Enhancing the Performance of Quadruple Cation Perovskite Solar Cells by N-bromosuccinimide

Hassen Dhifaoui,[1] Pierre Colson,[1] Gilles Spronck,[1] Wajdi Belkacem,[2] Abdelaziz Bouazizi,[2]

Rudi Cloots [1,] and Jennifer Dewalque [1]*

[1] Group of Research in Energy and Environment from Materials (GREEnMat), CESAM Research Unit, Chemistry Department, University of Liège, Allée du Six-Août 13, 4000 Liège, Belgium.

[2] Group of Organic Electronic and Molecular Photovoltaics Devices, Laboratory of Condensed Matter and Nanosciences, Faculty of Sciences of Monastir, University of Monastir, 5019 Monastir, Tunisia.

Carrier recombination originating from defects at the buried interface hinders the efficiency and stability of perovskite solar cells (PerSCs). Therefore, it is essential to suppress nonradiative recombination and facilitate carrier transfer through interface engineering. In this study, we introduce N-bromosuccinimide (NBS) as a multifunctional interlayer to modify the interface between quadruple cation perovskite and the hole transport layer. The incorporation of NBS not only regulates the crystal growth of the perovskite, ensuring improved charge transfer, but also significantly improves the hydrophobicity of the perovskite film, leading to enhanced device stability. X-ray photoelectron spectroscopy (XPS) confirms that NBS interacts with the perovskite through hydrogen bonding, effectively minimizing the surface and grain boundary defects and inhibiting nonradiative recombination centers. As result, the NBS-treated PerSCs achieved a power conversion efficiency of 17.35% with an increase by 14.90% compared to the pristine PerSC. The charge dynamics of PerSCs have been analyzed using electrochemical impedance spectroscopy, which is notably shown that the NBS interlayer effectively suppresses charge recombination while boosting charge carrier lifetime. This work underscores the critical

role of interface engineering in mitigating nonradiative recombination and improving PerSC performance.