Synthesis of Ferroelectric oxides for photovoltaic applications

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The production of Energy from Photovoltaic source is greatly developing in the recent years. It only accounted for 1% of the world production in 2014, but it is expected to dramatically increase to 16% in the next years. Therefore is extremely important to reduce the cost of production and develop new technologies in the photovoltaic field, in order to answer to the world demand. The research on solar cells based on hybrid solar cells has proved that pervoskites have a strong potential, with more than 20% solar cell efficiency already achieved.

Recently scientists have started to look into totally inorganic perovskites for their extremely unique characteristics: the presence of two or more metallic ions give to these materials properties such as ferroelectricity and multiferroicity. Among them, some ferroelectric (FE) perovskites have been proved to be able to provide photovoltaic effects, such as the one named "anomalous photovoltaic effect" [1-2]. In fact, it has been proved that solar cells based on these materials, after a polarization due to an external electric field, can show under illumination a short-circuit current parallel to the direction of the polarization [3-5] and an open circuit voltage much higher than the bandgap of the materials themselves. This behavior is generally believed to be linked to the fact that in these solar cells the polarization is the main factor for electron-hole pair separation, and that the electrons see each domain wall as a source of electrostatic potential that would mimic the association of several p-n junctions. Therefore the open circuit voltage can reach dozens of volts. The counterpart is a poor output photocurrent, as the defects inside the ferroelectric can be a source of recombination.

To date, many Ferroelectric perovskites are Bismuth based, because of the displacement of the atom on the B-site due to the presence of a large atom as Bismuth on the A-site [6-8].Our aim is to exploit the characteristic of two perovskites as $BiMnO_3$ (BMO) and Bi_2FeCrO_6 (BFCO) : in particular this last one has been used as photon absorber in a tandem solar cell with an efficiency of 8.1% [9]. It would be therefore possible to enhance this efficiency by doping and by an appropriate choice of contacts; as well, it would be even possible to establish new low-cost fabrication routes for such materials (spin coating by sol-gel).

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