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Graphical Abstract

Graphene-based materials can be employed in various parts of polymer solar cells with extraordinary performance.

Graphene-based materials for polymer solar cells

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Abstract
Due to the remarkable electronic, optical, thermal, and mechanical properties, graphene-based materials have shown great potential in a wide range of technique applications. Particularly, the high transparency, conductivity, flexibility, and abundance make graphene materials highly attractive for polymer solar cells (PSCs). Graphene-based materials have been regarded as one promising candidate used in various parts in PSCs not only as electrodes, but also as interfacial layers and active layers with an aim to boost the power conversion efficiency of the devices. In this review, we summarize the recent progress about the design and synthesis of graphene-based materials for efficient PSCs along with the related challenges and future perspectives.

Keywords
Graphene, Polymer solar cells, Electrodes, Interfacial layers, Active layers

1. Introduction

During the past decades, polymer solar cells (PSCs) have attracted tremendous interest due to a variety of competitive advantages, such as flexibility, lightweight, low-cost processing and suitability for industrial manufacturing of large-area and flexible devices [1–5]. With the development of novel photovoltaic materials [6–9], the improvement of fabrication processing [10] and optimization of device structures [11, 12], a 10% of the power conversion efficiency (PCE) have broken through for PSCs with either single junction [13] or tandem structure [14]. However, in comparison with the conventional and commercial photovoltaic devices, such as silicon solar cells, further improvements of the PCE and long-term stability of PSCs are still highly required. Besides, it is known that the overall device performance for these solar cells strongly depends not only on the device structure, but also on the properties of the materials. Therefore, developing new materials, which can be used as the different parts of solar cells such as the electrodes, active layers and interfacial layers, as well as the related device fabrication techniques, is of great significance.