CLAIMS:

1. A solar cell comprising a crystalline silicon substrate of one conductivity type having a light-receiving surface, an emitter layer formed on the light-receiving surface side of the substrate and having a dopant of opposite conductivity type added thereto, a passivation film formed on the surface of the substrate, an extraction electrode for extracting photogenerated charge from the silicon substrate, and a collector electrode in contact with at least a portion of the extraction electrode for collecting the charge drawn in the extraction electrode, characterized in that

the extraction electrode includes a first electrode in the form of a sintered conductive paste containing a dopant for imparting the same conductivity type as the emitter layer to silicon, at least the first electrode is formed so as to penetrate through the passivation layer, and the collector electrode includes a second electrode having a higher conductivity than the first electrode, and

a self-doped region is formed below the interface between the emitter layer of the silicon substrate and the first electrode, as a result of the dopant in the first electrode being diffused at a higher concentration than the emitter layer during the sintering step.

~~2. The solar cell of claim 1 wherein below the interface between the emitter layer of the silicon substrate and the first electrode, a self-doped region is formed as a result of the dopant in the first electrode being diffused during the sintering step.~~

32. The solar cell of claim 1 ~~or 2~~ wherein the self-doped region has a lower resistivity than the emitter layer disposed adjacent thereto.

3. The solar cell of claim 1 or 2 wherein the resistivity of the self-doped region at its surface is 2 mΩ.cm or less.

4. The solar cell of claim 3 wherein the resistivity of the emitter layer at its surface is 5 to 50 mΩ.cm.

45. The solar cell of any one of claims 1 to ~~3~~ 4 wherein the first

electrode is formed of a conductive paste based on Ag and containing B, Al, Ga, P, As, In or Sb alone or a compound thereof or a combination thereof as the dopant.

~~5. The solar cell of any one of claims 1 to 4 wherein the first electrode is partially contacted or entirely overlaid with the second electrode.~~

6. The solar cell of any one of claims 1 to 5 wherein the first electrode is formed of the conductive paste containing 2 to 15% by weight of the dopant.

~~6~~7. The solar cell of any one of claims 1 to 5 wherein the extraction electrode has a laminate structure consisting of the first and second electrodes, and the collector electrode has a monolayer structure consisting of the second electrode.

~~7~~8. The solar cell of any one of claims 1 to 5 wherein the extraction electrode and the collector electrode each have a laminate structure consisting of the first and second electrodes.

~~8~~9. The solar cell of any one of claims 1 to 5 wherein the extraction electrode consists of the first electrode, and the collector electrode consists of the second electrode.

~~9~~10. The solar cell of any one of claims 1 to ~~8~~9 wherein the passivation film comprises silicon oxide, silicon nitride, silicon carbide, aluminum oxide, amorphous silicon, microcrystalline silicon or titanium oxide or a combination thereof.

~~10~~11. ~~A~~ The solar cell of any one of claims 1 to 10 furthermore comprising ~~a crystalline silicon substrate having a non-light-receiving surface,~~ a non-light-receiving surface passivation film formed on the non-light-receiving surface of the substrate, ~~an~~ a non-light-receiving surface extraction electrode for extracting photogenerated charge from the silicon substrate, and a non-light-receiving surface collector electrode disposed at least partially in contact with the non-light-receiving surface extraction electrode for collecting the charge collected in the non-light-receiving surface extraction electrode, characterized in that

the non-light-receiving surface extraction electrode includes a first non-light-receiving surface electrode in the form of a sintered conductive paste containing a dopant for imparting conductivity to silicon, at least the first non-light-receiving surface electrode is formed so as to penetrate through the non-light-receiving surface passivation layer, and the non-light-receiving surface collector electrode includes a second non-light-receiving surface electrode having a higher conductivity than the first electrode~~.~~, and

a non-light-receiving surface self-doped region is formed at the interface between the silicon substrate and the first non-light-receiving surface electrode as a result of the dopant in the first non-light-receiving surface electrode being diffused during the sintering step.

~~11. The solar cell of claim 10 wherein at the interface between the silicon substrate and the first electrode, a self-doped region is formed as a result of the dopant in the first electrode being diffused during the sintering step.~~

~~12. The solar cell of claim 10 or 11 wherein the self-doped region has a lower resistivity than a non-self-doped region disposed adjacent thereto.~~

~~13. The solar cell of any one of claims 10 to 12 wherein the first electrode is formed of a conductive paste based on Ag and containing B, Al, Ca, P, As, In or Sb alone or a compound thereof or a combination thereof.~~

~~14. The solar cell of any one of claims 10 to 13 wherein the first electrode is partially contacted or entirely overlaid with the second electrode.~~

~~15. The solar cell of any one of claims 10 to 14 wherein the extraction electrode has a laminate structure consisting of the first and second electrodes, and the collector electrode has a monolayer structure consisting of the second electrode.~~

~~16. The solar cell of any one of claims 10 to 14 wherein the extraction electrode and the collector electrode each have a laminate structure consisting of the first and second electrodes.~~

~~17. The solar cell of any one of claims 10 to 14 wherein the extraction electrode consists of the first electrode, and the collector electrode consists of the second electrode.~~

~~18. The solar cell of any one of claims 10 to 17 wherein the passivation film comprises silicon oxide, silicon nitride, silicon carbide, aluminum oxide, amorphous silicon, microcrystalline silicon or titanium oxide or a combination thereof.~~

~~12~~12. A solar cell module comprising electrically connected solar cells according to any one of claims 1 to ~~11~~11.

13. A method for manufacturing a solar cell according to any one of claims 1 to 11, comprising:

(a) forming said emitter layer of a said light-receiving surface side of the crystalline substrate by addition of said dopant, and forming the passivation film on the surface of the substrate, and

(b) providing said extraction electrode including the first electrode and said collector electrode including the second electrode having higher conductivity, forming the first electrode by sintering a said conductive paste containing a dopant for imparting the same conductivity type as the emitter layer to silicon, and forming a said self-doped region below the interface between the emitter layer of the silicon substrate and the first electrode as a result of the dopant in the conductive paste being diffused at a higher concentration than the emitter layer during the sintering step.

14. The method of claim 13 in which the conductive paste is a silver paste obtainable by mixing silver powder, glass frit and dopant with an organic binder.

15. The method of claim 13 or 14 wherein the conductive paste for the first electrode contains 2 to 15% by weight of the dopant.

16. The method of any one of claims 13 to 15 wherein the electrode firing temperature during the sintering step is equal to or higher than 835°C.

17. The method of any one of claims 13 to 16 in which the first electrode is prepared by screen printing the conductive electrode paste to form a pattern solely of extraction electrodes or a pattern of both extraction and collector electrodes, and the second electrode is prepared by screen printing conductive electrode paste to form a pattern of both extraction and collector electrodes or a pattern of solely of collector electrodes.