High Mobility Electron Transporting Layer with Vertical ZnO Nanorod Array for the Organic Photovoltaic Devices

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For more than 20 years, solution-processed organic and hybrid organic−inorganic photovoltaics, such as dye-sensitized solar cells (DSSC), quantumdot-sensitized solar cells (QD-SSCs) and bulk heterojunction organic solar cells (OSCs), have been under extensive research. All the process of stacking each layers are carried out using low-temperature solution-based coating so that it can be applied at low cost using high throughput roll-to-roll processing on the plastic substrate.

In order to increase light absorbance of the solar cell, thick layer of heterojunction active material is necessary. However, thick active layer lower the power conversion efficiency (PCE) by light and photon blocking problems despite of high absorbance. One of the complementary measures can be an ultra-fast charge transfer layer with metal oxide semiconductor such as SnO_2, TiO_2, and ZnO. It goes on inorganic semiconductor embedded in a conjugated polymer structure using nanostructured metal oxide.

Here, we report vertically grown ZnO nanorod array which can be applied on the electron transporting layer of photovoltaics. Diameter of each nanowire is controlled by reaction time from the seed layer to 3μm. Through the structure, it enhances electron mobility as well as extraction properties over the device, resulting in the improvement of short circuit current in organic photovoltaic devices. There is highway effect of the generated excitons that the charge carriers are easily evacuated from the active layer.

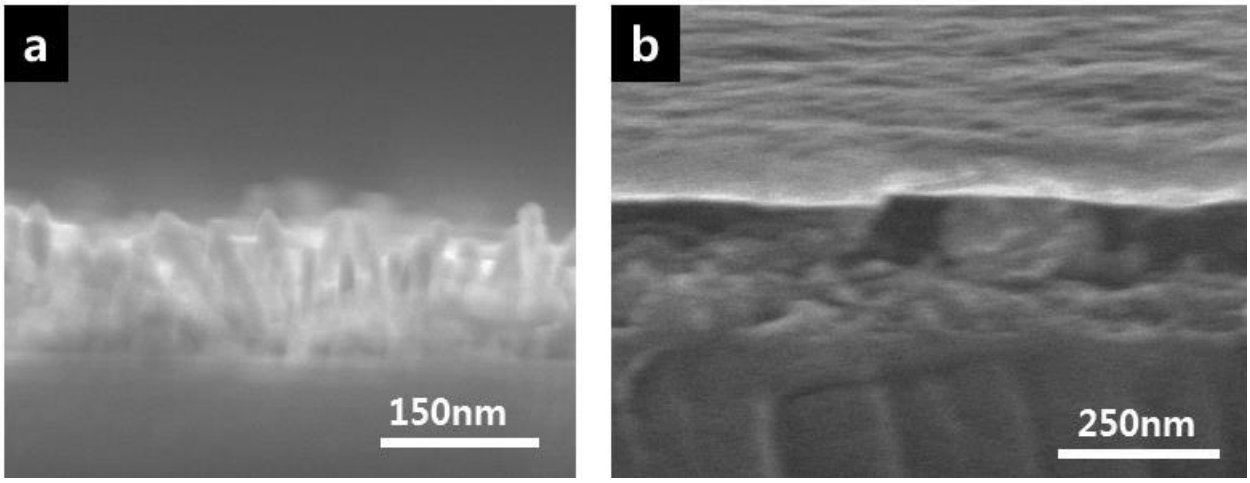

Fig. 1. Cross sectional SEM image (a) vertically grown ZnO nanorod (b) full device of organic photovoltaic on the ZnO nanorod electron transporting layer