Multi-cation and anti-solvent assisted high-performance flexible perovskite solar cell

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Introduction

Perovskite solar cells (PSCs) have attracted a lot of attention among the scientific community due rapid progress in photo-conversion efficiency (PCE) from 3% to above 22% and because of their low-cost fabrication with the ability to fabricate on flexible substrate [1,2]. However, PCE on flexible PSCs is still behind from the reported values on rigid substrates [3]. It has been already investigated that a small addition of formamidinium (FA) and lead thiocyanate $Pb(SCN)_2$ as a dopant in $MAPbI_3$ increases the solar cell performance [4,5]. At the same time in ITO resistance of PET substrate has a huge effect on the PCE due to its variation in transmittance. Therefore, in this present work, we aimed to optimize the performance of flexible PSCs on Indium tin oxide (ITO) coated polyethylene terephthalate (PET) film by utilizing the similar approach. The present work also discusses the effect of using different type of multication perovskite as absorber material. At the same time addition of $Pb(SCN)_2$ and effect employing different antisolvent, different PET/ITO resistance will be reported.

Experiment

Inverted structure with PET-ITO/PEDOT:PSS/Perovskite/C_{60}/BCP/Ag configuration, were fabricated with $FA_xMA_{1-x}PbI_3$ as an absorber layer which was prepared by mixing stoichiometric ratios of FAI, MAI and PbI_2 in N,N-dimethylmethanamide (DMF):dimethyl sulfoxide (DMSO) (4:1). PEDOT:PSS layer was spin-coated on ITO-PET substrates followed by annealing at 140°C. Perovskite layer was then prepared with 1-step method followed by the deposition of C_{60}, BCP and Ag through physical vapor deposition.

Results and discussion

PCE of the flexible PSCs was enhanced by the addition of FA in $MAPbI_3$. The average efficiency of $MAPbI_3$ was found to be around 10%, which was enhanced by incorporation of FA in $MAPbI_3$ to 11.5 % by employing 20% FA, respectively. Further, by doping of $Pb(SCN)_2$ increases the PCE that reaches up to of 13% with toluene as antisolvent. However further examining with the different anti-solvents such as chlorobenzene and ethyl acetate the PCE on flexible substrates reaches beyond 14% and maximum up to 15.03% with ethyl acetate antisolvent.

Reference

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