$Cs_2AgBiBr_6$ Lead-Free Perovskite for Solar cells and indoor-outdoor Applications

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This work brightly takes place into a research of innovative lead-free perovskite materials to be employed as a sensitive layer for a new generation solar cells, and their potential applications to green-houses, to move towards an eco-friendly environment safeguard.

$Cs_2AgBiBr_6$ lead-free perovskite films have been synthesised by means of liquid-process, using as precursor salts CsBr, AgBr and $BiBr_3$, and successively dropped on supports, mainly consisting of glasses, indium tin oxide (ITO)/glass, and poly(triaryl amine)/ITO/glass. Different support sizes, small as (2.5 × 2.5) cm^2, and large as (14 × 14) cm^2, both for thin films investigation, and screening to be placed on the roofs of green-houses for experiments *in-vivo* on tomato seed/plant culture.

In order to get crucial insights on physical-chemical properties of the $Cs_2AgBiBr_6$ perovskite films, various complementary measurements have been carried out, including x-ray diffraction (XRD), photoluminescence (PL), optical absorbance, scanning electron microscopy (SEM), core-levels x-ray photoelectron spectroscopy (XPS), and finally ultraviolet (UV) valence band spectroscopy. On the other hand, XRD revealed that the perovskite films are polycrystalline, where the intense reflection peaks, were attributed to the cubic phase, symmetry group $Fm\bar{3}m$; a gap of about 1.92 eV was deduced from the optical properties and PL measurements, as well as fascinating nanocrystals having different sizes, were observed by SEM. Very interestingly, the XPS measurements revealed, among other peaks, strong Cs3*d*, Ag3*d*, and Bi4*d* core levels, whereas UV spectroscopy exhibited a *p*-degenerate behaviour large-gap semiconductor, pointing to a $Cs_2Ag_{1-x}Bi_xBr_6$, inherently defects tolerant perovskite.

Experiments on tomato seed germination and plant growth under screen-induced stress by perovskite/ITO/Glass panels, are ongoing.

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