

Back-Contact Perovskite Solar Cells

Xiongfeng Lin¹, Qicheng Hou¹ and Udo Bach¹

¹ ARC Centre of Excellence in Exciton Science, Department of Chemical Engineering, Monash University, Clayton, VIC 3800, Australia

Back-contact concepts are well established in the field of silicon solar cells, where their implementation has resulted in significant efficiency gains, compared to conventional contacting architectures. The main advantage of back-contact concepts is that optical transmission losses can be avoided, arising from the top charge collection electrode. Charge collection in these devices is typically facilitated by a set of two interdigitated finger electrode arrays, co-located on the backside of the silicon wafer. Here we describe our efforts to apply the back-contact charge collection concept to thin-film perovskite solar cells. We introduce two novel back-contact architectures, namely the quasi-interdigitated and honeycomb back-contact designs. Charge diffusion lengths in single-crystalline silicon are in the order of millimeters while for perovskite solar cells they are in the micron range. This requires the fabrication of back-contact electrode arrays with micron or ideally sub-micron dimensions to achieve efficient charge collection. We study the effect of electrode spacing and perovskite crystallite size on the performance of bc-PSCs. Furthermore we report a novel photovoltaic device concept based on a gold-perovskite-gold Schottky-junction bc-PSCs in which the work-function of the gold electrodes is controlled by the presence of self-assembled molecular monolayers (SAM). We provide evidence of the successful workfunction tuning by means of Kelvin probe microscopy while also presenting the photovoltaic performance data of these devices. We show that the presence of these SAMs can produce photovoltages of up to 600 mV and photocurrents in excess of 12 mA/cm² under simulated sunlight, despite a large center-to-center electrode spacing of 6.5 μm .