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Achieving High Performance Perovskite Solar Cells

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Recently, metal halide perovskite based solar cell with the characteristics of rather low raw materials cost, great potential for simple process and scalable production, and extreme high power conversion efficiency (PCE), have been highlighted as one of the most competitive technologies for next generation thin film photovoltaic (PV). In UCLA, we have realized an efficient pathway to achieve high performance pervoskite solar cells, where the findings are beneficial to this unique materials/devices system. Our recent progress lies in perovskite film formation, defect passivation, transport materials design, interface engineering with respect to high performance solar cell, as well as the exploration of its applications beyond photovoltaics. These achievements include: 1) development of vapor assisted solution process (VASP) and moisture assisted solution process, which produces perovskite film with improved conformity, high crystallinity, reduced recombination rate, and the resulting high performance; 2) examination of the defects property of perovskite materials, and demonstration of a self-induced passivation approach to reduce carrier recombination; 3) interface engineering based on design of the carrier transport materials and the electrodes, in combination with high quality perovskite film, which delivers 15 $\sim$ 20% PCEs; 4) a novel integration of bulk heterojunction to perovskite solar cell to achieve better light harvest; 5) fabrication of inverted solar cell device with high efficiency and flexibility and 6) exploration the application of perovskite materials to photodetector. Further development in film, device architecture, and interfaces will lead to continuous improved perovskite solar cells and other organic-inorganic hybrid optoelectronics.