Charge carrier chemistry and interface effects in hybrid organic-inorganic halide based perovskites for solar cells with enhanced efficiency

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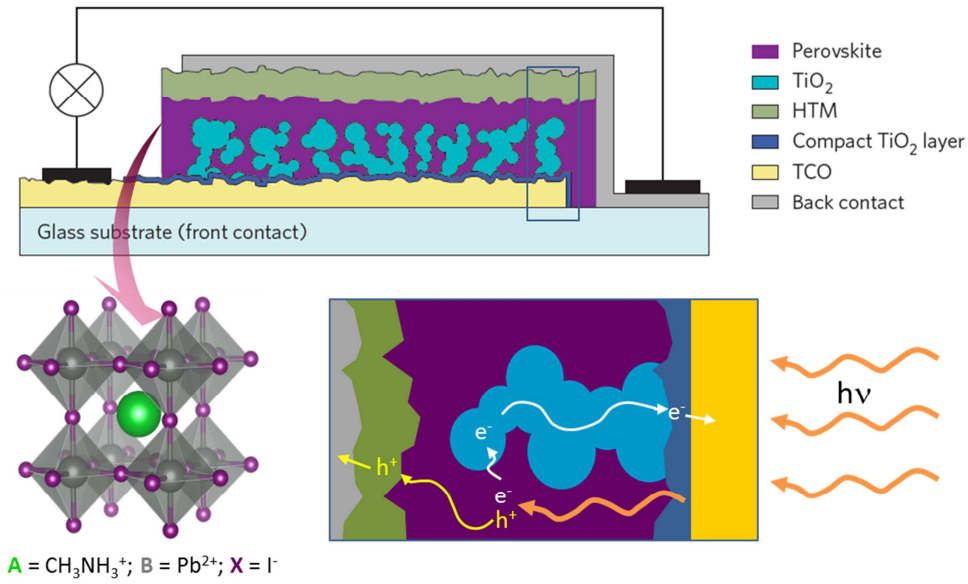

In the last few years a new generation of dye-sensitized solar cells has come to the fore. They consist of titania, a hybrid organic-inorganic halide based perovskite as a light absorber and a solid-state hole conductor and their rapid development has allowed to reach the outstanding power-conversion-efficiency of about 20%. In particular, it has been shown that the perovskite methylammonium lead iodide, $CH_3NH_3PbI_3$ ($MAPbI_3$) has superior optical and electronic properties for photovoltaic applications: (i) narrow bandgap (1.5 eV), which enables the absorption of the whole visible light spectrum, (ii) low exciton binding energy (30 meV), (iii) and high electronic charge carrier lifetime and mobility.
Nonetheless, further fundamental chemical and physical properties still need to be fully clarified in order to understand the promises of such organic-inorganic perovskites, such (i) the hysteretic behavior during a voltage sweep, (ii) the high apparent dielectric constant and (iii) the role of the organic cation. In all these respects we made substantial progress by taking account of the charge carrier chemistry and the ionic mobility as described in refs. 3,4.

Publications

1. J. Burschka, N. Pellet, S.-J. Moon, R. Humphry-Baker, P. Gao, M. K. Nazeeruddin, M. Grätzel "Sequential deposition as a route to high-performance perovskite-sensitized solar cells", **Nature** 499 (7458), 316 (2013).
2. P. Qin, S. Paek, M. I. Dar, N. Pellet, J. Ko, M. Grätzel, M. K. Nazeeruddin, "Perovskite solar cells with 12.8% efficiency by using conjugated quinolizino acridine based hole transporting material", **J. Am. Chem. Soc.** 136 (24), 8516 (2014).
3. N. Pellet, P. Gao, G. Gregori, T.-Y Yang, M.K. Nazeeruddin, J. Maier, and M. Grätzel, "Mixed organic cation perovskite photovoltaics for enhanced solar light harvesting", **Angew. Chem. Int. Ed.** 53 [12], 3151 (2014).
4. T.-Y. Yang, G. Gregori, N. Pellet, M. Grätzel, J. Maier, *under review* (2015).