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Since 2012, hybrid solar cells based on perovskite materials demonstrated several significant advances, with power conversion efficiencies now over 22%, attracting strong interest within the scientific community [1][2]. Still, efforts remain to be performed to improve photo-current extraction, especially concerning the development of efficient and reliable charge transporting electrodes and selective contacts. Titanium dioxide mesoporous layer, while remaining an important component for perovskite structuration and electron transport in high efficiency devices, can however still promote charge trapping and recombination. To reduce these phenomena and improve electron collection, our strategy consists in using the excellent conductivity properties of graphene materials through its incorporation within the TiO_2 electrode.

In this context, we develop high quality TiO_2/graphene composites in a single step by using the singular technique of laser pyrolysis that enables to synthesize nanoparticles with well-controlled properties, tuned for an optimal energy conversion. We combine here this specific know-how on material synthesis with our know-how on perovskite solar cells processing.

We pay particular attention to material characterizations such as morphological and structural analysis as well as physical properties evaluation of the nanocomposites and their role and effects within solar cells. Our first results show a larger conductivity of the TiO_2 layer in presence of graphene, as well as larger photocurrents and smaller series resistance under standard illumination, traducing the benefits of graphene for a better charge collection in the device. More generally, a significant increase in power conversion efficiency is observed for perovskite solar cells containing graphene in the TiO_2 mesoporous layer, demonstrating the benefit of the laser pyrolysis process for the production of high quality electron transport layer.

[1] www.nrel.gov/ncpv/
[2] H. Zhou et al., *Science* **2014**, *vol 345,* page 542-546