Graphene-based large area dye-sensitized solar cell module

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Abstract

In this work, we report the use of graphene nanoflakes, produced by liquid phase exfoliation of graphite [1], as a catalyst material for the realization of large area dye-sensitized solar cell (DSSC) module.
We report the electrochemical performances of graphene flakes-based ink used as counter electrode in small area DSSCs targeting the replacement of the standard catalyst material *i.e.*, platinum [2], an expensive noble metal. Our results demonstrate that pristine graphene flakes can be used as catalyst, offering advantages in term of cost, scalability and easier production/processing with respect to other low-dimensional materials such as reduced graphene oxide, which require post-processing treatments, and carbon nanotubes, transition metal di-chalcogenides and oxides, etc., which are instead expensive if compared with pristine graphite. The graphene-based ink was spray coated onto FTO-glass substrate to obtain a large area (>90cm^2) semi-transparent (transmittance 44%) counter-electrode[3]. As a proof of concept, we have fabricated the first graphene-based large area (43.2 cm^2 active area) DSSC Z-type connection module with ad-hoc vertical contacts layout, exhibiting a power conversion efficiency (PCE) of 3.5% at 1 Sun and 4.6% at 0.17 Sun. The graphene-based DSSC module demonstrated good response to diffuse light and low illumination conditions[3]. We have also demonstrated the viability of our approach on flexible substrates. We spray coated graphene-based ink onto a PET-ITO used as front electrode in flexible DSSC. A fine tuning between efficiency and transparency was carried out to optimize the PCE of the cells. These results pave the way for the realization of all-printed and (semi)transparent graphene based large-area and cost-effective DSSCs on arbitrary substrates by proving the possibility of enhancing the performance of large area printed DSSCs, under ambient conditions, upon the exploitation of graphene-based inks.

References

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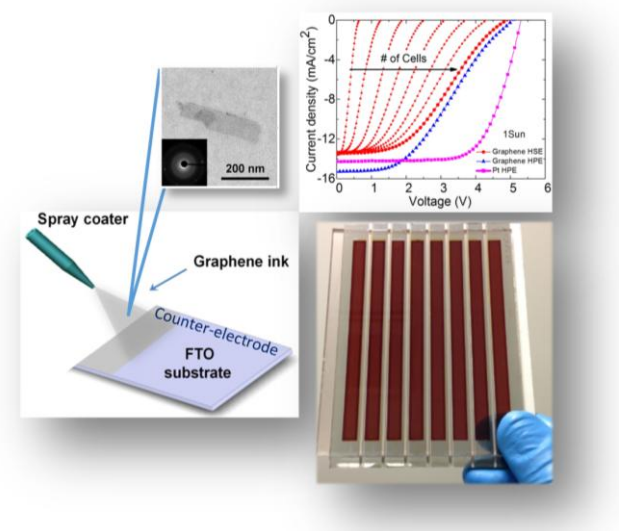

Figure: Spray coating of graphene-based ink for the realization of DSSC modules. The as produced module has shown a PCE of 3.5%.