CONDUCTIVITY ENHANCEMENT OF SOLAR CELLS

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Application No. 61/800,188 filed March 15, 2013, entitled "METHODS AND STRUCTURES FOR CONDUCTIVITY ENHANCEMENT OF SOLAR CELLS", the entire contents of which are hereby incorporated by reference.

BACKGROUND

[0002] Photovoltaic (PV) cells, commonly known as solar cells, are well known devices for conversion of solar radiation into electrical energy. Generally, solar radiation impinging on the surface of, and entering into, the substrate of a solar cell creates electron and hole pairs in the bulk of the substrate. The electron and hole pairs migrate to p-doped and n-doped regions in the substrate, thereby creating a voltage differential between the doped regions. The doped regions are connected to the conductive regions on the solar cell to direct an electrical current from the cell to an external circuit. When PV cells are combined in an array such as a PV module, the electrical energy collected from all of the PV cells can be combined in series and parallel arrangements to provide power with a certain voltage and current.

[0003] The disclosed techniques and structures for contact formation may reduce fabrication operations and improve overall output yield, decreasing overall solar cell manufacturing time and increasing the available product yield.

SUMMARY

According to the first aspect, it is provided a method for forming a contact region on a solar cell, the solar cell having a front side which faces the sun during normal operation, and a back side opposite the front side, the method comprising:

forming at least one contact opening through a first dielectric layer and over a silicon substrate of the solar cell, the silicon substrate having at least one doped region;

electrolessly plating a first metal contact over at least one contact opening;

forming a first metal paste over the first metal contact, the first metal paste having a thickness of at least 0.5 microns;

curing the first metal paste to form a first metal layer;

heating the first metal contact, first metal layer and the silicon substrate to a temperature of at least 550 ^{o}C; and

electrolyticaly plating a second metal layer on the first metal layer, wherein the first metal contact and first metal layer electrically couple the second metal layer to at least one doped region, wherein forming the aluminum paste comprises depositing an aluminum paste having a thickness of at least 0.5 microns, and subsequent to electrolyticaly plating the second metal layer on the first metal layer, electrolyticaly plating a third metal layer on the second metal layer, the third metal layer comprises an electrolyticaly plated metal selected from the group consisting of copper, tin, aluminium, silver, gold, chromium, iron, nickel, zinc, nuthenium, palladium and platinum.

According to the second aspect, it is provided a method for forming a contact region on a solar cell, the solar cell having a front side which faces the sun during normal operation, and a back side opposite the front side, the method comprising:

forming at least one contact opening through a first dielectric layer over a silicon substrate of the solar cell, the silicon substrate having at least one doped region;

electrolessly plating at least one nickel contact over at least one contact opening;

depositing an aluminum paste above at least one contact opening;

curing the aluminum paste to form a layer of aluminum;

annealing at least one nickel contact, layer of aluminum and the silicon substrate to a temperature of at least 550 ^{o}C; and

electrolyticly plating a second metal layer on the layer of aluminum, wherein the at least one nickel contact and layer of aluminum electrically couple the second metal layer to at least one doped region, wherein forming the aluminum paste comprises depositing an aluminum paste having a thickness of at least 0.5 microns and electrolyticaly plating a third metal layer on the seconametal layer, wherein the at least one nickel contact, layer of aluminium and first metal layer electrically couple the third metal layer to at least one doped region.

According to the third aspect, it is provided a solar cell having a front side which faces the sun during normal operation, and a back side opposite the front side, the solar cell comprising:

a contact opening through a first dielectric layer and over a silicon substrate of the solar cell, the silicon substrate having at least one doped region;

a nickel contact formed over the at least one contact opening;

a first metal layer formed over the nickel contact, wherein the first metal layer is in electrical connection to the nickel contact,

wherein the first metal layer comprises a second metal layer, wherein a third metal layer is formed over the second metal layer, wherein the nickel contact and first metal layer electrically couple the second metal layer to at least one doped region and the first metal layer comprises a printed metal such as aluminum having a thickness of at least 0.50 microns and wherein the third metal layer comprises an electrolyticaly plated metal selected from the group consisting of copper, tin, aluminium, silver, gold, chromium, iron, nickel, zinc, nuthenium, palladium and platinum.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] Figure 1 illustrates a schematic plan view of an example solar cell, according to some embodiments.

[0005] Figures 2 and 3 illustrate a cross-sectional view of an example solar cell, according to some embodiments.

[0006] Figure 4-12 illustrate cross-sectional views of various operations in forming a contact region on a solar cell, according to some embodiments.

[0007] Figure 13 illustrates a schematic plan view of another example solar cell, according to some embodiments.