

Carbon nanotube film and graphene as electron-blocking-layer and transparent electrode for various solar cells

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It was found that a film of single-walled carbon nanotubes (SWNTs) can be a dual-functional layer as electron-blocking-layer and transparent electrode through studies of nanotube-silicon heterojunction solar cells [1-3]. We have demonstrated efficient SWNT/Si solar cells using dry-deposited high-quality SWNTs [1] and honeycomb-structured SWNTs [2]. The SWNT/Si solar cells using the dry deposited SWNT film demonstrated the air-stable power conversion efficiency (PCE) of 11.6 % before any intentional doping process. With the stable copper oxide based doping, the PCE can be more than 13.5 %. Another long-term air stable doping using Lewis acid is also introduced. Adequately doped mm scale single crystal graphene [3] also exhibited the similar performance [4]. The dual functionality is also demonstrated for organic and perovskite solar cells. For organic solar cells, the SWNT/MoO_x/PEDOT:PSS layer was demonstrated as a dual functional layer replacing ITO and organic electron-blocking-layer. Using PTB7/PC₇₁BM mixture as active materials, the PCE of 6 % was obtained for glass substrate and 3.9 % on flexible PET substrate [5]. The dual-functional feature was also demonstrated in double-sided illumination perovskite solar cells using SWNT film instead of electron-blocking-layer and gold electrode with over 9 % PCE [6]. Another perovskite solar cell structure using SWNTs instead of ITO is also proposed [7].

References

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