Investigating the effect of adding combined Rubidium-Cesium cations on the performance of $FAMAPb(IBr)_3$ mixed halide and cation perovskite solar cells

Mohammad Jafar Namvar[1], Mohammad Hossein Abbaspour-Fard[1,*], Mahmood Rezaei Roknabadi[2], Abbas Behjat[3], Masoud Mirzaei[4]

[1] Department of Biosystems Engineering, Faculty of Agriculture, Ferdowsi University of Mashhad, Mashhad, Iran

[2] Department of Physics, Faculty of Science, Ferdowsi University of Mashhad, Mashhad, Iran

[3] Department of Atomic &Molecular, Faculty of Physics, Yazd University, Yazd, Iran

[4] Department of Chemistry, Faculty of Science, Ferdowsi University of Mashhad, Mashhad, Iran

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Abstract

Using mixed cations in perovskite solar cells is promising as they can extend the absorbing wavelength range and, hence, enhance the performance of the cells. In this study, a combined cation of Cesium and Rubidium ($RbCsI_2$) was injected into the main perovskite solution $MA_{0.17}FA_{0.83}Pb$ $(I_{0.83}Br_{0.17})_3$. This main solution contains both "MA" and "FA" cations as well as "Br" and "I" anions. The proportions of Rubidium and Cesium in the solution were the same, and the concentration of Cesium-Rubidium iodide ($RbCsI_2$) in the main solution was 5%. In the control sample, only cesium iodide (CsI) was added to the main solution. The two types of the fabricated cells were compared in terms of current-voltage (I-V) and SEM and XRD characterizations. Regarding the current-voltage measurements, it was found that the cell efficiency of the cation containing Rubidium-Cesium was higher (0.51 percent) than that of the cell containing just Cesium. The SEM images also showed that samples containing the Rubidium-Cesium cation had fewer pinholes on their surface layer than those with solely the Cesium cation. This led to a higher charge transfer and lower trapping of charge carriers, which ultimately increased the cell efficiency. The XRD patterns also showed that the precipitate crystallization of the cation containing Rubidium-Cesium was higher than that of cesium cation, which, in turn, resulted in higher transfer rates and, thus, higher efficiency. This characterization confirms the improved performance of the fabricated cells containing Rubidium-Cesium cation, as compared with a reference cell.

Keywords: Perovskite solar cells, Mixed cations, Crystallinity, Efficiency

* Corresponding Author:abaspour@um.ac.ir