CLAIMS

1. A solar cell comprising:

a back surface comprising a first region and a second region;

a positively-charged silicon oxide layer overlying the first region;

a negatively-charged aluminum oxide layer overlying the second region;

a positive electrode grid overlying the positively-charged silicon oxide layer; and

a negative electrode grid overlying the negatively-charged aluminum oxide layer.

2. The solar cell of claim 1,

wherein the positively-charged silicon oxide layer and the negatively-charged aluminum oxide layer are interdigitated; and

wherein the positive electrode grid and the negative electrode grid are interdigitated.

3. The solar cell of claim 2, wherein each of the positively-charged silicon oxide layer and the negatively-charged aluminum oxide layer are characterized by a thickness from 1 Å to 45 Å.

4. The solar cell of claim 2, wherein each of the positive electrode grid and the negative electrode grid comprise copper particles, copper alloy particles, silver particles, silver alloy particles, or a combination of any of the foregoing.

5. The solar cell of claim 2, wherein each of the positive electrode grid and the negative electrode grid comprise amorphous metal glass.

6. The solar cell of claim 2, wherein the back surface comprises a back surface of a N-type silicon solar cell.

7. The solar cell of claim 2, wherein the back surface comprises a back surface of a P-type silicon solar cell.

8. The solar cell of claim 2, wherein each of the positive electrode grid and the negative electrode grid comprise silver particles, silver alloy particles, silver coated with a metallic glass, a silver alloy coated with a metallic glass, copper particles, copper alloy particles, copper coated with a metallic glass, a copper alloy coated with a metallic glass, or a combination of any of the foregoing.

9. The solar cell of claim 1, wherein each of the positively-charged silicon oxide layer and the negatively-charged aluminum oxide layer are characterized by a thickness from 1 Å to 45 Å.

10. The solar cell of claim 9, wherein,

the positively-charged silicon oxide layer and the negatively-charged aluminum oxide layer are interdigitated; and

the positive electrode grid and the negative electrode grid are interdigitated.

11. The solar cell of claim 9, wherein each of the positive electrode grid and the negative electrode grid comprise copper particles, copper alloy particles, silver particles, silver alloy particles, or a combination of any of the foregoing.

12. The solar cell of claim 9, wherein each of the positive electrode grid and the negative electrode grid comprise amorphous metal glass.

13. The solar cell of claim 9, wherein the back surface comprises a back surface of a N-type silicon solar cell.

14. The solar cell of claim 9, wherein the back surface comprises a back surface of a P-type silicon solar cell.

15. The solar cell of claim 9, wherein each of the positive electrode grid and the negative electrode grid comprise silver particles, silver alloy particles, silver coated with a metallic glass, a silver alloy coated with a metallic glass, copper particles, copper alloy particles,

copper coated with a metallic glass, a copper alloy coated with a metallic glass, or a combination of any of the foregoing.

16. The solar cell of claim 1, wherein each of the positive electrode grid and the negative electrode grid comprise copper particles, copper alloy particles, silver particles, silver alloy particles, or a combination of any of the foregoing.

17. The solar cell of claim 16, wherein,

the positively-charged silicon oxide layer and the negatively-charged aluminum oxide layer are interdigitated; and

the positive electrode grid and the negative electrode grid are interdigitated.

18. The solar cell of claim 16, wherein each of the positively-charged silicon oxide layer and the negatively-charged aluminum oxide layer are characterized by a thickness from 1 Å to 45 Å.

19. The solar cell of claim 16, wherein each of the positive electrode grid and the negative electrode grid comprise amorphous metal glass.

20. The solar cell of claim 16, wherein the back surface comprises a back surface of a N-type silicon solar cell.

21. The solar cell of claim 16, wherein the back surface comprises a back surface of a P-type silicon solar cell.

22. The solar cell of claim 16, wherein each of the positive electrode grid and the negative electrode grid comprise silver particles, silver alloy particles, silver coated with a metallic glass, a silver alloy coated with a metallic glass, copper particles, copper alloy particles, copper coated with a metallic glass, a copper alloy coated with a metallic glass, or a combination of any of the foregoing.

23. The solar cell of claim 1, wherein each of the positive electrode grid and the negative electrode grid comprise amorphous metal glass.

24. The solar cell of claim 23, wherein,

the positively-charged silicon oxide layer and the negatively-charged aluminum oxide layer are interdigitated; and

the positive electrode grid and the negative electrode grid are interdigitated.

25. The solar cell of claim 23, wherein each of the positively-charged silicon oxide layer and the negatively-charged aluminum oxide layer are characterized by a thickness from 1 Å to 45 Å.

26. The solar cell of claim 23, wherein each of the positive electrode grid and the negative electrode grid comprise copper particles, copper alloy particles, silver particles, silver alloy particles, or a combination of any of the foregoing.

27. The solar cell of claim 23, wherein the back surface comprises a back surface of a N-type silicon solar cell.

28. The solar cell of claim 23, wherein the back surface comprises a back surface of a P-type silicon solar cell.

29. The solar cell of claim 23, wherein each of the positive electrode grid and the negative electrode grid comprise silver particles, silver alloy particles, silver coated with a metallic glass, a silver alloy coated with a metallic glass, copper particles, copper alloy particles, copper coated with a metallic glass, a copper alloy coated with a metallic glass, or a combination of any of the foregoing.

30. A method of interconnecting a semiconductor device, comprising:

screen printing a positively charged dielectric paste on a first region of a back surface of a silicon substrate, wherein the positively charged dielectric paste comprises a positively charged silicon oxide;

screen printing a negatively charged dielectric paste on a second region of the back surface of the silicon substrate, wherein the negatively charged dielectric paste comprises a negatively charged aluminum oxide;

curing the positively charged dielectric paste and the negatively charged dielectric paste under conditions sufficient to form positively charged oxide tunnel junctions and negatively charged oxide tunnel junctions;

screen printing a first gridline metallization paste on the positively charged oxide tunnel junctions;

screen printing a second gridline metallization paste on the negatively charged oxide tunnel junctions; and

firing the first gridline metallization paste and the second gridline metallization paste to form a positive electrode and a negative electrode,

wherein each of the first gridline metallization paste and the second gridline metallization paste comprises:

a metal selected from copper, silver, or a combination thereof; and

a metallic glass, a non-oxide glass, or a combination thereof.

31. The method of claim 30, further comprising, before screen printing the positively charged dielectric paste:

forming a doped layer on a front surface of the silicon substrate;

depositing an antireflection layer on the doped layer; and

planarizing the back surface.

32. The method of claim 30, wherein the positively charged dielectric paste comprises silicon dioxide.

33. The method of claim 30, wherein the negatively charged dielectric paste comprises aluminum dioxide.

34. The method of claim 30, wherein the positively charged oxide tunnel junctions and the negatively charged oxide tunnel junctions form an interdigitated pattern.

35. The method of claim 30, wherein the positively charged oxide tunnel junctions and the negatively charged oxide tunnel junctions are characterized by a thickness less than 50 Å.

36. The method of claim 30, wherein, the first gridline metallization paste and the second gridline metallization paste comprise the same composition.

37. The method of claim 30, wherein curing comprises simultaneously firing the first gridline metallization paste and the second gridline metallization paste.

38. The method of claim 30, wherein both the first gridline metallization paste and the second gridline metallization paste comprise metallic glass-coated copper particles, non-oxide glass-coated copper particles, metallic glass-coated silver particles, non-oxide glass-coated silver particles, or a combination of any of the foregoing.

39. The method of claim 30, wherein the positive electrode and the negative electrode form an interdigitated pattern.

40. The method of claim 30, wherein the semiconductor device comprises a solar cell.

41. A method of forming an electrode on a semiconductor device, comprising:

screen printing a positively-charged silicon oxide layer on a first region of a silicon substrate and forming a positively charged oxide tunnel junction on the first region of the silicon substrate, wherein the positively-charged silicon oxide layer comprises a doped silicon oxide;

screen printing a negatively-charged aluminum oxide layer on a second region of the semiconductor device and forming a negatively charged oxide tunnel junction on the second region the silicon substrate, wherein the negatively-charged silicon oxide layer comprises a doped aluminum oxide;

forming a positive electrode on the positively charged oxide tunnel junction; and

forming a negative electrode on the negatively charged oxide tunnel junction.

42. The method of claim 41, wherein,

forming the positively charged oxide tunnel junction comprises curing the positively charged oxide layer; and

forming the negatively charged oxide tunnel junction comprises curing the negatively charged oxide layer;

wherein curing comprises exposing the positively charged oxide layer and the negatively charged oxide layer to conditions sufficient to form at least one tunnel junction.

43. The method of claim 41, wherein,

forming the positive electrode comprises:

depositing by screen printing a first gridline metallization paste; and

curing the deposited first gridline metallization paste; and

forming the negative electrode comprises:

depositing by screen printing a second gridline metallization paste; and

curing the deposited second gridline metallization paste.

44. The method of claim 43, wherein the first gridline metallization paste and the second gridline metallization paste comprise a metallic glass, a non-oxide glass, or a combination thereof.

45. The method of claim 44, wherein curing the deposited first gridline metallization paste and the deposited second gridline metallization paste comprises at least partially crystallizing the metallic glass, at least partially crystallizing the non-oxide glass, or at least partially crystallizing both the metallic glass and the non-oxide glass.

46. The method of claim 43, wherein the first gridline metallization paste and the second metallization paste comprise the same composition.

47. The method of claim 43, wherein curing the deposited first gridline metallization paste and the deposited second gridline metallization paste comprises simultaneously firing the deposited first gridline metallization paste and the deposited second metallization paste.

48. The method of claim 41, wherein the semiconductor device comprises a solar cell.

49. The method of claim 41, wherein the first gridline metallization paste and the second gridline metallization paste comprise metallic glass-coated copper particles, non-oxide glass-coated copper particles, metallic glass-coated silver particles, non-oxide glass-coated silver particles, or a combination of any of the foregoing.