Poster

Impact of the chemical preparation of the electrical n-contact on the performance of perovskite solar cells

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ABSTRACT

Motivation: Solar energy is an alternative, sustainable energy source for mankind. Finding a convenient way to convert sunlight energy into chemical energy is a key step towards realizing large-scale solar energy utilization like artificial photosynthesis. A previous stage would be the complete study of a material with a high absorption capacity of sunlight and in this context, the perovskite type solar cells are presented. Perovskite solar cells are one of the most promising photovoltaic low-cost technologies due to the fast increase in efficiency from 3% in 2009 to 22% in 2016. In this work it has been studied how the combination of the main dopants in the n-contact of the solar cell, impacts on the optoelectronic properties of the device.

Methods: Perovskite solar cell reference devices: a titanium dioxide (TiO2) compact layer was deposited onto FTO-coated glass by spray pyrolysis and performing as electron transporter material. A mesoporous TiO2 layer was deposited by spin coating using a particle paste and then sintered. The perovskite was made using one-step deposition method. A solution of Spiro-OMeTad as Hole Transporter Material was prepared and spun-coated. Finally, an 80 nm layer of gold was thermally evaporated on the top of the cell as cathode under high vacuum. The mesoporous layer was doped with lithium and TiCl4 respectively to study the electronic properties of the n-contact. The characterization of all the devices is carried out under a solar simulator, fluorescence and absorption analysis, electrochemical impedance spectroscopy and intensity modulated photocurrent spectroscopy to know the charge extraction.

Results: Under environmental conditions and without a controlled atmosphere, reference cells were built with a 13% efficiency, quite close to the state-of-the devices currently fabricated in top research groups. It has been observed that doping the compact and mesoporous layers respectively with TiCl4, the best configuration from the electronic point of view is with the TiCl4 is deposited on the mesoporous layer. In the test with Lithium, a deleterious effect on all the properties of the cell is observed. Currently, some tests are being completed where Lithium and TiCl4 are combined, as the best configuration according to literature.

Conclusions: The chemical and physical treatment of the n-contact in perovskite solar cells is crucial to ensure the best performance of the resulting photovoltaic device.

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