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Photovoltaic properties of carbon p-i-n solar cell by microwave surface wave plasma CVD

マイクロ波表面波プラズマ CVD によるカーボン p-i-n 太陽電池の光起電力特性

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We report the photovoltaic and optical, electrical and structural properties of p-i-n solar cell developed by microwave wave 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 [2]. Argon, acetylene, tri ethyl boron and phosphine were used as a carrier, source and dopant gases.

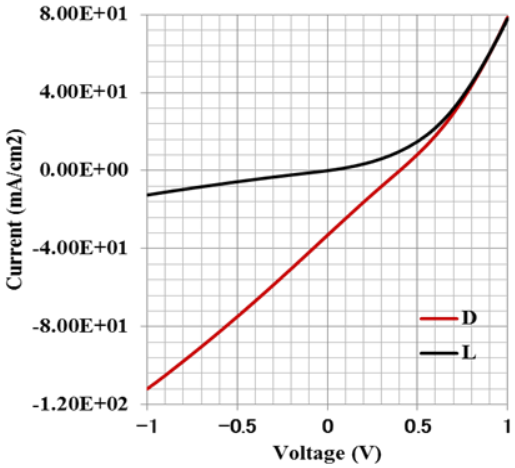

Fig.1 Current-voltage characteristics of p-i-n carbon film device under dark and light illumination (AM 1.5).

For deposition, CVD chamber was evacuated to a base pressure at approximately 5 × 10^{-4}Pa using a turbo pumps. The launched microwave power was typically 1100 W and a constant gas composition pressure is maintained at 40Pa during film preparation. High resolution transmission electron microscope (HR-TEM), Raman spectroscopy, Halls effect measurements and solar simulator were employed. Fig.1. shows photovoltaic device performances of p-i-n heterojunction carbon film and n-Si substrate. The preliminary photovoltaic results of the cell reveals a short-circuit current density of 33.18mA/cm^2, open-circuit voltage of 0.39V, FF=0.243 and photoelectrical conversion efficiency of 3.24%, 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.

References:-

[1] K. M. Krishna and M. Umeno et al., Sol. Energy Mater. Sol. Cells, 48**,** 25 (1997).
[2] Dilip. C. Ghimire and M. Umeno et. al. Diamond Related Mater. 1**7,** 1724 (2008).