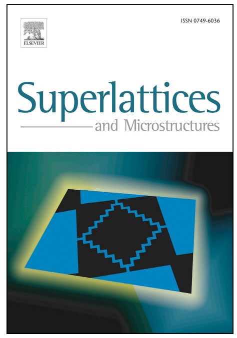
Accepted Manuscript



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PII: S0749-6036(16)30115-X

DOI: 10.1016/j.spmi.2016.03.022

Reference: YSPMI 4250

To appear in: *Superlattices and Microstructures*

Received Date: 18 December 2015

Revised Date: 15 March 2016

Accepted Date: 16 March 2016

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Abstract

Graphene has attracted great research interests due to its unique mechanical, electrical and optical properties, which opens up a huge number of opportunities for applications. Recently, Graphene-Silicon (Gr-Si) solar cell has been recognized as one interesting candidate for the future photovoltaic. Since the first Gr-Si solar cell reported in 2010, Gr-Si solar cell has been intensively investigated and the power converse efficiency (PCE) of it has been developed to 15.6%. This review presents and discusses current development of Gr-Si solar cell. Firstly, the basic concept and mechanism of Gr-Si solar cell are introduced. Then, several key technologies are introduced to improve the performance of Gr-Si solar cells, such as chemical doping, annealing, Si surface passivation and interlayer insertion. Particular emphasis is placed on strategies for Gr-Si interface engineering. Finally, new pathways and opportunities of "MIS-like structure" Gr-Si solar cells are described.

Keywords: Graphene; Silicon; solar cells; interface engineering

1. Introduction

In the past decade, graphene (Gr), a novel 2D material composed of sp^2 bonded single-layer carbon atoms with honeycomb lattice structure, has attracted great attention due to its unique properties [1-7]. Massive investigation focusing on production of large area Gr films with high quality has been performed [8-11]. Until now, Gr has been studied intensively in various applications such as lithium ion batteries (LIBs) [12-15], transistors [16-19] and supercapacitors [20-23], etc. More importantly, the extremely high room-temperature carrier mobility ($\sim 2\times10^6$ cm^2 V^{-1} s^{-1}) [24, 25] and optical transparency (only 2.3% of incident light absorbed in the range from near-infrared to violent) [26, 27] of Gr make it a promising material for photovoltaic applications [28-33]. Since Gr is semi-metallic, a Schottky junction formed when it contacts with n-Si. The Gr-Si Schottky solar cell was first reported by Dehai Wu's group in the year of 2010, with power converse efficiency (PCE) of 1.65% [34]. In general, the Gr-Si solar cells are assembled by a simple PMMA assisted wet transfer process [35] of CVD-grown Gr films in large-area onto the cleaned Si surfaces, where the high temperature and high energy consuming dopant diffusion process for conventional Si p-n junction solar cells is avoided. In the meantime, the photons are mostly absorbed by Si substrate underlying, suggesting that the theoretical

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