Polym Sci, 3:3
DOI: 10.4172/2471-9935-C1-003

Graphene/Transition metal dichalcogenite 2D materials for the development of ternary blend based polymer solar cells

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Solar cells are among the most promising technologies for renewable clean energy. However, conventional silicon-based solar cells are too expensive for everyday use. Organic Photovoltaic(OPV) devices have shown great promise due to the advantages of low cost, flexibility, light-weight, easy processing etc. The current state of- the-art laboratory efficiency is 10-11%. These improvements are mainly attributed to the development of new materials and device engineering, including non-fullerene acceptor, morphology control, interfacial engineering. Despite those achievements, many issues remain (e.g., efficiency,lifetime,stability, etc.) that need to be addressed before OPVs are practically utilized. Recently, ternary polymer solar cell(PSC) blends have been explored as a strategy to improve OPV performance; however, this approach has been demonstrated only for polymer–fullerene solar cells with organic ternary additives and has not yet addressed stability issues. Here, we will present the PSCs comprising ternary blends of semiconducting polymers, PCBM acceptor, and 2D materials Graphene Oxide(GO)/ Transition Metal Dichalcogenite(TMD) as third component additives. These 2D materials such as GO and TMD nanosheets have recently been explored in OPV owing to their high carrier mobilities, high chemical stability, and exceptional charge transport properties. We found that the addition of GO and TMD nanosheets in polymer-fullerene blends improves performance and photo stability of such OPV devices. This is attributed to the fact that third component additive GO nanosheets reduces recombination by increasing the separation of holes and electrons between donor and acceptor via cascade charge transfer mechanism, and also aids the efficient charge transport through the blend matrix as they contribute to high carrier mobilities. Besides, the addition of TMD nanosheets as additives provides extra advantage of complementary optical absorption in the visible and infrared. Therefore, the utilization of GO and TMD nanosheets as ternary additives in OPV creates new opportunities for the development of OPVs.

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