



Review

Graphene-enabled advancements in solar cell technology

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Abstract

Solar energy holds great promise, yet the efficiency of current solar cells limits its potential. Graphene, a unique two-dimensional material, offers transformative enhancements by improving light absorption, charge collection, and charge transport. This review examines graphene's roles as a transparent conductor, photocatalyst, and charge transporter in solar cells, supported by numerical data and comparative analysis. We also address scalability and manufacturing challenges, proposing novel solutions for commercial implementation. The novelty of this review lies in its integrative analysis of graphene's transformative impact on solar cell efficiency and a clear roadmap for future renewable energy technologies.

Introduction

The importances around solar energies have highlighted more and more compared to the last years, as it is within paramount importance to reduce the level of greenhouse gases in our atmosphere and fight to shrink climate change. Solar energy has the potential to meet a substantial portion of energy demand on Earth. A better efficiency is needed in solar cell technology to make it much more competitive when compared to other supplies of energy [1]. Solar cells, or photovoltaic (PV) cells, absorb sunlight directly to generate electrical energy using semiconducting materials. The most commonly known