

SOLAR CELL EMITTER REGION FABRICATION USING ION IMPLANTATION

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Application No. 61/913,614, filed on December 9, 2013, the entire contents of which are hereby incorporated by reference herein.

TECHNICAL FIELD

[0002] 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

[0003] 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.

[0004] 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

[0004a] In one aspect, there is a method of fabricating alternating N-type and P-type emitter regions of a solar cell, the method comprising:

forming a silicon layer above a substrate;

implanting, through a first shadow mask, dopant impurity atoms 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, through a second shadow mask, dopant impurity atoms 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 the first implanted regions and 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.

[0004b] In another aspect, there is a method of fabricating an emitter region of a solar cell, the method comprising:

forming a silicon layer above a substrate;

forming a carbosilane layer on the silicon layer;

implanting, through a shadow mask, dopant impurity atoms in the carbosilane layer and the silicon layer to form implanted silicon regions and corresponding self-aligned implanted regions of the carbosilane layer, and resulting in non-implanted regions of the silicon layer and corresponding non-implanted regions of the carbosilane layer;

removing the non-implanted regions of the silicon layer and the non-implanted regions of the carbosilane layer, wherein the implanted regions of the carbosilane layer protect the implanted regions of the silicon layer during the removing; and

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

[0004c] In yet another aspect, there is a back contact solar cell comprising:

a monocrystalline silicon substrate having a light-receiving surface and a back surface;

a thin dielectric layer disposed on the back surface of the monocrystalline silicon substrate;

a polycrystalline silicon emitter region disposed on the thin dielectric layer, the polycrystalline silicon emitter region doped with impurity atoms;

a carbosilane layer disposed on, and aligned with, the polycrystalline silicon emitter region; and

a conductive contact structure disposed through the carbosilane layer and on the polycrystalline silicon emitter region.

BRIEF DESCRIPTION OF THE DRAWINGS

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