18a-PB4-9

Amorphous silicon solar cells fabricated on high-quality LPCVD SnO_2:F/textured glass

Department of Physical Electronics[1], Photovoltaic Research Center (PVREC)[3],
Tokyo Institute of Technology.
Research Center, Asahi Glass Co., Ltd[2],
Amartya Chowdhury[1]*, Masanobu Isshiki[2], Takuji Oyama[2], Hidefumi Odaka[2],
Porponth Sichanugrist[1] and Makoto Konagai[1, 3]
* E-Mail: chowdhury.a.aa@m.titech.ac.jp

Introduction We have already reported[1] the superior properties of LPCVD SnO_2:F films coated on textured glass substrates and the performance of micro-crystalline silicon cells fabricated on them. Here we will report about how a-Si solar cells work on these substrates before they are applied to multi-junction type solar cells.

Experiment Glass substrates were macro-textured at different level using CF_4 plasma Reactive Ion Etching Method (RIE) and were coated with LPCVD SnO_2:F films. Solar cells with structure of Glass/SnO_2:F /p-SiC:H /a-Si:H /n-SiO_x:H/Ag/Al were deposited on these substrates. For comparison, one cell was also deposited on double textured ZnO:B (W-ZnO) coated glass substrate[2].

Results and discussion RMS roughness of the SnO_2:F substrates varies in the range of 147 to 335 nm and increases as RIE chamber pressure increases. Maximum initial efficiency of 9.91% is obtained using a substrate with RMS roughness 223 nm. Cell efficiency tends to increase with increase in roughness of SnO_2:F substrate, but fill factor (FF) reduces drastically as the RMS roughness increases over 250 nm.

Substrate	J_{sc} (mA/cm^2)	V_{oc} (V)	FF	η (%)	J_{sc} @ QE 300-550 nm (mA/cm^2)
ZnO:B	16.12	0.905	0.725	10.57	7.19
SnO_2:F	15.27	0.926	0.701	9.91	7.29

Table 1. Cell performance for developed SnO_2:F and W-ZnO substrates.

Table 1 shows, although W-ZnO substrate produces superior cell efficiency (η), but due to its total absorption of 300-380 nm wavelength range, SnO_2:F substrates produces better short circuit current density (J_{sc}) in 300-550 nm operating wavelength range. This is a prerequisite for a front cell of a multi-junction cell. Overall, performance of this newly developed SnO_2:F substrate is promising for the application in multi-junction solar cell.

Acknowledgement This work was supported by the New Energy and Industrial Technology Development Organization (NEDO) under the Ministry of Economy, Trade and Industry (METI), Japan.

1. M. Isshiki, et at, presented at PVSEC-23, October 23-November 1, 2013, Taiwan.
2. A. Tamang, et al, IEEE Journal of Photovoltaics, vol. 4, no. 1, January 2014