HYBRID EMITTER ALL BACK CONTACT SOLAR CELL

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STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

[0001] The invention described herein was made with Governmental support under contract number DE-FC36-07GO17043 awarded by the United States Department of Energy. The Government may have certain rights in the invention.

TECHNICAL FIELD

[0002] Embodiments of the subject matter described herein relate generally to solar cells. More particularly, embodiments of the subject matter relate to solar cell fabrication processes and structures.

BACKGROUND

[0003] Solar cells are well known devices for converting solar radiation to electrical energy. A solar cell has a front side that faces the sun during normal operation to collect solar radiation and a backside opposite the front side. In an all back contact solar cell, all metal contacts and corresponding emitters are formed on the backside of the solar cell. An external electrical circuit, e.g., a load, may be connected to the metal contacts to be powered by the solar cell.

[0004] To remain a commercially-viable renewable energy source, solar cells need to be manufactured at low cost. Embodiments of the present invention pertain to a hybrid emitter design that simplifies the manufacture of solar cells while retaining efficiency.

BRIEF SUMMARY

[0005] ~~In one embodiment~~According to a first aspect of the invention, an all back contact solar cell comprising

a single crystalline silicon substrate;

a thin dielectric layer formed on a backside surface of the single crystalline silicon substrate;

a first emitter of the solar cell, the first emitter of the solar cell being formed on the thin dielectric layer and comprising polycrystalline silicon doped to have a first polarity;

a second emitter of the solar cell, the second emitter of the solar cell being formed in the single crystalline silicon substrate and comprising single crystalline silicon doped to have a second polarity opposite the first polarity;

a first metal contact connected to the first emitter on a backside of the solar cell, the backside being opposite a front side of the solar cell that faces the sun during normal operation; and

a second metal contact connected to the second emitter on the backside of the solar cell. The all back contact solar cell has a hybrid emitter design. The solar cell may have a thin dielectric layer formed on a backside surface of a single crystalline silicon substrate. The thin dielectric layer may comprise silicon dioxide that

is formed directly on the backside surface of the single crystalline silicon substrate. One emitter of the solar cell may comprise doped polycrystalline silicon that is formed on the thin dielectric layer. The other emitter of the solar cell may be formed in the single crystalline silicon substrate and comprise doped single crystalline silicon. The solar cell includes contact holes that allow metal contacts to connect to corresponding emitters.

[0005a] According to a second aspect of the invention, a method of manufacturing an all back contact solar cell is provided, comprising

forming a thin dielectric layer on a backside surface of a single crystalline silicon substrate;

forming a first emitter on the thin dielectric layer on a backside of the solar cell, the first emitter comprising polycrystalline silicon that is doped with dopants of a first polarity, the backside of the solar cell being opposite a front side of the solar cell that faces the sun during normal operation;

forming a second emitter in the single crystalline silicon substrate on the backside the solar cell, the second emitter comprising single crystalline silicon that is doped with dopants of a second polarity opposite to the first polarity; and

forming a first metal contact connected to the first emitter and a second metal contact connected to the second emitter on the backside of the solar cell.

[0005b] According to a third aspect of the invention, a solar cell is manufactured with the method according to the second aspect.

[0005c] According to a further aspect of the invention, a solar cell is provided, comprising

a single crystalline silicon substrate;

a thin dielectric formed on a backside surface of the single crystalline silicon substrate;

a first emitter of the solar cell, the first emitter comprising doped polycrystalline silicon; and

a second emitter of the solar cell, the second emitter comprising doped single crystalline silicon and formed in the single crystalline silicon substrate.

[0006] These and other features of the present invention will be readily apparent to persons of ordinary skill in the art upon reading the entirety of this disclosure, which includes the accompanying drawings and claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] A more complete understanding of the subject matter may be derived by referring to the detailed description and claims when considered in conjunction with the following figures, wherein like reference numbers refer to similar elements throughout the figures. The drawings are not to scale.

[0008] FIGS. 1-12 show cross-sections that schematically illustrate a method of manufacturing a solar cell in accordance with an embodiment of the present invention.

[0009] FIG. 13 shows a flow diagram of a method of manufacturing a solar cell in accordance with an embodiment of the present invention.

DETAILED DESCRIPTION

[0010] In the present disclosure, numerous specific details are provided, such as examples of apparatus, process steps, and structures, to provide a thorough understanding of embodiments of the invention. Persons of ordinary skill in the art will recognize, however, that the invention can be practiced without one or more of the specific details. In other instances, well-known details are not shown or described to avoid obscuring aspects of the invention.

[0011] FIGS. 1-12 show cross-sections that schematically illustrate a method of manufacturing a solar cell in accordance with an embodiment of the present invention. FIGS. 1-12 are not drawn to scale.

[0012] In FIG. 1, a thin dielectric layer 102 is formed on a single crystalline silicon substrate 101. The substrate 101 may comprise a high-lifetime N-type single crystalline .