2D materials for Perovskite Solar Modules

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Abstract

Recently, the increasing energy demand pushes the scientific community in developing new technologies for the exploitation of the renewable energy sources, such as new generation photovoltaics. Indeed, organic and hybrid photovoltaic technologies such as Perovskite Solar Cells (PSCs) dominated the PV scientific research, by developing efficient and stable devices, produced by employing scalable and low-cost printing techniques, easily embedded in roll2roll or sheet2sheet production lines.

Despite the astonishing advancements in power conversion efficiency -PCE- (overcoming 25% over small area devices) and long-term stability, PSC technology still requires to demonstrate the transfer from lab to fab, pushing the scientific community in finding brilliant solution for drawing a feasible and reliable route toward its commercialization.

Indeed, when moving to large area substrates, the use of crystallization processes from the liquid phase tends to the formation of imperfections and defects in the bulk and surfaces that could give rise to non-radiative charge recombination. Moreover, energy levels in halide perovskite semiconductors and materials for the transporting layers cannot be simply controlled by chemical doping as for Si and III-V semiconductors. Here, the use of interface engineering based on bi-dimensional (2D) materials is proposed as an efficient tool for trap passivation and energy level alignment, by mitigating the performance losses induced by the scaling-up process. In particular, the successful application of 2D materials, i.e., graphene,[1] functionalized MoS2,[2] and MXenes [3,4] in perovskite solar modules (PSMs) allowed to achieve PCE overcoming 17% and 14.5% over 121 and 210 cm2 substrate area respectively. Moreover, an ad-hoc lamination procedure employing low temperature cross linking EVA (at

80°C-85°C) allowed to fabricate several 0.5 m2 panels, finally assembled in Crete Island, in the first worldwide fully operating 2D material-perovskite solar farm

References

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