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Nanodome-patterned Transparent Conductor for Highly Responsive Photoelectric Device

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An effective light-managing structure has been achieved by using a nano-imprint method. A transparent conductor of indium-tin-oxide (ITO) was periodically nanodome-shaped to have a height of 200 nm with a diameter of 340 nm on a p-type Si substrate. This spontaneously formed a heterojunction between the ITO layer and Si substrate and effectively reduced the light-reflection. The ITO nanodome device response was significantly enhanced to 6010 from the value of 72.9 of a planar ITO film. The transparent conducting ITO nanodome structure efficiently manipulates the incident light driving into the light-absorber and can be applied in various photoelectric applications.

Keyword: solar cell heterojunction

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Brush-painted Ti-doped In_2O_3 Transparent Conducting Electrodes Using Nano-particle Solution for Printable Organic Solar Cells

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We have demonstrated that simple brush-painted Ti-doped In_2O_3(TIO) films can be used as a cost effective transparent anodes for organic solar cells (OSCs). We examined the RTA effects on the electrical, optical, and structural properties of the brush painted TIO electrodes. By the direct brushing of TIO nano-particle ink and rapid thermal annealing (RTA), we can simply obtain TIO electrodes with a low sheet resistance of 28.25 Ohm/square and a high optical transmittance of 85.48% under atmospheric ambient conditions. Furthermore, improvements in the connectivity of the TIO nanoparticles in the top region during the RTA process play an important role in reducing the resistivity of the brush-painted TIO anode. In particular, the brush painted TIO films showed a much higher mobility (33.4 cm^2/V-s) than that of previously reported solution-process transparent oxide films (1～5 cm^2/V-s) due to the effects of the Ti dopant with higher Lewis acid strength (3.06) and the reduced contact resistance of TIO nanoparticles. The OSCs fabricated on the brush-painted TIO films exhibited cell-performance with an open circuit voltage (Voc) of 0.61 V, shot circuit current (Jsc) of 7.90 mA/cm^2, fill factor (FF) of 61%, and power conversion efficiency (PCE) of 2.94%. This indicates that brush-painted TIO film is a promising cost-effective transparent electrode for printing-based OSCs with its simple process and high performance.

Keywords: Brush-painting process, Ti-doped In_2O_3, Nano-particle solution, Transparent conducting electrode, Organic solar cells