CLAIMS

What is claimed is:

1. A photovoltaic module having a first side directed toward the sun during normal operation and a second side, the photovoltaic module comprising:

a perimeter frame; and

a photovoltaic laminate at least partially enclosed by and supported by the perimeter frame, the photovoltaic laminate comprising:

a transparent cover layer positioned toward the first side of the photovoltaic module;

an upper encapsulant layer beneath and adhering to the cover layer;

a plurality of photovoltaic solar cells beneath the upper encapsulant layer, the photovoltaic solar cells electrically interconnected;

a lower encapsulant layer beneath the plurality of photovoltaic solar cells, the upper and lower encapsulant layers enclosing the plurality of photovoltaic solar cells; and

a homogenous rear environmental protection layer, the rear environmental protection layer adhering to the lower encapsulant layer, the rear environmental protection layer exposed to the ambient environment on the second side of the photovoltaic module.

2. The photovoltaic module of Claim 1, wherein the material comprising the rear environmental protection layer is selected from the group including: a flouropolymer, a polyvinylidene fluoride, a polycarbonate, a polyester, a polypropylene, a polyphenylene sulfide, a polyphenylene oxide, polyacrylate, polyamide, and a polytetrafluoroethylene.

3. The photovoltaic module of Claim 1, wherein the lower encapsulant layer has a volume resistivity of at least $5x10^{13}$ ohm-cm at 50 degrees Celcius.

4. The photovoltaic module of Claim 1, wherein the lower encapsulant layer has a white color.

5. The photovoltaic module of Claim 3, wherein the lower encapsulant layer is at least partially composed of a polyethylene.

6. The photovoltaic module of Claim 3, wherein the lower encapsulant layer is at least partially composed of polyolefin.

7. The photovoltaic module of Claim 1, wherein the plurality of photovoltaic solar cells comprise back contact solar cells.

8. The photovoltaic module of Claim 1, wherein the lower encapsulant layer has a thickness of less than 650 micrometers.

9. The photovoltaic module of Claim 1, wherein the rear environmental protection layer has a thickness of less than 400 micrometers.

10. The photovoltaic module of Claim 1, wherein the cover layer comprises an anti-reflective coating.

11. A photovoltaic laminate comprising:

a plurality of photovoltaic solar cells, each of the solar cells having a upper side facing the sun during normal operation and a lower side facing away from the sun;

an encapsulant layer surrounding and enclosing the solar cells, the encapsulant layer extending between gaps in the solar cells;

a transparent cover layer disposed above the upper side of the plurality of solar cells and atop the encapsulant layer, the encapsulant layer adhering to the cover layer; and

a mono-stratum sealing layer below the lower side of the plurality of solar cells and beneath the encapsulant layer, the encapsulant layer adhering to the

sealing layer along an inner surface and having an outer surface exposed to the ambient environment.

12. The photovoltaic laminate of Claim 11, wherein the sealing layer is resistive to fluid.

13. The photovoltaic laminate of Claim 11, wherein the encapsulant layer has a volume resistivity greater than $5x10^{13}$ at 50° Celsius.

14. The photovoltaic laminate of Claim 11, wherein the encapsulant layer and sealing layer combine to permit less than 10 micro-amperes of electrical current to flow between the lower side of the plurality of solar cells and the outer surface when the electrical potential difference between the lower side of the plurality of solar cells and the outer surface is at least 1,000 volts.

15. The photovoltaic laminate of Claim 11, wherein the sealing layer and at least part of the encapsulant layer were formed by co-extrusion.

16. The photovoltaic laminate of Claim 11, further comprising a bonding layer between the sealing layer and the encapsulant layer.

17. The photovoltaic laminate of Claim 11, wherein the combined thickness of the encapsulant layer between the lower side of the plurality of solar cells and the outer surface of the sealing layer is less than 600 micrometers.

18. A backsheet for a photovoltaic laminate, the backsheet comprising:

a homogenous encapsulant layer; and

a homogenous outer layer; wherein:

the encapsulant layer and outer layer are jointly formed by co-extrusion, the encapsulant layer adhering to the outer layer;

the encapsulant layer has a resistivity of at least $5x10^{13}$ at 50° Celsius;

the outer layer is resistive to fluids;

the encapsulant layer has a thickness of at least 400 micrometers; and

the backsheet has an overall thickness of less than 400 micrometers.

19. The backsheet of Claim 18, wherein the encapsulant layer is composed of a material selected from the group comprising: polyolefin, ethylene vinyl acetate, and silicone.

20. The backsheet of Claim 18, wherein the outer layer has a thermal constant of at least 0.2 W/(m-K).

CLAIMS

1. A photovoltaic module having a first side directed toward the sun during normal operation and a second side, the photovoltaic module comprising:

a perimeter frame; and

a photovoltaic laminate at least partially enclosed by and supported by the perimeter frame, the photovoltaic laminate comprising:

a transparent cover layer positioned toward the first side of the photovoltaic module;

an upper encapsulant layer beneath and adhering to the cover layer; a plurality of photovoltaic solar cells beneath the upper encapsulant layer, the photovoltaic solar cells electrically interconnected;

a lower encapsulant layer beneath the plurality of photovoltaic solar cells, the upper and lower encapsulant layers enclosing the plurality of photovoltaic solar cells, wherein the lower encapsulant layer extends in gaps between adjacent raised features of the plurality of photovoltaic solar cells; and

a homogenous rear environmental protection layer, the homogenous rear environmental protection layer adhering to the lower encapsulant layer, the homogenous rear environmental protection layer exposed to the ambient environment on the second side of the photovoltaic module.

2. The photovoltaic module of Claim 1, wherein the homogenous rear environmental protection layer comprises a material selected from a group including: a fluoropolymer, a polyvinylidene fluoride, a polycarbonate, a polyester, a polypropylene, a polyphenylene sulfide, a polyphenylene oxide, polyacrylate, polyamide, and a polytetrafluoroethylene.

3. The photovoltaic module of Claim 1, wherein the lower encapsulant layer has a volume resistivity of at least $5x10^{13}$ ohm-cm at 50 degrees Celsius.

4. The photovoltaic module of Claim 1, wherein the lower encapsulant layer has a white color.

5. The photovoltaic module of Claim 3, wherein the lower encapsulant layer is at least partially composed of a polyethylene.

6. The photovoltaic module of Claim 3, wherein the lower encapsulant layer is at least partially composed of polyolefin.

7. The photovoltaic module of Claim 1, wherein the plurality of photovoltaic solar cells comprise back contact solar cells.

8. The photovoltaic module of Claim 1, wherein the lower encapsulant layer has a thickness of less than 650 micrometers.

9. The photovoltaic module of Claim 1, wherein the homogenous rear environmental protection layer has a thickness of less than 400 micrometers.

10. The photovoltaic module of Claim 1, wherein the cover layer comprises an anti-reflective coating.

11. A photovoltaic laminate comprising:

a plurality of photovoltaic solar cells, each of the plurality of photovoltaic solar cells having an upper side facing the sun during normal operation and a lower side facing away from the sun;

an encapsulant layer surrounding and enclosing the plurality of photovoltaic solar cells, the encapsulant layer extending in gaps between adjacent raised features of the plurality of photovoltaic solar cells;

a transparent cover layer disposed above the upper side of the plurality of photovoltaic solar cells and atop the encapsulant layer, the encapsulant layer adhering to the cover layer; and

a mono-stratum sealing layer below the lower side of the plurality of photovoltaic solar cells and beneath the encapsulant layer, the encapsulant layer adhering to the mono-stratum sealing layer along an inner surface and the mono-stratum sealing layer having an outer surface exposed to the ambient environment.

12. The photovoltaic laminate of Claim 11, wherein the mono-stratum sealing layer is resistive to fluid.

13. The photovoltaic laminate of Claim 11, wherein the encapsulant layer has a volume resistivity greater than $5x10^{13}$ at 50° Celsius.

14. The photovoltaic laminate of Claim 11, wherein the encapsulant layer and the mono-stratum sealing layer combine to permit less than 10 micro-amperes of electrical current to flow between the lower side of the plurality of photovoltaic solar cells and the outer surface of the mono-stratum sealing layer when the electrical potential difference between the lower side of the plurality of photovoltaic solar cells and the outer surface of the mono-stratum sealing layer is at least 1,000 volts.

15. The photovoltaic laminate of Claim 11, wherein the mono-stratum sealing layer and at least part of the encapsulant layer were formed by co-extrusion.

16. The photovoltaic laminate of Claim 11, further comprising a bonding layer between the mono-stratum sealing layer and the encapsulant layer.

17. The photovoltaic laminate of Claim 11, wherein the combined thickness of the encapsulant layer and the mono-stratum sealing layer between the lower side of the plurality of photovoltaic solar cells and the outer surface of the mono-stratum sealing layer is less than 600 micrometers.