The effects of Au nanoparticles in dye-sensitized solar cells based on the freestanding TiO_2 nanotube arrays

한승희, Chuquer Ana, 노원엽†
전북대학교
(rho7272@jbnu.ac.kr†)

Au nanoparticles (Au NPs) were introduced in freestanding TiO_2 nanotube arrays (TNTAs) by electrodeposition method and it was used as active layer of dye-sensitized solar cells (DSSCs) for better electron generation. The size of Au NPs was approximately 60 nm and the amount of Au NPs inside the TNTAs was adjusted by reduction time. Compare to without Au NPs, the energy conversion efficiency (ECE) of DSSCs with Au NPs embedded TNTAs for 30s was increased from 5.50% to 6.12%. Because of the charging effect and plasmonic effect of Au NPs, the amount of electron generation and electron density were increased and it affects the ECE improvement of DSSCs. However, the ECE of DSSCs with Au NPs embedded TNTAs for 40s was decreased to 5.34% because of the aggregation. The introduction of large amounts of Au NPs leads to the recombination of electrons and affects the overall $V_{oc,}$ $J_{sc,}$ electron density, and ECE. For better ECE, considered the electron transport ability of TNTAs, the barrier layer of TNTAs were removed by ion milling. As a result, the Au NPs were introduced into open-ended TNTAs and the ECE was increased to 7.12% because of improved electron transport and electrolyte diffusion.