LSPR, Diamond-Like Carbon and silver nanoparticles simultaneous effect on Quantum Dots Sensitize Solar Cells

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This study investigates the effects of diamond-like carbon (DLC) and Ag nanoparticles (Ag NPs) on photoanode of quantum dot sensitized solar cell (QDSSCs) for the first time. Photoanodes include thin films of the TiO_2 deposited on the FTO substrate, subsequently, Graphene and CdS quantum dots (QDs) added on. Some photoanodes decorate by Ag nanoparticles and DLC thin film. Current density-voltage (J–V) characterization showed that short-circuit current density (J_{sc}) and power conversion efficiency (PCE) of QDSSCs containing Ag NPs and DLC thin film are significantly improved. Localized surface plasmon resonance (LSPR) of Ag NPs and anti-corrosion, photon and electron barrier properties of DLC thin film increase photon harvesting and improve solar cells performance. Total reflective on the boundary of DLC thin film and the electrolyte causes the light remission to photoanode and absorption by CdS QDs. DLC thin film reflects light to increase the absorption in the visible region. The electron barrier of this thin layer was evident in the solar cell performance, J_{sc} reaches from about 8.87 to 14.6 mA/cm^2, nearly doubled. The Ag NPs scatter photon and increase the photon harvesting in QDs. The results were showing that the presence of DLC thin film on TiO_2/CdS/G photoanodes increases the efficiency to 97%, short circuit current to 64%, and open circuit voltage to 16%. Efficiency changed from 0.8 to 1.58 by the presence of DLC and Ag NPs in cells. In this case, in compare with cells without Ag NPs and DLC thin films, our configuration shows almost twice increment in efficiency.

References

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Figures

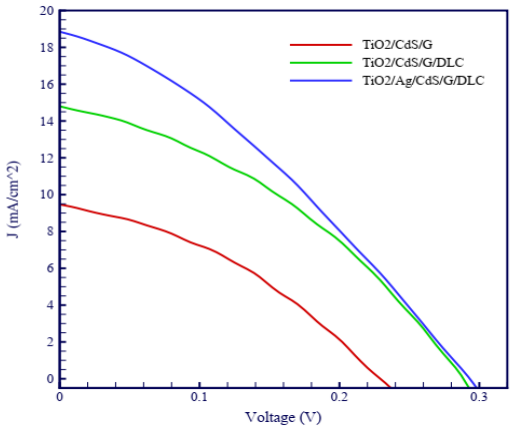

Figure 1: The photocurrent–voltage (J–V) characteristics of the QDSSCs with Ag NPs and DLC thin film.