

Perovskite Solar Panels with Graphene. An industrial perspective

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Perovskite solar cells (PSCs) have raised research interest in the scientific community due to their high efficiency comparable to traditional commercial solar cells (i.e., amorphous Si, GaAs, and CIGS). Apart from that, PSCs are lightweight, can be flexible, and have lower production costs. Recently, graphene and 2D materials have been used as a novel material for PSC applications due to their excellent optical, electrical, and mechanical properties. For example, Graphene and its derivatives have been used as interface layers or dopant to improve charge transfer¹, to increase mobility², to improve band alignment, to tune the work-function and to limit the ion diffusion³. Moreover, recently more usages of the graphene for the fabrication of Perovskite solar Modules (PSMs) have been demonstrated.⁴ By exploring the application of graphene in PSCs, a new class of strategies can be developed to improve the device performance and stability before it can be commercialized in the photovoltaic market in the near future. We have experimented several of these techniques within an industrial environment and we have verified the benefits of a graphene interface engineering in our perovskite solar devices. In this talk, we will discuss the points of strength of this technology, and we will propose the following prospects:

- i) Front and rear electrodes composed of graphene materials in order to be compatible with perovskite absorber layer fabricated under low temperature. Replacing the gold rear electrode with multi-layer graphene materials would allow to save about 30% on the final cost of the solar modules.
- ii) Widespread adoption by the industry would inevitably require further developments in deposition techniques to uniformly deposit graphene-material on a large area, we are working on large area deposition technique of graphene and graphene doped ETLs suitable with PSMs technology.

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