The method of manufacturing a solar cell according to a first aspect of the present invention is a method of manufacturing a solar cell, in which a porous layer is formed on a surface of a silicon substrate by etching with metal ions, including the steps of: immersing the silicon substrate in a first aqueous solution containing hydrofluoric acid to remove a natural oxide film on the surface of the silicon substrate; immersing the silicon substrate from which the natural oxide film has been removed in a second aqueous solution containing the metal ions and not containing oxidizing agent and hydrofluoric acid to deposit the metal ions on the surface of the silicon substrate by electroless plating; and immersing the silicon substrate having the metal ions deposited on the surface in a third aqueous solution containing hydrofluoric acid and hydrogen peroxide water to form the porous layer on the surface of the silicon substrate by a catalytic reaction with the metal ions, wherein, in the step of depositing the metal ion on the surface of the silicon substrate, a concentration of the metal ions is measured and then the concentration of the metal ion is controlled to be constant.

Advantageous Effects of Invention

[0010]

According to the first aspect of the present invention, prior to the formation of the porous layer by etching, the metal ions are deposited on the surface of the silicon substrate. Accordingly, the metal ions can be deposited on the surface of

the silicon substrate more uniformly than in the conventional procedure in which deposition of metal ions and etching take place simultaneously. Then, the porous layer is formed on the surface of the silicon substrate by the catalytic reaction of the metal ions. Accordingly, by controlling the immersion time of the silicon substrate and the ratio of the hydrofluoric acid to the hydrogen peroxide water, the size of holes formed by the catalytic reaction can be controlled. Therefore, a texture having more uniform size and density can be formed on the surface of the silicon substrate. In addition, by controlling the concentration of the metal ions contained in the second aqueous solution more reliably, variation in the amount of the metal ions adhering can be suppressed on the whole.

Brief Description of Drawings

[0011]

Figure 1 is a perspective view showing an overall structure of a solar cell according to the present embodiment;

Figure 2 is a flowchart showing a method of manufacturing a solar cell according to the present embodiment;

Figure 3 is a SEM image of a silicon substrate surface having metal ions deposited;

Figure 4 is a SEM image of the silicon substrate surface showing an example in which a porous layer is formed, in the manufacturing method according to the present embodiment;

Figure 5 is a SEM image of a texture formed on the silicon substrate surface by etching the porous layer with mixed acid mainly containing fluoronitric acid, in

Claims

1. A method of manufacturing a solar cell, in which a porous layer is formed on a surface of a silicon substrate by etching with metal ions, the method comprising steps of:

immersing the silicon substrate in a first aqueous solution containing hydrofluoric acid to remove a natural oxide film on the surface of the silicon substrate;

immersing the silicon substrate after removing the natural oxide film therefrom in a second aqueous solution containing the metal ions to deposit the metal ions on the surface of the silicon substrate by electroless plating; and

immersing the silicon substrate having the metal ions deposited on the surface in a third aqueous solution containing hydrofluoric acid and hydrogen peroxide water to form the porous layer on the surface of the silicon substrate by a catalytic reaction with the metal ions.

2. The method of manufacturing a solar cell according to claim 1, wherein, in the step of depositing the metal ion on the surface of the silicon substrate, a concentration of the metal ions is measured and the concentration of the metal ion is controlled to be constant.

3. The method of manufacturing a solar cell according to claim 1, wherein the third aqueous solution has a concentration of the hydrogen peroxide water of 25% to 50% relative to that of the hydrofluoric acid.

4. The method of manufacturing a solar cell according to claim 1, further comprising a step of immersing the silicon substrate having the porous layer formed thereon in a fourth aqueous solution containing hydrofluoric acid and nitric acid to etch the substrate.

5. The method of manufacturing a solar cell according to claim 1, further comprising a step of immersing the silicon substrate in an alkaline chemical solution to etch the substrate.

6. The method of manufacturing a solar cell according to claim 1, wherein, in the step of forming the porous layer on the surface of the silicon substrate,

immersion time for the silicon substrate and

a ratio of the hydrofluoric acid to the hydrogen peroxide water is controlled to control a size of holes forming the porous layer.

7. The method of manufacturing a solar cell according to claim 1, wherein, in the step of depositing the metal ions on the surface of the silicon substrate, the second

aqueous solution containing the metal ions is flown to perform electroless plating.

CLAIMS

1. A method of manufacturing a solar cell, in which a porous layer is formed on a surface of a silicon substrate by etching with metal ions, the method comprising steps of:

immersing the silicon substrate in a first aqueous solution containing hydrofluoric acid to remove a natural oxide film on the surface of the silicon substrate;

immersing the silicon substrate after removing the natural oxide film therefrom in a second aqueous solution containing the metal ions and not containing oxidizing agent and hydrofluoric acid to deposit the metal ions on the surface of the silicon substrate by electroless plating; and

immersing the silicon substrate having the metal ions deposited on the surface in a third aqueous solution containing hydrofluoric acid and hydrogen peroxide water to form the porous layer on the surface of the silicon substrate by a catalytic reaction with the metal ions, wherein, in the step of depositing the metal ion on the surface of the silicon substrate, a concentration of the metal ions is measured and then the concentration of the metal ion is controlled to be constant.

2. The method of manufacturing a solar cell according to claim 1, wherein the third aqueous solution has a

concentration of the hydrogen peroxide water of 25% to 50% relative to that of the hydrofluoric acid.

3. The method of manufacturing a solar cell according to claim 1 or 2, further comprising a step of immersing the silicon substrate having the porous layer formed thereon in a fourth aqueous solution containing hydrofluoric acid and nitric acid to etch the substrate.

4. The method of manufacturing a solar cell according to any one of claims 1 to 3, further comprising a step of immersing the silicon substrate in an alkaline chemical solution to etch the substrate.

5. The method of manufacturing a solar cell according to any one of claims 1 to 4, wherein, in the step of forming the porous layer on the surface of the silicon substrate,

immersion time for the silicon substrate and

a ratio of the hydrofluoric acid to the hydrogen peroxide water is controlled to control a size of holes forming the porous layer.

6. The method of manufacturing a solar cell according to any one of claims 1 to 5, wherein, in the step of depositing the metal ions on the surface of the silicon

substrate, the second aqueous solution containing the metal ions is flown to perform electroless plating.