SOLAR CELL EMITTER REGION FABRICATION USING ION IMPLANTATION

TECHNICAL FIELD

[0001] Embodiments of the present disclosure are in the field of renewable energy and, in particular, methods of fabricating solar cell emitter regions using ion implantation, and the resulting solar cells.

BACKGROUND

[0002] Photovoltaic cells, commonly known as solar cells, are well known devices for direct conversion of solar radiation into electrical energy. Generally, solar cells are fabricated on a semiconductor wafer or substrate using semiconductor processing techniques to form a p-n junction near a surface of the substrate. Solar radiation impinging on the surface of, and entering into, the substrate 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 generating a voltage differential between the doped regions. The doped regions are connected to conductive regions on the solar cell to direct an electrical current from the cell to an external circuit coupled thereto.

[0003] Efficiency is an important characteristic of a solar cell as it is directly related to the capability of the solar cell to generate power. Likewise, efficiency in producing solar cells is directly related to the cost effectiveness of such solar cells. Accordingly, techniques for increasing the efficiency of solar cells, or techniques for increasing the efficiency in the manufacture of solar cells, are generally desirable. Some embodiments of the present disclosure allow for increased solar cell manufacture efficiency by providing novel processes for fabricating solar cell structures. Some embodiments of the present disclosure allow for increased solar cell efficiency by providing novel solar cell structures.

Summary

[0003a] According to a first aspect, a method of fabricating alternating N-type and P-type emitter regions of a solar cell is provided, comprising: forming a silicon layer above a substrate;

implanting dopant impurity species of a first conductivity type in the silicon layer to form first implanted regions and resulting in non-implanted regions of the silicon layer;

implanting ancillary impurity species into the first implanted regions of the silicon layer, the ancillary impurity species different from the dopant impurity species of the first conductivity type;

implanting dopant impurity species of a second, opposite, conductivity type in portions of the non-implanted regions of the silicon layer to form second implanted regions and resulting in remaining non-implanted regions of the silicon layer;

removing the remaining non-implanted regions of the silicon layer with a selective etch process preserving at least a portion of the first implanted regions and preserving the second implanted regions of the silicon layer; and

annealing the first implanted regions and the second implanted regions of the silicon layer to form doped polycrystalline silicon emitter regions.

[0003b] According to a second aspect, a method of fabricating alternating N-type and P-type emitter regions of a solar cell is provided, comprising forming a silicon layer above a substrate;

implanting dopant impurity species of a first conductivity type in the silicon layer to form first implanted regions and resulting in non-implanted regions of the silicon layer;

modifying a shallow surface of the first implanted regions of the silicon layer, the modifying performed by flowing a precursor for an ancillary impurity species different from the dopant impurity species of the first conductivity type;

implanting dopant impurity species of a second, opposite, conductivity type in portions of the non-implanted regions of the silicon layer to form second implanted regions and resulting in remaining non-implanted regions of the silicon layer;

removing the remaining non-implanted regions of the silicon layer with a selective etch process preserving at least a portion of the first implanted regions and preserving the second implanted regions of the silicon layer; and

annealing the first implanted regions and the second implanted regions of the silicon layer to form doped polycrystalline silicon emitter regions.

[0003c] According to a third aspect, a back contact solar cell is provided, comprising a crystalline silicon substrate having a light-receiving surface and a back surface;

a first polycrystalline silicon emitter region disposed above the crystalline silicon substrate, the first polycrystalline silicon emitter region doped with dopant impurity species of a

first conductivity type and further comprising ancillary impurity species different from the dopant impurity species of the first conductivity type;

a second polycrystalline silicon emitter region disposed above the crystalline silicon substrate and adjacent to but separated from the first polycrystalline silicon emitter region, the second polycrystalline silicon emitter region doped with dopant impurity species of a second, opposite, conductivity type; and

first and second conductive contact structures electrically connected to the first and second polycrystalline silicon emitter regions, respectively.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] Figures 1A-1G illustrate cross-sectional views of various stages in the fabrication of a solar cell, in accordance with an embodiment of the present disclosure.

[0005] Figure 2 is a flowchart listing operations in a method of fabricating a solar cell as corresponding to Figures 1A-1G, in accordance with an embodiment of the present disclosure.