OMICS Group Conferences
Accelerating Scientific Discovery

3rd International Conference on
Nanotek & Expo

December 02-04, 2013 Hampton Inn Tropicana, Las Vegas, NV, USA

All-carbon p-i-n solar cell by microwave surface wave plasma CVD

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We report the photovoltaic and optical, electrical and structural properties of p-i-n solar cell developed by microwave surface wave plasma chemical vapor deposition (CVD). Carbon thin films were synthesized by microwave (MW) surface wave plasma (SWP) CVD on quartz, silicon and copper substrates. The detail of MW SWP CVD and substrate cleaning process is described elsewhere. Argon, acetylene, tri ethyl boron and phosphine were used as a carrier, source and dopant gases. The CVD chamber was evacuated to a base pressure at approximately 5×10^{-4} Pa using turbo pumps. The launched microwave power was typically 1100 W and a constant gas composition pressure is maintained at 40 Pa during film preparation. For film characterization, UV/VIS/NIR spectrophotometer, high resolution transmission electron microscope (HR-TEM), Raman spectroscopy, Halls effect measurements and solar simulator were employed. The preliminary photovoltaic characteristics of the cell reveals a short-circuit current density of 33.18 mA/cm^2, open-circuit voltage of 0.39 V, FF=0.243 and photoelectrical conversion efficiency of 3.9%, a reproducible result. The spectral photo response characteristic of the device configuration was explained in terms of transmission/absorption characteristics of the two individual carbon layers. The detailed results and discussions will be presented during the conference.

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