Efficiency and Stability Improvement of Perovskite Solar Cells

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Lead (Pb) -based perovskite solar cells (PSCs) currently show great efficiency. However, their stability, toxicity and longtime fabrication are the main barriers against commercialization. Finding a highly efficient, non-toxic material compared to lead is limited by the use of TiO2 as an electron transport material (ETM). Poor absorption of the visible light is shown by TiO2 which is a limitation for its application. In this work, reduced graphene oxide (RGO) composited with cadmium sulfide (CdS) has been explored by using a fast and environmentally friendly Pulsed Laser Ablation in Liquid technique as the ETM. Also, bismuth (Bi) and copper (Cu) based PSCs were investigated as Pb-free PSCs, in addition to Pb-PSC for comparison. The layers were deposited by drop casting which makes for a simpler, faster and cost-efficient technique. Voltage and current were measured for the three types of cells. Bi-based PSCs display the highest voltage and greater stability after 48 hours. Pb-PSCs voltage and current were the lowest, which indicates that the safer Cu-PSCs and Bi-PSCs are better alternatives to Pb-PSCs when RGO-CdS nanocomposite is used as the ETM. Right after fabrication, the voltage of the Bi-PSC exceeded by 200 and 95 times compared to Pb- and Cu-based PSCs respectively. After 48 hours, a drop in the voltage of Pb-PSC by 37.5% occurred, while Bi-PSC decreased by only 13.5%, which proves the instability of Pb-PSC. The Bi-PSC containing RGO-CdS as ETM had its efficiency excelling Bi-PSCs containing TiO2 as ETM by 88%. As a conclusion, the use of RGO-CdS as ETM enhances the efficiency of lead-free PSCs, which may contribute in the future to an improved environmentally friendly energy source.