

High-Performance Organic Photovoltaic Cells for Indoor Light Energy Harvesting

Alfonsina Abat Amelenan Torimtubun,

J. G. Sánchez, Josep Pallarès*, and Lluís F. Marsal*

Department of Electronic, Electric and Automatic Engineering, Universitat Rovira i Virgili, 43007 Tarragona, Spain.

E-mail: lluis.marsal@urv.cat

Abstract

Organic photovoltaic (OPV) cells have attracted renewed interest for indoor energy harvesting because they can provide reliable and sustainable energy source for low power consumption electronic devices such as the rapid growth of Internet of Things. In this work, a high performance OPV under AM 1.5G illumination with a power conversion efficiency (PCE) of up to 10% are illuminated under indoor light source of commercial LED lamp with different light intensities. A strong dependency of the OPV performance with the illumination level is revealed by the optical and electrical characterization. As a result, the PCE of the devices illuminated under LED light is skyrocketed of up to 50% higher than those of OPV devices illuminated under 1 sun condition. The results suggest that OPV is an excellent candidate as a future dim-light power sources for the indoor application.

References

- [1] V. S. Balderrama, J. G. Sánchez, G. Lastra, W. Cambarau, S. Arias, J. Pallarès, E. Palomares, M. Estrada and L. F. Marsal, *J. Mater. Chem. A*, 6 (2018), 22534-22544
- [2] H. Ka, H. Lee, S. M. P. Meroni, T. Du, C. Lin, A. Pockett, J. Troughton, S. M. Jain, F. De Rossi, J. Baker, M. J. Carnie, M. A.

- Mclachlan, T. M. Watson and J. R. Durrant, *Sol. RRL*, 1800207 (2018), 1-7
- [3] B. Ecker, J. C. Nolasco, J. Pallarès, L. F. Marsal, J. Posdorfer, J. Parisi and E. Von Hauff, *Adv. Funct. Mater.*, 21 (2011), 2705-2711
- [4] J. S. Goo, J. H. Lee, S. C. Shin, J. S. Park and J. W. Shim, *J. Mater. Chem. A*, 6 (2018), 13094-13102
- [5] Y. Cui, Y. Wang, J. Bergqvist, H. Yao, Y. Xu, B. Gao and C. Yang, *Nat. Energy*, 4 (2019), 768-775
- [6] E. Osorio, J. G. Sánchez, L. N. Acquaroli, M. Pacio, J. Ferré-Borrull, J. Pallarès and L. F. Marsal, *ACS Omega*, 2 (2017), 3091-3097
- [7] C. L. Cutting, M. Bag and D. Venkataraman, *J. Mater. Chem. C*, 4 (2016), 10367-10370
- [8] M. Freitag, J. Teuscher, Y. Saygili, X. Zhang, F. Giordano, P. Liska, J. Hua, S. M. Zakeeruddin, J. E. Moser, M. G rätzel and A. Hagfeldt, *Nat. Photonics*, 11, (2017), 372-378
- [9] S. Mori, T. Gotanda, Y. Nakano, M. Saito, K. Todor and M. Hosoya, *Jpn. J. Appl. Phys.*, 54 (2015), 071602
- [10] Y. Cui, H. Yao, T. Zhang, L. Hong, B. Gao, K. Xian, J. Qin and J. Hou, *Adv. Mater.* 42 (2019), 1904512

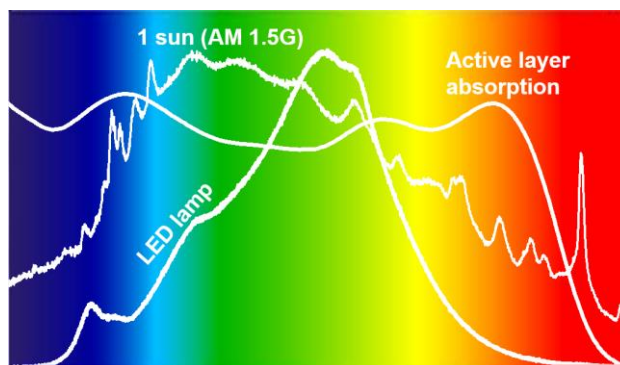


Figure 1: The spectra of AM 1.5G illumination (1 sun condition), LED lamp illumination (indoor light) and the active layer materials absorption.