# PHOTOVOLTAIC PROPERTIES OF SEMI-TRANSPARENT ORGANIC SOLAR CELL

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Organic solar cell (OSC) is one of the emerging solar cells for the next generation. OSCs have attracted much interest since it has unique functions such as flexibility, lightweight, availability of low-cost fabrication processes, and semi-transparency of the photoactive layer, etc. Many kinds of studies have been conducted to fulfill the requirements for practical use. Especially the understanding of photovoltaic mechanisms in the OSC is critically important to enhance its efficiency. In this presentation, we will discuss the working mechanism of OSC thorough our resent study of semi-transparent OSCs. As a semi-transparent OSC, we have fabricated OSCs with two transparent electrodes, which are a carbon nanotube (CNT) sheet as the top transparent electrode and an indium tin oxide (ITO) as the bottom one. The illumination direction dependence on the photovoltaic properties of semi-transparent OSC was studied. It was found that the power conversion efficiency (PCE) under the CNT side illumination showed a lower value than that under the ITO side illumination. To understand the origin of the asymmetricity of photovoltaics, we fabricated semi-transparent OSCs with different thickness of the active layer and explored the illumination direction dependence of the photovoltaic properties. It was found that the discrepancy of the PCE between the ITO side and the CNT side was increased with the increase of thickness. We consider three possible origins of asymmetry: the difference in the transparency of electrodes, the polymer segregation, and the difference in the extraction efficiency of carriers. The CNT electrode had lower transparency than the ITO electrode. In addition, the polymer segregation at the CNT electrode side reduced the light intensity. These effects lower a PCE of constant value under CNT side illumination but do not explain the thickness dependence of asymmetry. The main factor for the asymmetry is the extraction efficiency. From the comparison of experimental photocurrent and simulated carrier densities, we estimated that the hole extraction efficiency is higher than the electron one. The present results infer that the detailed analysis of photovoltaic properties of semi-transparent solar cells provides fruitful insight into the photovoltaic mechanism of OSCs.

***Keywords:*** *Organic solar cells, Photovoltaics, Semi-transparent*