

a second polycrystalline silicon emitter region disposed on a second portion of the thin dielectric layer proximate to the first polycrystalline silicon emitter region disposed on the first portion of the thin dielectric layer, the second polycrystalline silicon emitter region doped with an impurity of a second, opposite, conductivity type, wherein a total concentration of the impurity of the first conductivity type in the first polycrystalline silicon emitter region is at least an order of magnitude greater than a total concentration of the impurity of the second conductivity type in the second polycrystalline silicon emitter region.

[0003b] According to the second aspect, a method of fabricating a solar cell is provided, comprising:

forming a thin dielectric layer on a portion of a back surface of a substrate, the substrate having a light-receiving surface opposite the back surface;

forming a first polycrystalline silicon emitter region on a first portion of the thin dielectric layer and doped with an impurity of a first conductivity type; and

forming a second polycrystalline silicon emitter region on a second portion of the thin dielectric layer proximate to the first polycrystalline silicon emitter region, the second polycrystalline silicon emitter region doped with an impurity of a second, opposite, conductivity type, wherein a total concentration of the impurity of the first conductivity type in the first polycrystalline silicon emitter region is at least an order of magnitude greater than a total concentration of the impurity of the second conductivity type in the second polycrystalline silicon emitter region.

[0003c] According to a third aspect, a method of fabricating alternating N-type and P-type emitter regions of a solar cell, the method comprising:

forming a boron-containing silicon layer above a portion of a substrate by an in situ deposition process;

implanting first regions, but not second regions, of the boron-containing silicon layer with phosphorous ions to provide phosphorous-implanted regions of the boron-containing silicon layer;

heating to provide N-type polycrystalline silicon emitters in the first regions and to provide P-type polycrystalline silicon emitters in the second regions; and forming a plurality of conductive contact structures, each of the N-type polycrystalline silicon emitters and the P-type polycrystalline silicon emitters electrically connected to one of the plurality of conductive contact structures. A total concentration of phosphorous in the N-type polycrystalline silicon

emitters is at least an order of magnitude greater than a total concentration of the boron in the P-type polycrystalline silicon emitters.

BRIEF DESCRIPTION OF THE DRAWINGS

[0001] 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, wherein:

[0002] Figure 1A illustrates a thin dielectric layer formed on a portion of a back surface of a substrate of a solar cell;

[0003] Figure 1B illustrates the structure of Figure 1A having a boron-containing silicon layer formed thereon;

[0004] Figure 1C illustrates the structure of Figure 1B having first regions, but not second regions, of the boron-containing silicon layer implanted with phosphorous ions;

[0005] Figure 1D illustrates the structure of Figure 1C heated to provide N-type polycrystalline silicon emitters and P-type polycrystalline silicon emitters; and

CLAIMS

What is claimed is:

1. A solar cell, comprising:
 - a substrate having a light-receiving surface and a back surface;
 - a thin dielectric layer disposed on a portion of the back surface of the substrate;
 - a first polycrystalline silicon emitter region disposed on a first portion of the thin dielectric layer and doped with an impurity of a first conductivity type; and
 - a second polycrystalline silicon emitter region disposed on a second portion of the thin dielectric layer proximate to the first polycrystalline silicon emitter region disposed on the first portion of the thin dielectric layer, the second polycrystalline silicon emitter region doped with an impurity of a second, opposite, conductivity type, wherein a total concentration of the impurity of the first conductivity type in the first polycrystalline silicon emitter region is at least an order of magnitude greater than a total concentration of the impurity of the second conductivity type in the second polycrystalline silicon emitter region.
2. The solar cell of claim 1, further comprising:
 - a P/N junction between the first polycrystalline silicon emitter region and the second polycrystalline silicon emitter region.
3. The solar cell of claim 1, wherein the impurity of the first conductivity type in the first polycrystalline silicon emitter region is an N-type impurity, and the impurity of the second conductivity type in the second polycrystalline silicon emitter region is a P-type impurity.
4. The solar cell of claim 3, wherein the N-type impurity is phosphorous and the total concentration of the impurity of the first conductivity type in the first polycrystalline silicon emitter region is $1\text{E}20\text{ atoms/cm}^3$, and wherein the P-type impurity is boron and the total concentration of the impurity of the second conductivity type in the second polycrystalline silicon emitter region is approximately $1\text{E}18\text{ atoms/cm}^3$.
5. The solar cell of claim 1, wherein the first polycrystalline silicon emitter region further comprises the impurity of the second conductivity type.
6. The solar cell of claim 5, wherein the total concentration of the impurity of the first conductivity type in the first polycrystalline silicon emitter region is two orders of magnitude greater than the total concentration of the impurity of the second conductivity type in the second polycrystalline silicon emitter region and in the first polycrystalline silicon emitter region.

7. The solar cell of claim 1, further comprising:
 - a first conductive contact structure electrically connected to the first polycrystalline silicon emitter region; and
 - a second conductive contact structure electrically connected to the second polycrystalline silicon emitter region.
8. A method of fabricating a solar cell, the method comprising:
 - forming a thin dielectric layer on a portion of a back surface of a substrate, the substrate having a light-receiving surface opposite the back surface;
 - forming a first polycrystalline silicon emitter region on a first portion of the thin dielectric layer and doped with an impurity of a first conductivity type; and
 - forming a second polycrystalline silicon emitter region on a second portion of the thin dielectric layer proximate to the first polycrystalline silicon emitter region, the second polycrystalline silicon emitter region doped with an impurity of a second, opposite, conductivity type, wherein a total concentration of the impurity of the first conductivity type in the first polycrystalline silicon emitter region is at least an order of magnitude greater than a total concentration of the impurity of the second conductivity type in the second polycrystalline silicon emitter region.
9. A solar cell fabricated according to the method of claim 8.
10. A method of fabricating alternating N-type and P-type emitter regions of a solar cell, the method comprising:
 - forming a boron-containing silicon layer above a portion of a substrate by an in situ deposition process;
 - implanting first regions, but not second regions, of the boron-containing silicon layer with phosphorous ions to provide phosphorous-implanted regions of the boron-containing silicon layer;
 - heating to provide N-type polycrystalline silicon emitters in the first regions and to provide P-type polycrystalline silicon emitters in the second regions; and
 - forming a plurality of conductive contact structures, each of the N-type polycrystalline silicon emitters and the P-type polycrystalline silicon emitters electrically connected to one of the plurality of conductive contact structures,wherein a total concentration of phosphorous in the N-type polycrystalline silicon emitters is at least an order of magnitude greater than a total concentration of the boron in the P-type polycrystalline silicon emitters.