Spray-coating of graphene doped mesoporous TiO2 film as electron transport layer in perovskite photovoltaic devices

Babak Taheri, Antonio Agresti, Sara Pescetelli, Aldo Di Carlo

CHOSE, Centre for Hybrid and Organic Solar Energy, University of Rome "Tor Vergata", Rome (Italy)
babak.taheri@uniroma2.it

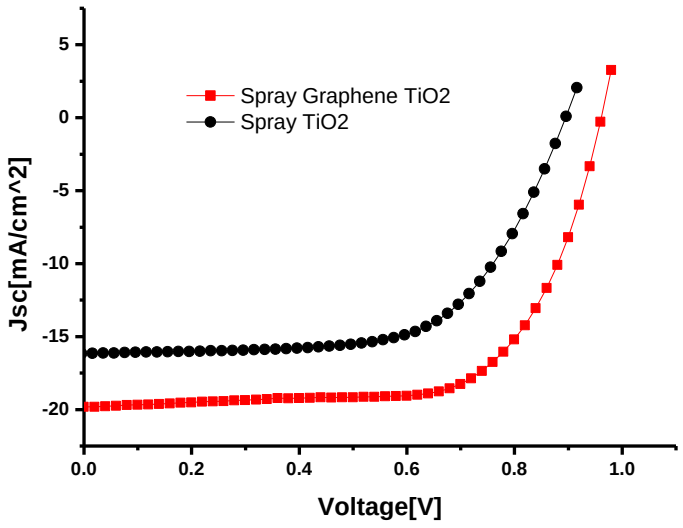
Abstract

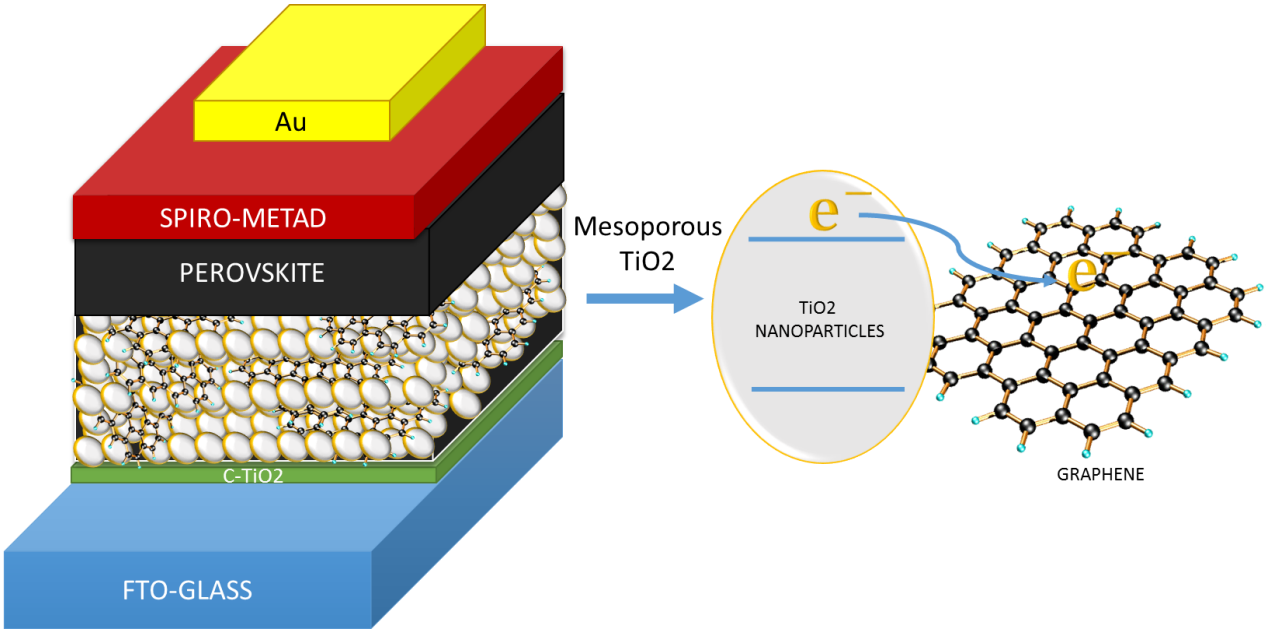
In the energy field, the use of hybrid perovskite materials, such as $CH_3NH_3PbI_3$ ($MAPbI_3$), has opened up new directions for producing cheaper solar energy through large area deposition and high throughput serial production of solar cells. To this end, particular attention should be made to materials and fabrication processes that can be scalable to large area devices, such as modules and panels.
In this work, we demonstrated that the spray coating technique could effectively replace the spin-coating deposition method widely used for the fabrication of small area thin film devices. In particular, we realized a first-ever sprayed graphene doped TiO2 scaffold to improve the efficiency of perovskite solar cells. As a matter of fact, sprayed mesoporous TiO2 layer exhibits improved repeatability with respect to spin-coated layer by retaining the same final device efficiency. Moreover, the insertion of graphene additive has been demonstrated to significantly promote electron transport/injection at the sprayed TiO2/perovskite interface due to an improved energy level matching.
The $CH_3NH_3PbI_3$ device based on sprayed mesoscopic architecture achieves power conversion efficiency (PCE) of 11,5% under 1 SUN illumination, while the use of Graphene flakes into the sprayed scaffold boost the PCE up to 13%. Moreover, long-term stability of the cell is improved. The demonstrated feasibility of spray deposition of a uniform mesoporous film on large-area (16×16 cm2) provides a viable route to easily combine low-cost, stability and high efficiency for the next generation perovskite photovoltaic devices.

References

[1] M. Kim, B. J. Kim, J. Yoon, J. Lee, D. Suh, N. Park, M. Choi and H. S. Jung, Nanoscale, 2015, DOI: 10.1039/C5NR06558E.
[2] H.Huang, J.Shi, S.Lv, D.Li, Y.Luo and Q.Meng, Chem.Commun., 2015, DOI: 10.1039/C5CC01939G.

Figures




Au
SPIRO-METAD
PEROVSKITE
C-TiO2
FTO-GLASS
Mesoporous
TiO2
e⁻
TiO2
NANOPARTICLES
e
GRAPHENE