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Li:Al cathode layer and its influence on interfacial energy level and efficiency in polymer-based photovoltaics

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Recent development of organic solar cell approaches the level of 8% power conversion efficiency by the introduction of new materials, improved material engineering, and more sophisticated device structures. As for interface engineering, various interlayer materials such as LiF, CaO, NaF, and KF have been utilized between Al electrode and active layer. Those materials lower the work function of cathode and interface barrier, protect the active layer, enhance charge collection efficiency, and induce active layer doping. However, the addition of another step of thin layer deposition could be a little complicated. Thus, on a typical solar cell structure of Al/P3HT:PCBM/PEDOT:PSS/ITO glass, we used Li:Al alloy electrode instead of Al to render a simple process. J-V measurement under dark and light illumination on the polymer solar cell using Li:Al cathode shows the improvement in electric properties such as decrease in leakage current and series resistance, and increase in circuit current density. This effective charge collection and electron transport correspond to lowered energy barrier for electron transport at the interface, which is measured by ultraviolet photoelectron spectroscopy. Indeed, through the measurement of secondary ion mass spectroscopy, the Li atoms turn out to be located mainly at the interface between polymer and Al metal. In addition, the chemical reaction between polymer and metal electrodes are measured by X-ray photoelectron spectroscopy.