A type of nanostructure succeeds in increasing the efficiency of electricity-producing photovoltaic cells

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Sagrario Domínguez-Fernández, a telecommunications engineer, has managed to increase light absorption in silicon by means of nanostructures etched onto photovoltaic cells. This increases the efficiency obtained in these electronic devices which are made of this element and which transform solar energy into electricity.

"Over 30 percent of the sunlight that strikes a silicon surface is reflected, which means it cannot be used in the photoelectric conversion," explained Sagrario Domínguez. "Because the nanostructures on the surface of a material have dimensions in the light wavelength range, they interfere with the surface in a particular way and allow the amount of reflected light to be modified."

Sagrario Domínguez designed and optimised structures on a nanometric scale "to try and find one that would minimise the reflectance [ability of a surface to reflect light] of the silicon in the wavelength range in which solar cells function." In their manufacturing process, she resorted to what is known as laser interference lithography which consists of applying laser radiation to a photo-sensitive material to create structures on a nanometric scale. Specifically, she used polished silicon wafers to which she gave the shape of cylindrical pillar and obtained a 77 percent reduction in the reflectance of this element.

Sagrario Domínguez then went on to modify the manufacturing processes to produce the nanostructures on the silicon substrates used in commercial solar cells. "These substrates have dimensions and a surface roughness that makes them, 'a priori', unsuitable for laser interference lithography processes," pointed out the researcher.

Having overcome the difficulties, she incorporated nanostructures onto solar cells following the standard processes of the photovoltaics industry. "According to the literature, this is the first time that it has been possible to manufacture periodic nanostructures; they are the ones that on the surface of a material are continuously repeated on substrates of this type, and therefore, the first standard solar cell with periodic nanostructures," pointed out the new PhD holder. The efficiency obtained is 15.56 percent, which is a very promising value when compared with others included in the literature."

Research at the MIT

She then went on to steer her work towards the manufacture of nanostructures for applications on a higher bandwidth, such as sensors. She managed to create nanocones of a great height in comparison with the base diameter. "These structures are presented in the literature as the best anti-reflection solution on the high bandwidth. The process to manufacture these structures is complicated and could be carried out thanks to the knowledge acquired in the first part of the thesis," explained Domínguez. She did this part of the work at the Massachusetts Institute of Technology (MIT), the American university where she did a nine-month internship.

These nanocone structures "cut the 30 percent silicon reflectance to values below between 4 percent and 0.2 percent depending on the wavelength range. This is the lowest value of reflectance found in the literature for periodic nanostructures," concluded Domínguez.

Provided by Elhuyar Fundazioa

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