CLAIMS

1. A thin film III-V compound solar cell free of a substrate, the thin film III-V compound solar cell comprising:

an active layer; and

a backing layer formed on the active layer;

wherein the thin film III-V compound solar cell is formed on a substrate and the substrate is subsequently removed to leave the thin film III-V compound solar cell free of the substrate.

2. The thin film III-V compound solar cell of claim 1, wherein the active layer is formed of a III-V compound.

3. The thin film III-V compound solar cell of claim 1, wherein the thin film III-V compound solar cell comprises a single junction thin film III-V compound solar cell solar cell.

4. The thin film III-V compound solar cell of claim 1, wherein the thin film III-V compound solar cell comprises a multiple junction thin film III-V compound solar cell solar cell.

5. The thin film III-V compound solar cell of claim 1, further comprising:

surface grid metallization formed on a surface of the active layer opposite the backing layer; and

an antireflection coating formed on the surface of the active layer opposite the backing layer.

6. The thin film III-V compound solar cell of claim 1, further comprising at least one more active layer.

7. A thin film III-V compound solar cell free of a substrate, the thin film III-V compound solar cell comprising:

a plurality of active layers; and

a backing layer formed on a surface of the active layer having the lowest bandgap energy level;

wherein the thin film III-V compound solar cell is formed on a substrate and the substrate is subsequently removed to leave the thin film III-V compound solar cell free of the substrate.

8. The thin film III-V compound solar cell of claim 7 wherein, at least two of the plurality of active layers are wafer bonded together.

9. A thin film III-V compound solar cell free of a substrate, the thin film III-V compound solar cell comprising:

a GaAs active layer; and

a GaInP active layer; and

wherein the thin film III-V compound solar cell is formed on a substrate and the substrate is subsequently removed to leave the thin film III-V compound solar cell free of the substrate.

10. The thin film III-V compound solar cell of claim 9 wherein, the GaAs active layer has a bandgap energy of about 1.85 eV.

11. The thin film III-V compound solar cell of claim 9 wherein, the GaInP active layer has a bandgap energy of about 1.85 eV.

12. A thin film III-V compound solar cell free of a substrate, the thin film III-V compound solar cell comprising:

a GaInAs active layer; and

a GaInAsP active layer;

wherein the thin film III-V compound solar cell is formed on a substrate and the substrate is subsequently removed to leave the thin film III-V compound solar cell free of the substrate.

13. The thin film III-V compound solar cell of claim 12 wherein, the GaInAs active layer has a bandgap energy of between about 0.75 eV and about 1.14 eV.

14. The thin film III-V compound solar cell of claim 12 wherein, the GaInAsP active layer has a bandgap energy of between about 0.95 eV and about 1.00 eV.

15. A wafer bonded thin film III-V compound solar cell free of a substrate, the thin film III-V compound solar cell comprising:

a GaInAs active layer;

a GaInAsP active layer;

a GaAs active layer;

an AlGaInP active layer;

a GaInP active layer;

an AlGaInP active layer; and

a backing layer;

wherein the wafer bonded thin film III-V compound solar cell is formed on a substrate and the substrate is subsequently removed to leave the wafer bonded thin film III-V compound solar cell free of the substrate.

16. The wafer bonded thin film III-V compound solar cell of claim 15, wherein the backing layer is formed on a surface of the active layer having the lowest bandgap energy level.

17. The wafer bonded thin film III-V compound solar cell of claim 15, wherein the backing layer allows the wafer bonded thin film III-V compound solar cell to flex in two or more dimensions.

18. The wafer bonded thin film III-V compound solar cell of claim 15, wherein at least two of the active layers are wafer bonded together.

19. The wafer bonded thin film III-V compound solar cell of claim 15, further comprising:

surface grid metallization formed on a surface of the active layer opposite the backing layer; and

an antireflection coating formed on the surface of the active layer opposite the backing layer.

20. The wafer bonded thin film III-V compound solar cell of claim 15, wherein the substrate was previously used to form another wafer bonded thin film III-V compound solar cell.

Claims

1. A thin film III-V compound solar cell free of a substrate, the thin film III-V compound solar cell comprising:

an active layer; and

a metal backing layer formed on and in direct contact with the active layer;

wherein the thin film III-V compound solar cell is formed on a substrate and the substrate is subsequently removed to leave the thin film III-V compound solar cell free of the substrate; and

wherein the backing layer provides support to the active layer during removal of the substrate from the solar cell.

2. The thin film III-V compound solar cell of claim 1, wherein the active layer is formed of a III-V compound.

3. The thin film III-V compound solar cell of claim 1, wherein the thin film III-V compound solar cell comprises a single junction thin film III-V compound solar cell solar cell.

4. The thin film III-V compound solar cell of claim 1, wherein the thin film III-V compound solar cell comprises a multiple junction thin film III-V compound solar cell.

5. The thin film III-V compound solar cell of claim 1, further comprising:

surface grid metallization formed on a surface of the active layer opposite the backing layer; and

an antireflection coating formed on the surface of the active layer opposite the backing layer.

6. The thin film III-V compound solar cell of claim 1, further comprising at least one more active layer.

7. The thin film III-V compound solar cell of claim 1, further comprising:

a plurality of active layers;

wherein the backing layer is formed on a surface of the active layer having the lowest bandgap energy level.

8. The thin film III-V compound solar cell of claim 7 wherein, at least two of the plurality of active layers are wafer bonded together.

9. The thin film III-V compound solar cell of claim 7, wherein a first of the active layers is a GaAs active layer, and wherein a second of the active layers is a GaInP active layer.

10. The thin film III-V compound solar cell of claim 9 wherein, the GaAs active layer has a bandgap energy of about 1.42 eV.

11. The thin film III-V compound solar cell of claim 9 wherein, the GaInP active layer has a bandgap energy of about 1.85 eV.

12. The thin film III-V compound solar cell of claim 7, wherein a first of the active layers is a GaInAs active layer, and wherein a second of the active layers is a GaInAsP active layer.

13. The thin film III-V compound solar cell of claim 12 wherein, the GaInAs active layer has a bandgap energy of between about 0.75 eV and about 1.14 eV.

14. The thin film III-V compound solar cell of claim 12 wherein, the GaInAsP active layer has a bandgap energy of between about 0.95 eV and about 1.00 eV.

15. The thin film III-V compound solar cell of claim 7, wherein the plurality of active layers comprises:

a GaInAs active layer;

a GaInAsP active layer;

a GaAs active layer;

an AlGaInP active layer; and

a GaInP active layer.

16. The thin film III-V compound solar cell of claim 1, wherein the backing layer allows the thin film III-V compound solar cell to flex in two or more dimensions.

17. The thin film III-V compound solar cell of claim 1, wherein the substrate was previously used to form another thin film III-V compound solar cell.

18. The thin film III-V compound solar cell of claim 15, wherein a first set of the active layers is wafer bonded to a second set of the active layers.

19. The thin film III-V compound solar cell of claim 1, wherein the substrate on which the thin film III-V compound solar cell is formed is a wafer substrate of up to 152.4 mm (6 inches) in diameter.

20. The thin film III-V compound solar cell of claim 19, wherein the substrate on which the thin film III-V compound solar cell is formed is a wafer substrate of 101.6-152.4 mm (4-6 inches) in diameter.

21. The thin film III-V compound solar cell of claim 19, wherein the substrate on which the thin film III-V compound solar cell is formed is a wafer substrate of 152.4 mm (6 inches) in diameter.

22. The thin film III-V compound solar cell of claim 1, wherein the active layer is formed of GaAs, and wherein the current density across an operational voltage range of the thin film III-V compound solar cell free of the substrate and including the active layer formed of GaAs is greater than the current density across the operational voltage range of a thin

film III-V compound solar cell attached to a substrate and including an active layer formed of GaAs.

23. The thin film III-V compound solar cell of claim 8, wherein the wafer bonded active layers have smooth surfaces obtained by chemical etching of the active layers.

24. The thin film III-V compound solar cell of claim 1, further comprising four or more junctions.

25. The thin film III-V compound solar cell of claim 1, wherein the backing layer is formed by metal deposition on the surface of the active layer.

26. The thin film III-V compound solar cell of claim 1, wherein the backing layer includes a first surface in direct contact with the active layer and an opposing second surface forming an outermost surface of the solar cell.