Contribution ID: **10** Type: **Abstract for Research Paper**

Numerical simulation as a key feature in the growth of solar energy

Climate change has reached a major crisis point worldwide as a result of exhaust emissions arising from use of traditional transport fuels. Therefore, renewable sources of energy such as solar energy and biodiesel that seem to mitigate against environmental impacts have attracted intense research attention. The concept of numerical simulation has equipped researchers with important knowledge on solar cell fabrication and simulation. Furthermore, it has reduced the cost of time during the actual fabrication of photovoltaic (PV) devices. The various simulation models that have been applied to PV devices include, technology computer-aided design (TCAD), one dimension solar cell capacitance simulator (SCAPS-1D) and general-purpose photovoltaic device model (GPVDM). This research study lays specific emphasis on SCAPS-1D software in simulating complicated practical problems in PV cells encountered during manufacture, not limited to time, cost and installation problems. The SCAPS-1D package provides physical information on solar cells in a quicker, better and practical information than any other inferior human method. In this paper, SCAPS-1D is used to model a solid state dye sensitized solar cell (SsDSSCs) consisting of all solid state layers with the configuration FTO/ETL/N719/CuSCN/Au, where electron transport layers (ETL) include IGZO, ZnO, SnO2, TiO2 and WS2. The simulated output is analyzed from the current-voltage characteristics and summarized based on maximum incident photon conversion efficiency of every ETL material that was used. This paper also provides a high efficient solid state dye sensitized (SsDSSCs) solar cell architecture based on best transport materials, back contact and optimized input parameters. However, there is still room for exploration on SsDSSCs to match the silicon solar cells that currently dominates the market with a power conversion efficiency of about 32%.
Keywords: Renewable energy, SCAPS-1D, simulation, solar energy

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Track Classification: Emerging Issues and Practices in Renewable and Non-renewable Energy Management.