Res. Rev. J Mat. Sci. 2017, 5:7
DOI: 10.4172/2321-6212-C1-012

Use carbon nanotubes/carbon composite counter electrodes as whole transport layer for efficient methylammonium lead bromide perovskite solar cells

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Organic–inorganic metal halide perovskites, especially methylammonium lead halide or mixed halide, have attracted significant attention as promising materials for photovoltaic applications due to their high absorption coefficients, excellent carrier transport, chemical and structural diversity, and proper band gap. Most efficient perovskite solar cell devices employ organic charge transfer materials, such as an organic hole transport material (HTM) of 2,2',7,7'-tetrakis-(N,N-di-p-methoxy phenylamine)-9,9' -bifluorene (spiro-MeOTAD) or an electron transport material of phenyl-C61-butyric acid methyl ester in combination with metal electrodes. The utilization of organic electronic components not only raises devices cost but also affects their long-team stability. Thus, it is highly desirable to develop perovskite photovoltaics which are free of organic materials. Carbon materials, due to their excellent stability, low cost and facile process ability, have been used to replace the expensive HTM and noble metal electrode in perovskite solar cells and achieved reliable efficiency and impressive stability carbon nanotubes being a promising candidate due to their extraordinary electrical and mechanical properties. Here we focused different carbon materials such as commercial graphite, carbon black, commercial hard coal, biochar and active carbon, thus can find a better material for the improvement of the perovskite solar cells. The semi-transparent, high voltage MAPbBr3/CNT solar cells will show great potential in solar cell windows, tandem solar cells and solar fuels applications. Carbon nanotubes are excellent electronic transporting materials due to their exceptional charge transport feature as well as their chemical stability and hydrophobicity. Carbon nanotubes have become one of the promising components in perovskite solar cells.

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