IRCUWU2021

5th INTERNATIONAL RESEARCH CONFERENCE

"Exploring Potentials in Challenging Periods"

2021
1-2, July

Uva Wellassa University of Sri Lanka

Enhanced Photovoltaic Properties of Cadmium Sulfide Quantum Dot Sensitized TiO_2 Solar Cells with Novel SnO_2 Based Counter Electrode

W.I. Sandamali[1,2]*, G.K.R. Senadeera[1,2], M.A.K.L. Dissanayake[2], T. Jaseetharan[2,3], J.M.K.W. Kumari[2], K. Umair[2], V.P.S. Perera[1], J.C.N. Rajendra[1] and N. Karthikeyan[1]

[1]*Department of Physics, The Open University of Sri Lanka, Nawala, Nugegoda, Sri Lanka*
[2]*National Institute of Fundamental Studies, Hantana Road, Kandy, Sri Lanka*
[3]*Department of Physical Sciences, Faculty of Applied Sciences, South Eastern University of Sri Lanka, Sammanthurai, Sri Lanka*
**Corresponding Author E-mail: ishara.we@nifs.ac.lk, TP: +94768649214*

Quantum dot sensitized solar cells (QDSSCs) have gained increased attention due to the unique properties of the semiconductor quantum dots (QDs), as light captivating materials. QDs facilitates multiple exciton generation, tunable bandgaps, high absorption coefficient, and low power consumption. Many studies have been carried out towards producing affordable QDSSCs with high power conversion efficiencies, utilizing these properties. As a critical component of QDSSCs, counter electrodes hold significant importance among these studies. Platinum (Pt), a widely used counter electrode with QDSSCs, is being disfavored due to high cost, diminishing material supply, and reduced catalytic activity, when used with polysulfide electrolyte which is the most common electrolyte for QDSSCs, due to surface, adsorbed sulphur. Therefore, substantial investigations have been carried out in searching for an alternative, affordable and effective counter electrode in these devices. Among the suitable materials, tin oxide (SnO_2), a wide bandgap semiconductor, has become a promising candidate for counter electrode due to its high chemical stability, high electron mobility, low cost and environmentally friendly nature. In this study, counter electrodes were fabricated by depositing SnO_2 films on fluorine-doped tin oxide (FTO) glass substrates by using a simple spray pyrolysis technique. These counter electrodes were characterized by scanning electron microscopic and Raman techniques. Photovoltaic properties of CdS quantum dots sensitized TiO_2 solar cells with polysulfide electrolyte were tested by using this novel counter electrode. QDSSCs fabricated with optimized SnO_2 counter electrode showed 1.47% power conversion efficiency under the illumination of 100 mW cm^{-2}, whereas the devices fabricated with conventional Pt coated counter electrodes showed 1.08% under the same conditions. Therefore, about 36% enhancement in power conversion efficiency could be obtained by employing this novel low-cost counter electrode in these QDSSCs.

Keywords: Counter electrode; SnO_2; CdS; Quantum dot sensitized solar cell