Optimization of Single-Walled Carbon Nanotube/Silicon Heterojunction Solar Cells

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High electron mobility, possibilities of multi-exciton-excitation and chirality depended wide-spectrum band gap of single-walled carbon nanotubes (SWNT) make it advantageous in photon absorption, photocurrent generation and collection processes of photovoltaic energy conversion. In addition, the excellent mechanical properties of SWNT can be exploited for reliable and even flexible solar cell. In this study, we have tried to optimize SWNT structure and morphology for SWNT/n-Si heterojunction solar cell [1, 2] (Figure 1). As shown in Fig. 1 (a), this is the simplest solar cell system employing SWNT. Through adjustment of SWNT morphology, reported photovoltaic conversion efficiency are rapidly improving by adjusting SWNTs morphology up to 2.4 % [2]. We try to modify the morphology of SWNTs mat by using several dispersion and coating methods, by direct growth of spaghetti-like SWNTs [3], and by using recently developed N-doped SWNTs [4].

As an example, Raman scattering from as grown spaghetti-like SWNT mat [3] is shown in Fig. 1 (b). By using the in-situ laser absorption method [5] originally developed for the thickness control of vertically aligned SWNTs, we can control the thickness of SWNTs mat. As shown in SEM image in Fig. 1 (c), well-percolated SWNT network can be obtained with the thickness of around 0.88 μm and transmittance of 75%. By comparing the properties of SWNTs mats with the solar cell characteristic of SWNT/n-Si heterojunction made by transferring such SWNTs mat, the optimum condition of SWNTs mat is discussed.

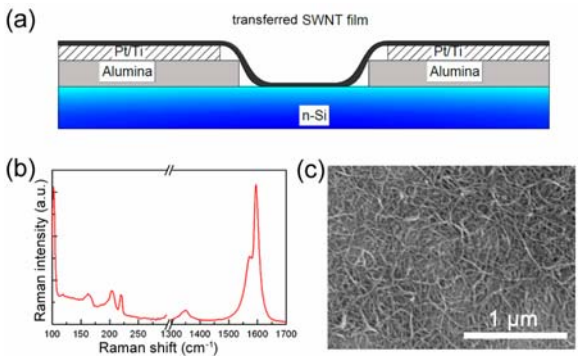

Fig. 1 (a) Schematic of SWNT/n-Si heterojunction; (b) Raman spectroscopy and (c) SEM image of transferred "spaghetti" ACCVD SWNT on device.

Reference

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