Towards the Optimization of the Performance of N-I-P Microcrystalline Silicon nc-Si:H Flexible Solar Cells

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ABSTRACT

The use of low-cost flexible substrates reduces the installation and transportation charges, thereby reducing the system price. This study focuses on the investigation and the optimization of the efficiency of a thin-film flexible microcrystalline silicon nc-Si:H solar cell by simulation tools. As a result, we could achieve the 6.37% relatively high efficiency for n-i-p single junction nc-Si:H flexible solar cell.

INTRODUCTION

Flexible thin film solar cells have received worldwide attention [1]. However, given that conversion efficiency is crucial for cost-competitiveness, it is necessary to develop devices on flexible substrates that perform as well as those obtained on rigid substrates [2]. The performances of laboratory µc-Si:H single junction cells on plastic substrates are starting to reach values comparable with those initially obtained for µc-Si:H cells deposited on TCO coated glass [3]. For this purpose, we have carried simulation study on nc-Si:H flexible cells. The relationship between the material properties of nc-Si:H thin film solar cell different layers and their performance cells was investigated systematically

EXPERIMENTAL/THEORETICAL STUDY

The structure of the n-i-p flexible solar cells simulated in this study was SUS substrate/Cr (20 nm)/Ag (300 nm)/ZnO:Al (100 nm)/n-nc-Si:H (30 nm)/i-nc-Si:H (1.0 µm)/p-nc-Si:H(15 nm)/ITO (80 mn)/Al grid. Which has been fabricated by Cho et al.[4].

RESULTS AND DISCUSSION

In order to figure out the effect of using nc-Si:H in flexible solar cells, we have simulated the electrical output of these devices. Fig.1: shows the photo J-V curves of the flexible nc-Si:H solar cell. The cell characteristics are also listed in Table 1.

Table 1: photoelectrical parameters of simulated solar cell

Jsc (mA/cm2)	FF (%)	η(%)	VOC(V)
19.87	75.90	6.37	0.42

For the nc-Si:H solar cell with the narrow-bandgap p-nc-Si:H window layer, a conversion efficiency of 6.37% is obtained. This due to the higher conductivity of nc-Si:H.

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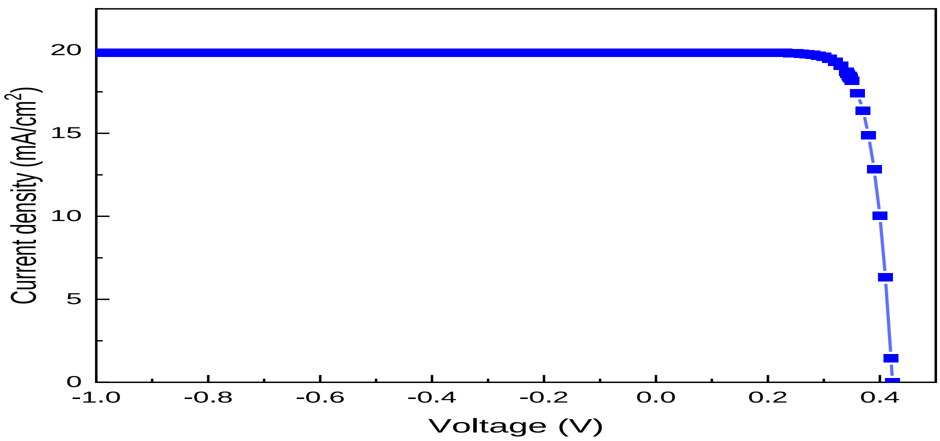

Fig. 1 : Current density-voltage characteristics of the n-i-p junction nc-Si:H device under AMI (100 mW/cm2) illumination at 300K.

CONCLUSION

Our simulation results indicated that thin microcrystalline silicon films with high quality can be used to fabricate relatively high performance and stable flexible solar cells. Also, we showed that the optimization of nc-Si:H layers parameters enhanced the simulated device power conversion efficiency to 6.37%.

REFERENCES

1. Ramanujam J, Bishop DM, Todorov TK, Gunawan O, Rath J, Nekovei R, et al. « Flexible CIGS, CdTe and a-Si:H based thin film solar cells: A review». Progress in Materials Science. 2020;110:1–20.
2. Chirilă A, Buecheler S, Pianezzi F, Bloesch P, Gretener C, Uhl AR, et al. «Highly efficient Cu(In,Ga)Se2 solar cells grown on flexible polymer films». Nature Materials [Internet]. Nature Publishing Group; 2011;10:857–61.
3. Bassler H. « thin film solar cells fabrication, characterization and applications» . Poortmans J, Arkhipov V, editors. Thin Film Solar Cells. Chichester, UK: John Wiley & Sons, Ltd; 2006.
4. Cho JS, Jang E, Lim D, Ahn S, Yoo J, Cho A, et al. « Wide-bandgap nanocrystalline silicon-carbon alloys for photovoltaic applications». Solar Energy Materials and Solar Cells [Internet]. Elsevier B.V.; 2018;182:220–7.

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