Future solar panels

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A module to which two cells have been connected in series, powering a toy. Credit: IK4-Ikerlan

Conventional photovoltaic technology uses large, heavy, opaque, dark silicon panels, but this could soon change. The IK4-Ikerlan research centre is working with the UPV/EHU-University of the Basque Country within the X10D European project on new materials to produce solar panels in order to come up with alternatives to the current panels. What is needed to improve the functioning of cells with a large surface are materials that cost less to produce and offer greater energy efficiency.

The solar panels we see tend to be rigid and black. Organic photovoltaic technology, by contrast, enables more translucent and more flexible solar panels in a range of colours to be manufactured. But this technology needs to meet certain requirements if it is to be accepted on the market: greater efficiency, longer duration and low production cost. So this research has set out "to analyse the capacity new materials have to absorb solar energy as well as to seek appropriate strategies to move from the lab to actual operations," pointed out Ikerne Etxebarria, a researcher of the UPV/EHU and IK4-Ikerlan. The research team has analysed what the maximum size is for the cells, which must have a large surface area, if they are to work properly.

Various cells with different structures and surfaces have been designed for this purpose. Once the results had been analysed, "we found that in cells of up to approximately 6 cm2 the power was in direct proportion to their surface area. On larger surface areas, however, the performance of the cells falls considerably," stressed Etxebarria, who has reached the following conclusion: to be able to manufacture cells with a large surface area it is necessary to build modules, to which cells with a smaller surface will be connected in series or in parallel, on the substrate itself. To manufacture these modules, the layers existing between the electrodes need to be structured, in other words, the cells have to be connected to each other. "Until now, that structuring has been done mechanically or by means of laser but with the risk of damaging the substrate. However, in this research we have developed a new automatic structuring technique," she pointed out.

This technique involves transforming the features of the surface of the substrate. Aim: to improve efficiency Another of the aims of this research was to find a way of manufacturing highly efficient cells. To do this, the first step was to optimize the production process of cells based on different polymers, in order to achieve the maximum efficiency of these materials; secondly, polymers that absorb light at different wavelengths have been used to produce cells with a tandem structure in order to make them more efficient. "Each polymer absorbs light at a different wavelength. The ideal thing would be to take advantage of all the sun's rays, but there is no polymer capable of absorbing the light at all the wavelengths. So to be able to make the most efficient use of the sunlight, one of the possibilities is to build tandem-type structures, in other words, to fit the cells manufactured with different polymers one on top of the other," explained Etxebarria.

These tandem-type structures can be connected in series or in parallel. "We have seen that after many measurements greater efficiency is achieved in the cells installed in series than in the ones fitted in parallel," added the researcher. The production of cells manufactured using polymers or new materials will be much more cost-effective, since these polymers are produced in the laboratory, unlike silicon that has to be mined. Etxebarria works in the laboratory of IK4-Ikerlan trying out different polymers in the quest for suitable materials for manufacturing cells. "We try out (different) materials in small devices," she pointed out. Many materials of many types are in fact tried out and the most efficient ones are selected, in other words, those that capture the most solar energy and which make the most of it.

More information: I. Etxebarria, A. Furlan, J. Ajuria, F. W. Fecher, M. Voigt, C.J. Brabec, M. M. Wienk, L. Slooff, S. Veenstra, J. Gilot, R. Pacios, "Series vs Parallel connected organic tandem solar cells: Cell performance and impact on the design and operation of functional modules," *Solar Energy Materials and Solar Cells*, 130 (2014) 495-504.

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