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Silicon Photovoltaic Solar Cells with Electroplated Aluminum Electrodes

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Background

In recent years the cost of photovoltaic solar modules has dropped significantly, but further cost reductions are needed for the cost of solar to meet grid parity objectives. Electrons are collected from silicon wafers through metal grid lines that transfer the electricity to the power transmission grid. These metal grid lines are electrodes that are made from silver, which is highly conductive. Unfortunately, silver is expensive, and the worldwide supply is limited. Because of this, the cost of silver is uncertain and unstable. Copper is a highly conductive material and research has been conducted to determine if it can be used as a suitable replacement material for silver metal grid lines. Unfortunately, copper bleeds into silicon, and expensive coatings are required to make this material suitable for use. Aluminum has been used as metal gridlines, but past technology has required application with the use of evaporation or sputtering. These processes require application in a vacuum and are not cost effective in production manufacturing.

Invention Description

Researchers at Arizona State University have developed a method that allows aluminum metal grid lines to be electroplated on silicon solar cells. Aluminum is a very abundant element on earth. Therefore the cost of the material is low and stable. Although aluminum has a higher resistivity than silver or copper, the resistivity is reduced by depositing a denser layer of the material. Aluminum is stable when applied to silicon and does not bleed into the silicon wafer. This eliminates the need for expensive coatings such as those used in applying copper to silicon wafers. Electroplating aluminum metal grid lines does not require a vacuum for application and can be done at low temperatures, making the manufacturing process less expensive. It is anticipated that this process will reduce the cost of silicon solar modules by 10 cents per watt. The cost saving is more when the price of silver is higher.

Potential Applications

- Silicon Solar Cells
- Light emitting diodes
- Integrated circuits

Benefits and Advantages

- **Lower Costs** – Substantially reduces the cost of manufacturing silicon solar cells
- **Simple Process** – Rapid, high-production technique for applying metal grid lines
- **Retrofit** – Process can be adapted to existing solar cell production facilities