Substantial improvement in essential cheap solar cell process

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A cheap alternative to silicon solar cells can be found in dye-sensitised solar cells. This type of cell imitates the natural conversion of sunlight into energy by, for instance, plants and light-sensitive bacteria. Annemarie Huijser has succeeded in substantially improving a process in this type of solar cell, which is similar to Grätzel cells. Huijser will receive her PhD on this subject from TU Delft on Tuesday 25 March.

The use of solar cells is increasing very slowly. One of the reasons is that the most commonly used type, made from silicon, is quite expensive to manufacture. That is why there has been a great deal of research into alternative solar cells over the past few years.

In searching for solutions, scientists are inspired by nature. Plants are able to transport absorbed solar energy over long distances, typically about 15-20 nanometres, to a location in which it is converted into chemical energy. This is because the chlorophyll molecules in their leaves are arranged in the best possible sequence. During her PhD, Annemarie Huijser attempted a partial recreation in solar cells of this process as found in plants.

She focused on what are known as dye-sensitised solar cells. These comprise a semiconductor, such as titanium dioxide, covered with a layer of dye. The dye absorbs energy from sunlight, which creates what are known as excitons. These energy parcels then need to move towards to the semiconductor. Once there, they generate electric power.

Lego

Huijser: “You can compare dye molecules to Lego bricks. I vary the way the bricks are stacked and observe how this influences the exciton transport through the solar cells. Excitons need to move as freely as possible through the solar cells in order to generate electricity efficiently.”

By studying the best sequence of dye molecules, Huijser succeeded in increasing the average distance which the excitons move in the solar cell by twenty times up to a distance of approximately 20 nanometres, comparable to systems found in nature. This substantially increases the efficiency of the cells.

In order to make this new type of solar cell commercially viable, Huijser estimates that the mobility of the excitons needs to increase further by a factor of three. She believes that this is certainly possible. ‘Once that has been achieved, there is nothing to stop this type of solar cell being developed further.’

Grätzel cells

The solar cells used by Huijser are closely related to the more widely known Grätzel cells. In the case of Grätzel cells, however, the dye and semiconductor are very close to each other, they are almost blended. As a result, the excitons do not need to move that far. One disadvantage of this type of cell, however, is the complicated method of charge transport. For this reason, Huijser chose to adopt a different approach and use this simple dual-layer system of dye and semiconductor.

Source: Delft University of Technology