University of Peradeniya

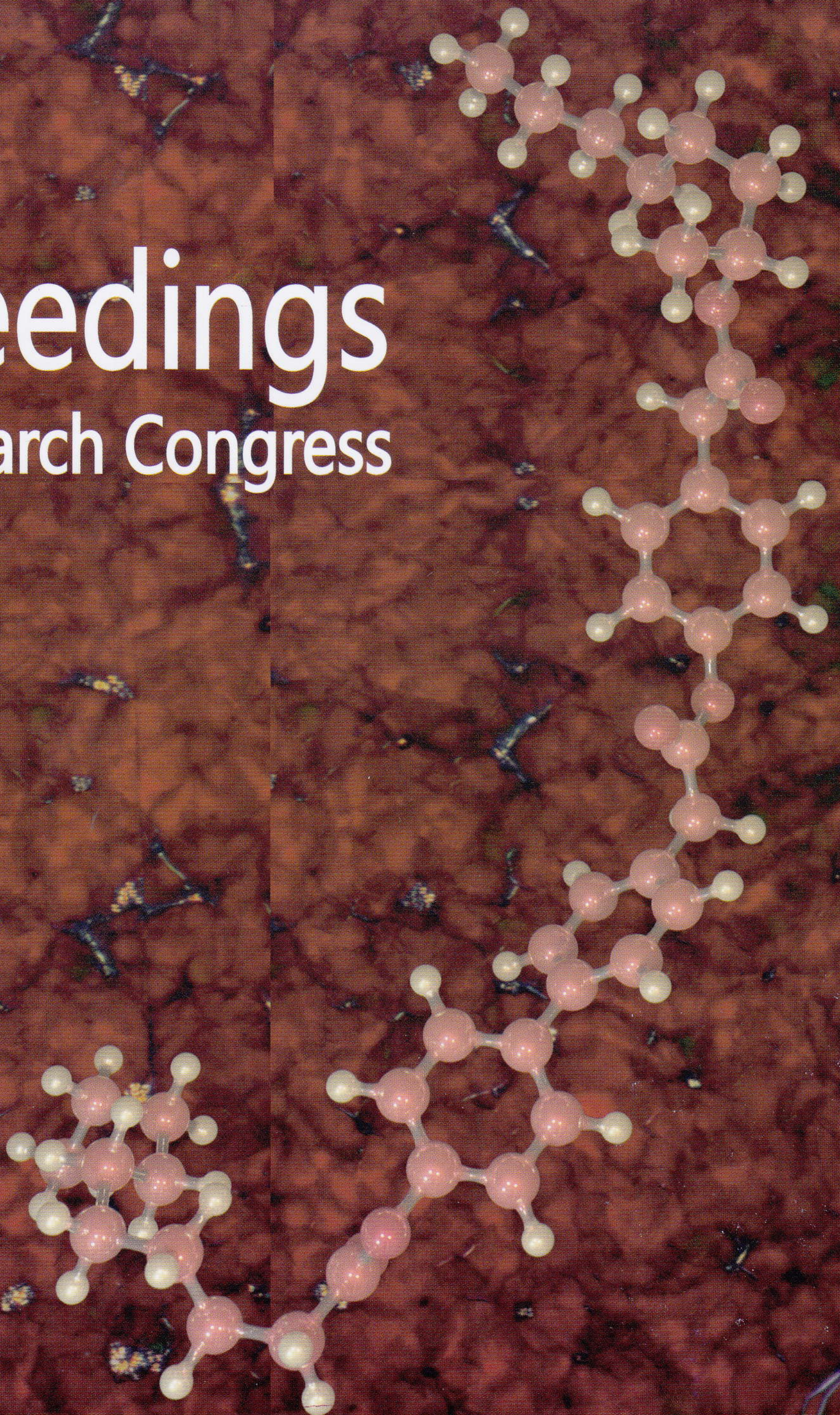
Postgraduate Institute of Science

jointly with

Ministry of Science, Technology & Research

Proceedings

PGIS Research Congress 2019



Volume 6

Abstract No: 16 ***Physical Sciences***

SURFACE PLASMON RESONANCE EFFECT OF Au NANOPARTICLES ON THE EFFICIENCY OF CdS QUANTUM DOT- SENSITIZED SOLAR CELLS

T. Jaseetharan[1,2,3*], M.A.K.L. Dissanayake[1] and G.K.R. Senadeera[1,4]

[1]National Institute of Fundamental Studies, Hantana Road, Kandy, Sri Lanka
[2]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
[3]Department of Physical Sciences, Faculty of Applied Sciences, South Eastern University of Sri Lanka, Sammanthurai, Sri Lanka
[4]Department of Physics, The Open University of Sri Lanka, Nawala, Nugegoda, Sri Lanka
[*]jaseetharan@seu.ac.lk

Quantum dot-sensitized solar cells are emerging as most promisingly cost-effective, third generation photovoltaic devices. Semiconductor quantum dots have gained more attention for a variety of optoelectronic device fabrications including solar cells, sensors, light emitting diodes, lasers and spectrometers, due to their size-dependent optical absorption and emission, ability of multiple exciton generation and high molar extinction coefficients. In order to enhance the performance of quantum dot solar cells, photoanode can be modified by introducing different TiO_2 nanostructures or by incorporating metallic nanoparticles. In this work, TiO_2 photoanode was sensitized with CdS quantum dots by successive ionic layer adsorption and reaction (SILAR) technique and the number of SILAR cycles were optimized with similar TiO_2 electrodes for best solar cell performance. Au colloidal nanoparticles were synthesized by the citrate reduction method. Solar cells were fabricated by using CdS quantum dot-sensitized TiO_2 photoanodes incorporating Au plasmonic nanoparticles. The best plasmon-enhanced solar cell shows an efficiency of 3.97% with a short-circuit current density of 19.25 mA cm^{-2} and open-circuit voltage of 531.3 mV, under the simulated light of 100 mW cm^{-2} with AM 1.5 spectral filter. Efficiency and short-circuit photocurrent density have been enhanced by 24.45% and 18.53% respectively. The enhancement in the short-current photocurrent is evidently due to the localized surface plasmon resonance effect by the Au nanoparticles.

Financial assistance from National Science Foundation of Sri Lanka (Grant No: NSF/SCH/2018/04) is gratefully acknowledged.

Keywords: Localized surface plasmon resonance, Multiple exciton generation, Quantum dot-sensitized solar cell