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NON-CONFIDENTIAL DISCLOSURE

NSi NewSouth Innovations

Thin-film solar module

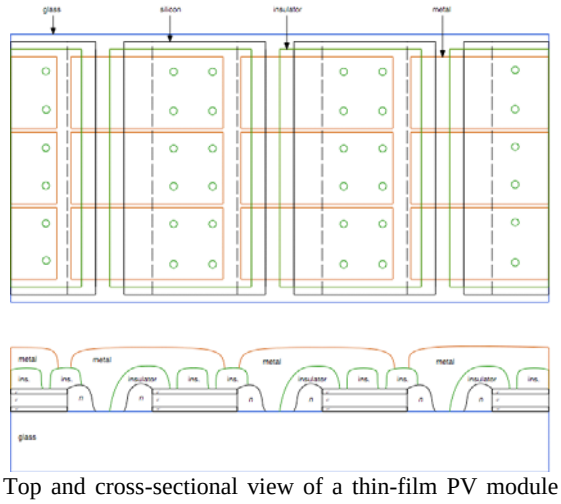
Background:
Thin-film solar cells on glass have the potential to dramatically reduce the cost ($/Watt) of solar photovoltaic (PV) modules due to the fact that they only require a fraction of the semiconductor material as compared to traditional, wafer-based solar cells. Thin-film solar cells, furthermore, have the advantage that it is possible to make them on large-area substrates (~1 m^2), streamlining the production process and further reducing costs. Whilst the output current of a solar cell scales with device size, the output voltage does not, and hence large-area solar cells have a very high current and a low voltage. Since resistive losses are proportional to the square of the current, large-area solar cells have large resistive losses (i.e., low efficiency) and are thus uneconomic. The usual way to overcome this problem is to divide the large-area solar cell into many (say *k*) smaller cells, each having the same size, and electrically interconnect them in series, so that their voltages add up and their current is only 1/*k*th of the current of the large-area cell.

The standard way to interconnect thin-film PV cells on glass is based on the use of transparent conductive oxides (TCOs) such as zinc oxide. A TCO is a high-bandgap semiconductor that does not absorb sunlight but nevertheless is a good electrical conductor. TCOs are a key component of PV modules made from semiconductors that do not exhibit a good lateral conductance (i.e., the doped layers have a very high sheet resistance). PV cells made from poorly conductive semiconductors (such as a-Si) usually use two TCO films – one on the front and one on the back. The interconnection of adjacent cells is realised by a combination of laser scribing and sequential deposition of individual TCO or semiconductor layers.

If the semiconductor layers have good lateral conductance, then the use of TCOs can be avoided, and instead the semiconductor can directly be contacted by grid or stripe-like metal contacts. The present invention provides a novel method for interconnecting such thin-film solar cells on glass. It appears superior to existing methods because it requires a smaller number of processing steps to achieve the same result. This will obviously lead to significant cost savings in a production environment.

What is the technology?
This invention provides a method for making a monolithically interconnected PV module from a large-area, asymmetrically doped, thin-film solar cell on a foreign insulating superstrate, as follows:

- Scribing a set of parallel grooves into the semiconductor film using a laser, separating the large-area solar cell into long, narrow cells. Due to the asymmetric doping structure of the precursor thin-film cell, the laser-scribed sidewalls of the long, narrow solar cells will have the same doping type as the superstrate-side heavily doped layer of the cells.
- Applying a non-continuous insulating layer to the surface of the cells, for example by ink-jet printing, such that one sidewall and a substantial portion of the surface of each cell is covered by the insulator, but the other sidewall of each cell as well as several "contact regions" on the surface of each cell are left uncovered by the insulator.
- Removing the thermal oxide from the exposed laser-scribed sidewalls and the native oxide from the surface contact regions.
- Applying a non-continuous metal layer by screen or ink-jet printing, over the surface of the device such that, for each pair of adjacent cells, an electrically conductive path is provided between the exposed sidewall of one solar cell and the air-side contact regions of the adjacent solar cell, but that there is no electrically conductive path between the exposed sidewall of each solar cell and the air-side contact regions of the same cell.



Top and cross-sectional view of a thin-film PV module fabricated according to this invention.

Commercial Opportunity:
NewSouth Innovations is seeking partners who are interested in manufacturing thin-film PV modules according to this invention.

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