Graphene-based interconnections for a novel class of Dye Sensitized Solar Modules (DSSMs)

Paolo Mariani[1],
Antonio Agresti[1], Luigi Vesce[1], Sara Pescetelli[1], Flavia Tomarchio[2], Andrea Ferrari[2] and Aldo Di Carlo[1]

[1]*C.H.O.S.E. (Centre for Hybrid and Organic Solar Energy), Department of Electronic Engineering, University of Rome Tor Vergata, Via del Politecnico 1, I-00133 Rome, Italy*

[2]*Graphene Cambridge Centre, University of Cambridge, 9 JJ Thomson Ave, Cambridge CB3 0FA - UK*

paolo.mariani@uniroma2.it

Owing to its peculiar properties such as transparency, weak angle dependence and improved power conversion efficiency (PCE) for diffused light, DSSCs (Dye Sensitized Solar Cells) are well suited for Building Integrated PhotoVoltaic (BIPV). One of the major drawback of DSSC is the corrosive action of the electrolyte. Thus, a rugged encapsulation strategy is required to isolate electrolyte chamber from metal connections. In turn, this reduce the active area (AA) of the module. In this work, we realized and characterized Z-Type DSSC-based modules (DSSMs) [1] by using printable graphene-based vertical interconnections [2] and conventional screen printing technique [3]. Defining the dead area (DA) as that part of module dedicated to the interconnections and to their protection, we define the aperture ratio (AR) as AR = AA/(AA+DA), where the sum of AA and DA is also called aperture area (APA). In the proposed module configurations, contact between the electrolytic species and the graphene-based interconnections, could occur without any corrosion as in the case of silver interconnections. This feature paves the way to design new layouts with decreased DA and consequently by increasing the generated power per APA. In particular, by enlarging the width of the single cells [fig.1] or by increasing the number of cells [fig.2] an enhancement of efficiency on APA exceeding 12 % was achieved with respect to the silver-based module. Moreover, the new developed layouts allowed to definitively overcome the possible corrosion of silver grids and the subsequent electrolyte bleaching. This novel class of DSSC devices pivoted on the neutrality of graphene-based ink with respect to electrolytic species, strengthens the commitment of DSSC technology in BIPV sector where the efficiency on aperture area is the effective parameter for evaluating this technology.

References

[1] Giordano F. et al., Elect. Devices, IEEE transaction on. 58,(2011) pp 2759-2764
[2] Karagiannidis P.G. et al., *ACS Nano*. 11 (3), (2017) pp 2742–2755
[3] Mariani P. et al., Semicond. Sci. Technol. 30 (2015) 104003

Figures

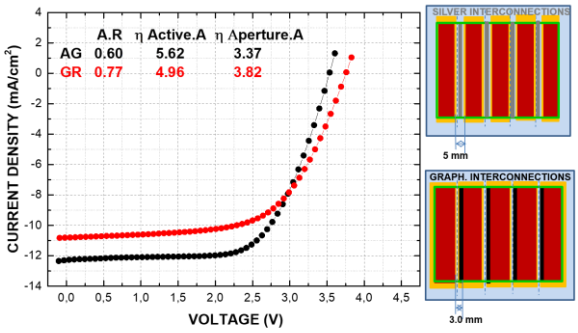

Figure 1: J-V curves of graphene DSSM and silver DSSM: enlarging the cells, the efficiency on aperture area shows an increment around 12%

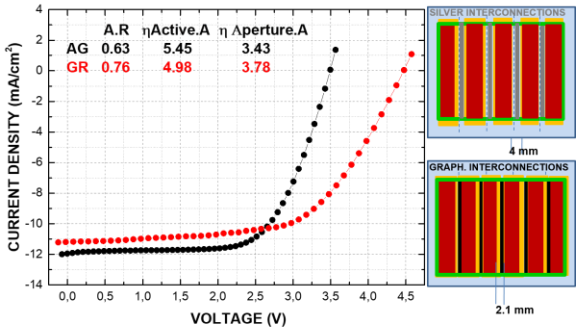

Figure 2: J-V curves of graphene DSSM and silver DSSM: adding a cell, the efficiency on aperture area shows an increment around 10%