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Organic photovoltaic cells using low sheet resistance ofITO for large-area applications

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Organic photovoltaic (OPV)cells have attracted considerable attention due to their potential forflexible, lightweight, and low-cost application of solar energy conversion.Since a 1% power conversion efficiency (PCE) OPV based on a single donor–acceptor heterojunction was reported by Tang, the PCEhas steadily improved around 5%. It is well known that a high parallel (shunt)resistance and a low series resistance are required simultaneously to achieveideal photovoltaic devices. The device should be free of leakage currentthrough the device to maximize the parallel resistance. The series resistanceis attributed to the ohmic loss in the whole device, which includes the bulkresistance and the contact resistance. The bulk resistance originated from thebulk resistance of the organic layer and the electrodes; the contact resistancecomes from the interface between the electrodes and the active layer.

Furthermore, it has been reported that thebulk resistance of the indium tin oxide (ITO) of the devices dominates theseries resistance of OPVs for a large area more than 0.01 cm^2. Therefore, in practical application, the large area ofITO may significantly reduce the device performance. In this work, weinvestigated the effect of sheet resistance (R_{sh}) of deposited ITO on the performance of OPVs. It wasfound that the device performance of polythiophene–fullerene (P3HT:PCBM) bulk heterojunction OPVs wascritically dependent on Rsh of the ITO electrode. With decreasing R_{sh} of the ITO from 39 to 8.5 Ω/□, the fillfactor (FF) of OPVs wasdramatically improved from 0.407 to 0.580, resulting in improvement of PCE from1.63 ± 0.2 to 2.5 ± 0.1 % underan AM1.5 simulated solar intensity of 100 mW/cm^2.

Keywords: Organic photovoltaic(OPV), ITO electrode

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자발적 상분리법과 수열합성법을 이용한 ZnO계 일차원 나노구조의 수직 합성법 연구

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From 10 years ago, thedevelopment of nano-devices endeavored to achieve reconstruction of informationtechnology (IT) and nano technology (NT) industry. Among the many materials forthe IT and NT industry, zinc oxide (ZnO) is a very promising candidate materialfor the research of nano-device development. Nano-structures of ZnO-basedmaterials were grown easily via various methods and it attracts huge attentionbecause of their superior electrical and optical properties for optoelectronicdevices. Recently, among the various growth methods, MOCVD has attractedconsiderable attention because it is suitable process with benefits such aslarge area growth, vertical alignment, and accurate doping for nano-devicefabrication. However, ZnO based nanowires grown by MOCVD process were had theprincipal problems of 1st interfacial layers between substrate and nanowire,2nd a broad diameter (about 100 nm), and 3rd high density, and 4th criticalevaporation temperature of Zinc precursors. In particular, the growth of highperformance nanowire for high efficiency nano-devices must be formed at hightemperature growth, but zinc precursors were evaporated at high temperature.These problems should be repaired for materialization of ultra high performancequantum devices with quantum effect. For this reason, we firstly proposed thegrowth method of vertical aligned slim MgZnO nanowires (< 10 nm) without interfacial layers using self-phaseseparation by introduced Mg at critical evaporation temperature of Zincprecursors (500 °C). Here, the self-phase separation was reported that MgO-richand the ZnO-rich phases were spontaneously formed by additionally introduced Mgprecursors. In the growth of nanowires, the nanowires were only grown on thewurzite single crystal seeds as ZnO-rich phases with relatively low Mgcomposition (~ 36 at %). In this study, we investigated the microstructuralbehaviors of self-phase separation with increasing the Mg fluxes in the growthof MZO NWs, in order to secure drastic control engineering of density,diameter, and shape of nanowires.

Keywords: hydrothermal, ZnOnanorods, MOCVD, MgO NWs