Nanostructures improve solar cell efficiency

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To make solar cells a competitive alternative to other renewable energy sources, researchers are investigating different alternatives. A step in the right direction is through new processes that change the surfaces of silicon solar cells. By creating different nanostructures on the surfaces, the energy harvesting properties of solar cells can be improved.

Within the EU-funded research project N2P (Nano To Production) researchers work on nanostructured surfaces of solar cells. At the Fraunhofer Institute in Dresden, Germany, researchers have focused on the development of atmospheric pressure plasma chemical etching (AP-PCE) processes. This technology is as an alternative to the wet chemical processing approach, used in the solar industry. The advantages of AP-PCE over the etching technology based on wet chemical processing are, for example, reduced chemical waste, cost efficiency and reduced

handling. AP-PCE is used for modifying crystalline silicon solar wafers' surfaces down to the nanoscale. The researchers have achieved a one-percent improvement in solar cell efficiency, from 16 to 17 percent, by making the rear surface very smooth.

Within the N2P research project scientists at the Ecole Polytechnique Federale de Lausanne (EPFL) in Neuchatel, Switzerland, are instead working on improving different solar cells, the thin film silicon solar cells. Currently, these solar cells can only harvest about seven percent of the sunlight, which is about 40 percent less efficient compared to conventional wafer silicon cells. However, the thin film solar cells are cheaper and more eco-friendly because their production demands less time, material and energy. The researchers in Switzerland are changing the top glass structure of the solar cell, by depositing a layer of nanosized crystals from a transparent conductive oxide (TCO) onto the glass. This layer gives a high scattering effect and the light beam generates more electrons when it travels a longer distance though the cell, which enhances the cell's light absorption. The researchers have managed to achieve a 30 percent increase in efficiency in comparison with standard thin film solar cells.

Another process that could increase the efficiency of thin film silicon solar cells, through changing the surface structures, includes ultrafast pulsed laser irradiation. Researchers at Singapore Institute of Manufacturing Technology have shown that this irradiation makes a nanospike pattern on the silicon surface which reduces reflection of the light from the surface. More light will therefore be absorbed.

New processes which create nanostructured surfaces are improving solar cell efficiency substantially. With lower manufacturing costs in the future the interest in solar cell investments may increase impressively.