The use of 2D materials for perovskite photovoltaics: graphene and beyond.

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Hybrid perovskite solar cells (PSCs) are one of the most promising technologies for new-generation photovoltaics due to outstanding semiconductor properties and low-cost solution processing methods for the fabrication. Indeed, PSCs dominated the PV scientific research in the last decade, by developing efficient and stable devices, produced by employing scalable and low-cost printing techniques, easily embedded in roll2roll or sheet2sheet production lines. However, 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, the use of perovskite 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.[1] In particular, the successful application of 2D materials, i.e., graphene,[2] functionalized MoS_2,[3] and MXenes [4,5] in perovskite solar modules (PSMs) allowed to achieve PCE overcoming 17% and 14.5% over 121 and 210 cm^2 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 m^2 panels, finally assembled in Crete Island, in the first worldwide fully operating 2D material-perovskite solar farm.

REFERENCES

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FIGURES

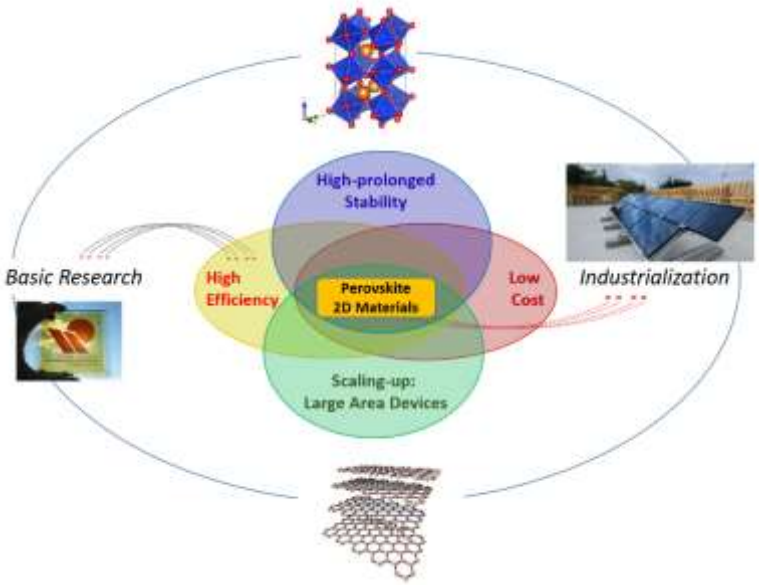

Figure 1: The use of 2D materials as inter or intra layer in perovskite solar cells is a winning strategy to boost perovskite photovoltaics in term of power conversion efficiency and stability under real working conditions, allowing the low cost production of large area solar module and panels.