Employing Nanotechnology: Improving Solar Cell Performance by Integrating Quantum Dots and Gold Nanoparticles

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Abstract: An optimization study of dye-sensitized solar cells (DSSCs) enhanced power conversion efficiency by integrating gold nanoparticles into a TiO_2 semiconductor and refining particle sizes, leveraging the unique properties of noble metal nanostructures for improved performance.

It has engineered quantum solar cells (i.e., with traditional quantum dots, QDs, and carbon quantum dots, CQDs) with a focus on the refinement of light absorption and charge carrier separation and probing innovative concepts such as multiple exciton generation to boost overall device efficiency.

An optimization study on dye-sensitized solar cells (DSSCs) utilizing both synthetic and natural dyes was conducted through a meticulous synthesis process that involved incorporating gold nanoparticles into a TiO_2 semiconductor and refining the particle sizes of the TiO_2 in the scattering layer (Fig. 1). Noble metal nanostructures are recognized for their unique properties derived from surface plasmon resonance, which has been applied across various fields such as sensing, photocatalysis, optical antennas, and photovoltaic devices [1-3]. By integrating gold nanoparticles into the mesoporous TiO_2 layer and introducing a scattering layer, we enhanced the power conversion efficiency (PCE).

During these experiments, we observed promising results in terms of light absorption and charge transfer efficiency, which are crucial parameters for the improved performance of solar cells. This will lead to a significant advancement in photovoltaic technologies and promote the scalable use of QDs in energy harvesting applications.

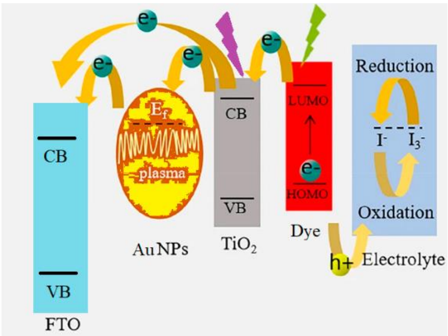

Fig. 1 Cross-section view of plasmonic-based dye-sensitized solar cell [4]

References

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