Impact of Coupled Plasmonic Effect with Multishaped Silver Nanoparticles on Efficiency of Dye Sensitized Solar Cells

Dye sensitized solar cells (DSSCs) have numerous advantages, but in order to use widespread industrial deployment we need to boost the power conversion efficiency. One promising approach to improve DSSC performance is to improve the spectral response of sensitizers with metal nanoparticle-based surface plasmon resonance. Even single shaped nanoparticles (NPs), however, have physical limitations. Thus, in this study a simple synthesis route is used to fabricate multishaped silver (Ag) NPs to create a coupled plasmonic effect in DSSC to cover more of the solar spectrum. The impact of multishaped AgNPs combinations are studied to determine which aspects improve the power conversion efficiency of DSSC. A detailed investigation was made of both the TiO$_2$ (XRD) and AgNPs (UV-Vis spectrometry) to couple the impacts on the DSSC (I-V) with the combination of the morphologies (TEM and FESEM) of AgNPs. Synthesized AgNPs with distinct extinction cross section covers the visible and IR regime from 300 nm to 1100 nm by tuning its plasmonics band. It is inferred that multi-shaped AgNPs predominately enhance the light harvesting, charge separation and carrier transportation. The results show that the increment in short circuit current and open circuit voltage resulted in an increase of 45% overall power conversion efficiency in the standard DSSC device is attributed to the usage of multi-shaped AgNPs. Finally, a mechanism is proposed to support the outcome of the experiment by demonstrating the extinction cross section and the local field of the various shaped AgNPs using Finite-difference time-domain (FDTD) simulation.

Source

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**See also**

- Microwave-Assisted Synthesized Gadolinium Doped Barium Strontium Titanate Nanostructures: Structural and Optical Properties for DSSC Applications
- Effect of microwave power irradiation on TiO2 nano-structures and binder free paste screen printed dye sensitized solar cells
- Peanut shaped ZnO microstructures: controlled synthesis and nucleation growth toward low-cost dye sensitized solar cells
- Dual morphology titanium dioxide for dye sensitized solar cells
- Reaction Induced Multifunctional TiO2 Rod/Spherical Nanostructured Materials for Screen Printed Dye Sensitized Solar Cells
- Enhanced Dye-Sensitized Solar Cell Performance using Strontium Titanate Perovskite Integrated Photoanodes Modified with Plasmonic Silver Nanoparticles