Record efficiency with tandem solar cells

February 24 2016

The cover of the thesis of Alice Furlan displays the stacking of layers in solar cells as a cake. Photo: Alice Furlan.

On Thursday Alice Furlan receives her PhD for her study in which she experimented with stacking different types of material layers in flexible, thin solar cells. By combining these with a thin layer of silicon into a 'tandem solar cell' she, along with researchers from TU Delft, achieved a record level of efficiency in this kind of hybrid solar cell.

Flexible, plastic solar cells are an attractive alternative to the current standard crystalline silicon solar cells (with their characteristic gray-blue color). Using organic materials makes for easier and cheaper production while the printable, bendable character means they can be used in a wide variety of situations. The problem, however, is the yield.

Plastic combination

In her PhD thesis, Alice Furlan, PhD student in the Molecular Materials

and Nanosystems group of professor René Janssen at the Department of Chemical Engineering, tested how you can best combine two or three different layers of semi-conductive plastic. Given that each type of plastic absorbs a different color light, the idea is that by combining these, you can utilize a larger portion of the incoming sunlight. Furlan also looked at the electrical connections between the different layers, where losses tend to be greatest.

Marriage

She hit the jackpot of her research together with colleagues from TU Delft, combining the Eindhoven plastic cells with thin layers of amorphous silicon to a 'tandem solar cell'. This 'marriage' of two different kinds of absorption material – silicon and plastic – led to an efficiency of 13.2%. Never before had such cells generated such a high yield. The findings have been published in the journal *Advanced Materials*.

Combining strengths

Where the plastic used is mainly a strong absorber of infrared light, the silicon converts light from the visible and ultraviolet spectrum. In this way the method combines the aforementioned advantages of plastics with the broad absorption property of silicon. For the science researchers themselves there was also a kind of 'marriage': two disciplines (plastic and silicon solar cells) joining forces where they would normally have worked fully independently of each other.

More information: Hairen Tan et al. Highly Efficient Hybrid Polymer and Amorphous Silicon Multijunction Solar Cells with Effective Optical Management, *Advanced Materials* (2016). DOI: 10.1002/adma.201504483

Provided by Eindhoven University of Technology