Plasmonic photoelectrochemical cells

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The rising global demand for clean energy is driving the need for innovative technologies that can efficiently produce renewable energy. One promising direction of research involves developing thin-film solar panels, which are highly effective at converting sunlight into usable form of energy (e.g. chemical or electrical). This cutting-edge technologie enables for example the production of hydrogen – element whose properties makes it a promising candidate to become a key component in storing renewable energy in the future.

The effectiveness of solar panels depends on various factors, including the materials they're made of and how they absorb and convert light into energy. To boost their efficiency, researchers are exploring the use of metallic nanoparticles. Metallic nanoparticles can enhance light absorption and energy conversion because of their unique properties, such as ability to trap and amplify electromagnetic fields due to collective oscillations of electron plasma excited on nanoparticle by resonant frequency of light. Absorption in the system with matrix of nanoparticles can be spectrally tuned by selecting optimal nanoparticles' parameters, such as their size, shape, and material they are made of.

This study focused on improving the performance of solar cells with copper oxide working electrode by incorporating silver nanoparticles doped with palladium. Nanoparticles were produced using physical vapor deposition. The researchers investigated how these nanoparticles affected the cells' ability to absorb light using theoretical finite-differences time-domain method and optical characterization methods spectrophotometry and scanning electron microscopy.

The results of the study showed that solar cells using electrodes with plasmonic nanoparticles exhibited increased efficiency, particularly when the nanoparticles were subjected to a process of annealing after deposition. This annealing process improved the durability and optical properties of the nanoparticles, ultimately leading to better performance of the solar cells.