversing the structure such that the content of the at least one group III nitride in consecutive quantum well layers increases on moving further away from an extent of the solar cell upon which, in use, sunlight is incident.
- 20 26. The method of claim 25 wherein the substrate is transparent.
- 25 27. The method of claim 19 including the step of growing the quantum well layers having the lowest indium content before those having higher indium contents.
28. A solar cell formed by the method of claim 18.