Solar Cell with Silicon Oxynitride Dielectric Layer

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TECHNICAL FIELD

Embodiments of the present invention are in the field of renewable energy and, in particular, solar cells with silicon oxynitride dielectric layers.

BACKGROUND

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.

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 invention allow for increased solar cell manufacture efficiency by providing novel processes for fabricating solar cell structures. Some embodiments of the present invention allow for increased solar cell efficiency by providing novel solar cell structures.

SUMMARY

In a first aspect, there is provided an emitter region of a solar cell, the emitter comprising a portion of a substrate having a back surface opposite a front surface;

a silicon oxynitride (SiO_xN_y, 0 < x, y) dielectric layer disposed on the back surface of the portion of the substrate, wherein the silicon oxynitride dielectric layer has a non-homogeneous distribution of nitrogen; and

a semiconductor layer disposed on the silicon oxynitride dielectric layer.

In a second aspect, there is provided a solar cell, comprising a first emitter region, comprising:

a first portion of a substrate having a back surface opposite a light receiving surface;

a silicon oxynitride (SiO_xN_y, 0 < x, y) dielectric layer disposed on the back surface of the first portion of the substrate, wherein the silicon oxynitride dielectric layer has a non-homogeneous distribution of nitrogen; and

a P-type semiconductor layer disposed on the silicon oxynitride dielectric layer; and

a second emitter region, comprising:

a second portion of the substrate;

the silicon oxynitride dielectric layer disposed on the back surface of the second portion of the substrate; and

an N-type semiconductor layer disposed on the silicon oxynitride dielectric layer.

In a third aspect, there is provided an emitter region of a solar cell, the emitter region comprising a portion of an N-type bulk silicon substrate having a back surface opposite a light receiving surface;

a silicon oxynitride (SiO_xN_y, 0 < x, y) dielectric layer disposed on the back surface of the portion of the N-type bulk silicon substrate, wherein the silicon oxynitride dielectric layer has a non-homogeneous distribution of nitrogen;

a boron-doped polycrystalline silicon layer disposed on the silicon oxynitride dielectric layer; and

a metal contact disposed on the boron-doped polycrystalline silicon layer.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a cross-sectional view illustrating an emitter region of a solar cell, in accordance with an embodiment of the present invention.

Figure 2 is a cross-sectional view illustrating another emitter region of a solar cell, in accordance with another embodiment of the present invention.

Figure 3 is a cross-sectional view illustrating another emitter region of a solar cell, in accordance with yet another embodiment of the present invention.