What is claimed is:

A photovoltaic device, comprising:

a semiconductor structure combination, having a plurality of side surfaces, and comprising one selected from the group consisting of a p-n junction, an n-p junction, a p-i-n junction, an n-i-p junction, a tandem junction and a multi-junction; and

a first protection layer, formed to overlay the side surfaces of the semiconductor structure combination, wherein the first protection layer is capable of inhibiting potential-induced degradation effect of the photovoltaic device.

The photovoltaic device of claim 1, wherein the first protection layer is formed of one selected from the group consisting of aluminum oxide, titanium oxide, zirconium oxide, hafnium oxide and a mixture therebetween.

The photovoltaic device of claim 2, further comprising a second protection layer, formed to overlay the first protection layer, wherein the second protection layer is formed of one selected from the group consisting of silicon nitride, silicon oxynitride and a mixture therebetween.

The photovoltaic device of claim 2, wherein the semiconductor structure combination also has a front surface and a back surface opposite to the front surface, the front surface is treated by a texturing treatment, the first protection layer also extends to a first edge of the front surface and a second edge of the back surface, said photovoltaic device further comprises:

an anti-reflective layer, being formed on the front surface and overlaying the first protection layer on the first edge of the front surface;

a front electrode, being formed on the anti-reflective layer and ohmically contacting the front surface;

at least one back bus bar, formed on the back surface; and

a back electrode, formed to overlay the back surface other than the at least one back bus bar.

The photovoltaic device of claim 2, wherein the semiconductor structure combination also has a front surface and a back surface opposite to the front surface, the front surface is treated by a texturing treatment, the first protection layer also extends to an edge of the back surface and to overlay the front surface, said photovoltaic device further comprises:

an anti-reflective layer, formed to overlay the first protection layer on the front surface;

a front electrode, being formed on the anti-reflective layer and ohmically contacting the front surface;

at least one back bus bar, formed on the back surface; and

a back electrode, formed to overlay the back surface other than the at least one back bus bar.

The photovoltaic device of claim 2, wherein the semiconductor structure combination also has a front surface and a back surface opposite to the front surface, the front surface is treated by a texturing treatment, the first protection layer also extends to an edge of the front surface and to overlay the back surface, said photovoltaic device further comprises:

an anti-reflective layer, being formed on the front surface and overlaying the first protection layer on the edge of the front surface;

a front electrode, being formed on the anti-reflective layer and ohmically contacting the front surface;

at least one back bus bar, being formed on the first protection layer on the back surface and ohmically contacting the back surface; and

a back electrode, formed to overlay the first protection layer on the back surface other than the at least one back bus bar.

The photovoltaic device of claim 2, wherein the semiconductor structure combination also has a front surface and a back surface opposite to the front surface, the front surface is treated by a texturing treatment, the first protection layer also extends to overlay the front surface and to overlay the back surface, said photovoltaic device further comprises:

an anti-reflective layer, formed to overlay the first protection layer on the front surface;

a front electrode, being formed on the anti-reflective layer and ohmically contacting the front surface;

at least one back bus bar, being formed on the first protection layer on the back surface and ohmically contacting the back surface; and

a back electrode, formed to overlay the first protection layer on the back surface other than the at least one back bus bar.

A method of manufacturing a photovoltaic device, comprising the steps of:

preparing a semiconductor structure combination, wherein the semiconductor structure combination has a plurality of edge surfaces, and comprises one selected from the group consisting of a p-n junction, an n-p junction, a p-i-n junction, an n-i-p junction, a tandem junction and a multi-junction; and

forming a first protection layer to overlay the side surfaces of the semiconductor structure combination, wherein the first protection layer is capable of inhibiting potential-induced degradation effect of the photovoltaic device.

The method of claim 8, wherein the first protection layer is formed of one selected

from the group consisting of aluminum oxide, titanium oxide, zirconium oxide, hafnium oxide and a mixture therebetween.

The method of claim 9, further comprising the step of forming a second protection layer to overlay the first protection layer, wherein the second protection layer is formed of one selected from the group consisting of silicon nitride, silicon oxynitride and a mixture therebetween.

The method of claim 9, wherein the semiconductor structure combination also has a front surface and a back surface opposite to the front surface, said method further comprises the steps of:

treating the front surface by a texturing treatment;

extending the first protection layer also to a first edge of the front surface and a second edge of the back surface;

forming an anti-reflective layer to overlay the front surface and the first protection layer on the first edge of the front surface;

forming a front electrode on the anti-reflective layer, wherein the front electrode ohmically contacts the front surface;

forming at least one back bus bar on the back surface; and

forming a back electrode to overlay the back surface other than the at least one back bus bar.

The method of claim 9, wherein the semiconductor structure combination also has a front surface and a back surface opposite to the front surface, said method further comprises the steps of:

treating the front surface by a texturing treatment;

extending the first protection layer also to an edge of the back surface and to overlay the front surface;

forming an anti-reflective layer to overlay the first protection layer on the front surface;

forming a front electrode on the anti-reflective layer, wherein the front electrode ohmically contacts the front surface;

forming at least one back bus bar on the back surface; and

forming a back electrode to overlay the back surface other than the at least one back bus bar.

The method of claim 9, wherein the semiconductor structure combination also has a front surface and a back surface opposite to the front surface, said method further comprises the steps of:

treating the front surface by a texturing treatment;

extending the first protection layer also to an edge of the front surface and to overlay the back surface;

forming an anti-reflective layer to overlay the front surface and the first protection layer on the edge of the front surface;

forming a front electrode on the anti-reflective layer, wherein the front electrode ohmically contacts the front surface;

forming at least one back bus bar on the first protection layer on the back surface, wherein the at least one back bus bar ohmically contacts the back surface; and

forming a back electrode to overlay the first protection layer other than the at least one back bus bar.

The method of claim 9, wherein the semiconductor structure combination also has a front surface and a back surface opposite to the front surface, said method further comprises the steps of:

treating the front surface by a texturing treatment;

extending the first protection layer also to overlay the front surface and to overlay the back surface;

forming an anti-reflective layer to overlay the first protection layer on the front surface;

forming a front electrode on the anti-reflective layer, wherein the front electrode ohmically contacts the front surface;

forming at least one back bus bar on the first protection layer on the back surface, wherein the at least one back bus bar ohmically contacts the back surface; and

forming a back electrode to overlay the first protection layer on the back surface other than the at least one back bus bar.

What is claimed is:

1. A photovoltaic device, comprising:

a semiconductor structure combination, having a plurality of side surfaces, and comprising one selected from the group consisting of a p-n junction, an n-p junction, a p-i-n junction, an n-i-p junction, a tandem junction and a multi-junction; and

a first protection layer, formed to overlay the side surfaces of the semiconductor structure combination, wherein the first protection layer is capable of inhibiting potential-induced degradation effect of the photovoltaic device.

2. The photovoltaic device of claim 1, wherein the first protection layer is formed of one selected from the group consisting of aluminum oxide, titanium oxide, zirconium oxide, hafnium oxide and a mixture therebetween.

3. The photovoltaic device of claim 2, further comprising a second protection layer, formed to overlay the first protection layer, wherein the second protection layer is formed of one selected from the group consisting of silicon nitride, silicon oxynitride and a mixture therebetween.

4. The photovoltaic device of claim 2, wherein the semiconductor structure combination also has a front surface and a back surface opposite to the front surface, the front surface is treated by a texturing treatment, the first protection layer also extends to a first edge of the front surface and a second edge of the back surface, said photovoltaic device further comprises:

an anti-reflective layer, being formed on the front surface and overlaying the first protection layer on the first edge of the front surface;

a front electrode, being formed on the anti-reflective layer and ohmically contacting the front surface;

at least one back bus bar, formed on the back surface; and

a back electrode, formed to overlay the back surface other than the at least one back bus bar.

5. The photovoltaic device of claim 2, wherein the semiconductor structure combination also has a front surface and a back surface opposite to the front surface, the front surface is treated by a texturing treatment, the first protection layer also extends to an edge of the back surface and to overlay the front surface, said photovoltaic device further comprises:

an anti-reflective layer, formed to overlay the first protection layer on the front surface;

a front electrode, being formed on the anti-reflective layer and ohmically contacting the front surface;

at least one back bus bar, formed on the back surface; and

a back electrode, formed to overlay the back surface other than the at least one back bus bar.

6. The photovoltaic device of claim 2, wherein the semiconductor structure combination also has a front surface and a back surface opposite to the front surface, the front surface is treated by a texturing treatment, the first protection layer also extends to an edge of the front surface and to overlay the back surface, said photovoltaic device further comprises:

an anti-reflective layer, being formed on the front surface and overlaying the first protection layer on the edge of the front surface;

a front electrode, being formed on the anti-reflective layer and ohmically contacting the front surface;

at least one back bus bar, being formed on the first protection layer on the back surface and ohmically contacting the back surface; and

a back electrode, formed to overlay the first protection layer on the back surface other than the at least one back bus bar.

7. The photovoltaic device of claim 2, wherein the semiconductor structure combination also has a front surface and a back surface opposite to the front surface, the front surface is treated by a texturing treatment, the first protection layer also extends to overlay the front surface and to overlay the back surface, said photovoltaic device further comprises:

an anti-reflective layer, formed to overlay the first protection layer on the front surface;

a front electrode, being formed on the anti-reflective layer and ohmically contacting the front surface;

at least one back bus bar, being formed on the first protection layer on the back surface and ohmically contacting the back surface; and

a back electrode, formed to overlay the first protection layer on the back surface other than the at least one back bus bar.

8. A method of manufacturing a photovoltaic device, comprising the steps of:

preparing a semiconductor structure combination, wherein the semiconductor structure combination has a plurality of edge surfaces, and comprises one selected from the group consisting of a p-n junction, an n-p junction, a p-i-n junction, an n-i-p junction, a tandem junction and a multi-junction; and

forming a first protection layer to overlay the side surfaces of the semiconductor structure combination, wherein the first protection layer is capable of inhibiting potential-induced degradation effect of the photovoltaic device.

9. The method of claim 8, wherein the first protection layer is formed of one

selected from the group consisting of aluminum oxide, titanium oxide, zirconium oxide, hafnium oxide and a mixture therebetween.

10. The method of claim 9, further comprising the step of forming a second protection layer to overlay the first protection layer, wherein the second protection layer is formed of one selected from the group consisting of silicon nitride, silicon oxynitride and a mixture therebetween.

11. The method of claim 9, wherein the semiconductor structure combination also has a front surface and a back surface opposite to the front surface, said method further comprises the steps of:

treating the front surface by a texturing treatment;

extending the first protection layer also to a first edge of the front surface and a second edge of the back surface;

forming an anti-reflective layer to overlay the front surface and the first protection layer on the first edge of the front surface;

forming a front electrode on the anti-reflective layer, wherein the front electrode ohmically contacts the front surface;

forming at least one back bus bar on the back surface; and

forming a back electrode to overlay the back surface other than the at least one back bus bar.

12. The method of claim 9, wherein the semiconductor structure combination also has a front surface and a back surface opposite to the front surface, said method further comprises the steps of:

treating the front surface by a texturing treatment;

extending the first protection layer also to an edge of the back surface and to overlay the front surface;

forming an anti-reflective layer to overlay the first protection layer on the front surface;

forming a front electrode on the anti-reflective layer, wherein the front electrode ohmically contacts the front surface;

forming at least one back bus bar on the back surface; and

forming a back electrode to overlay the back surface other than the at least one back bus bar.

13. The method of claim 9, wherein the semiconductor structure combination also has a front surface and a back surface opposite to the front surface, said method further comprises the steps of:

treating the front surface by a texturing treatment;

extending the first protection layer also to an edge of the front surface and to overlay the back surface;

forming an anti-reflective layer to overlay the front surface and the first protection layer on the edge of the front surface;

forming a front electrode on the anti-reflective layer, wherein the front electrode ohmically contacts the front surface;

forming at least one back bus bar on the first protection layer on the back surface, wherein the at least one back bus bar ohmically contacts the back surface; and

forming a back electrode to overlay the first protection layer other than the at least one back bus bar.

14. The method of claim 9, wherein the semiconductor structure combination also has a front surface and a back surface opposite to the front surface, said method further comprises the steps of:

treating the front surface by a texturing treatment;

extending the first protection layer also to overlay the front surface and to overlay the back surface;

forming an anti-reflective layer to overlay the first protection layer on the front surface;

forming a front electrode on the anti-reflective layer, wherein the front electrode ohmically contacts the front surface;

forming at least one back bus bar on the first protection layer on the back surface, wherein the at least one back bus bar ohmically contacts the back surface; and

forming a back electrode to overlay the first protection layer on the back surface other than the at least one back bus bar.