Upscaling of Perovskite Solar Cells: Fully Ambient Roll Processing of Flexible Perovskite Solar Cells with Printed Back Electrodes

A scaling effort on perovskite solar cells is presented where the device manufacture is progressed onto flexible substrates using scalable techniques such as slot-die roll coating under ambient conditions. The printing of the back electrode using both carbon and silver is essential to the scaling effort. Both normal and inverted device geometries are explored and it is found that the formation of the correct morphology for the perovskite layer depends heavily on the surface upon which it is coated and this has significant implications for manufacture. The time it takes to form the desired layer morphology falls in the range of 5–45 min depending on the perovskite precursor, where the former timescale is compatible with mass production and the latter is best suited for laboratory work. A significant loss in solar cell performance of around 50% is found when progressing to using a fully scalable fabrication process, which is comparable to what is observed for other printable solar cell technologies such as polymer solar cells. The power conversion efficiency (PCE) for devices processed using spin coating on indium tin oxide (ITO)-glass with evaporated back electrode yields a PCE of 9.4%. The same device type and active area realized using slot-die coating on flexible ITO-polyethyleneterphthalate (PET) with a printed back electrode gives a PCE of 4.9%.

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