Correction to High-Yield Sorting of Small-Diameter Carbon Nanotubes for Solar Cells and Transistors

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We found that the external quantum efficiency (EQE) measurements of our solar cells in one instance were inaccurate (measurement methods, see below). We did not use a collimated apertured light source in our fluorescence spectrometer. In addition, the light intensity may fluctuate during measurement due to the lack of a reference sample measured simultaneously to correct for this fluctuation. Therefore, the EQE can be easily underestimated or overestimated. This was discovered when we recently compared the EQE of the same solar cell measured by both our fluorescence spectrometer and an independent lock-in system (measurement methods below).

We fabricated the devices again with both sorted CoMoCAT and HiPco single-walled carbon nanotubes (SWNTs) under the same condition (fabrication methods, see below) and measured EQEs properly with a lock-in system. The measured EQEs are summarized in Figure 5f attached below to replace the graph in the original article. We would like to correct the EQEs stated in the article as follows:

Page 2610, left column, second paragraph, line 18, “16%” should be replaced to be “4%” for CoMoCAT SWNTs. At line 20, “4%” should be replaced to be “less than 1%” for HiPco SWNTs.

Page 2614, right column, line 9, “16% at 1050 nm” should be replaced to be “4% at 1020 nm” for CoMoCAT SWNTs. At line 13, “only 4%” should again be replaced to be “less than 1%” for HiPco SWNTs.

The above devices are lower performance than the maximum performance of the devices reported in the paper. The CoMoCAT SWNT solar cell again showed much higher infrared EQEs than the HiPco SWNT solar cell, consistent with the EQE comparison we had in the paper.

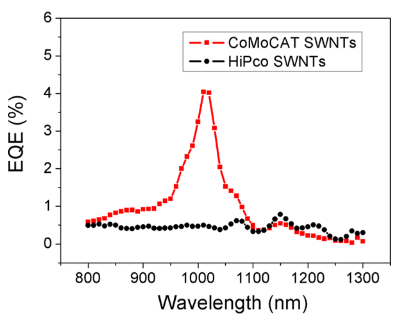

Figure 5f. External quantum efficiency (EQE) for the comparison of HiPco and CoMoCAT single-walled carbon nanotubes (SWNTs) in the infrared regime.

Therefore, this change does not affect the conclusion and our interpretations described in our paper.

METHOD

External Quantum Efficiency (EQE) Measurement by Fluorescence Spectrometer. A Nanolog fluorescence spectrometer was used to generate a monochromatic light. The spectrometer light source is controlled through a Labview program that simultaneously measured the current from photodetectors with Keithley 2700. The equation for calculating the EQE is

$$\mathrm{EQE} = \frac{J \times h \times c}{P \times \lambda}$$

where J is current density (A/cm^2), P is power density (W/cm^2), and λ is wavelength in (m).

First, the light intensity out of the spectrometer was measured by the inorganic calibrated germanium photodiode (FDG03-CAL, Thorlabs Inc.), P. Then, the current generated by the organic solar cell with this light source was also measured, J. These two measurements allow the determination of EQE.

External Quantum Efficiency (EQE) Calculation by Lock-In System. EQE was taken at short circuit using monochromated white light from a tungsten lamp. The white light was split with half incident on a reference silicon photodiode and the other half incident on the device being tested. The photocurrent responses of both devices were measured simultaneously as a function of wavelength using a lock-in amplifier (Stanford Instruments SR830). This simultaneous measurement accounts for fluctuations in lamp intensity or changes in optics over time. EQE was calculated by comparing the photocurrent action spectrum of the device to that of a NIST traceable calibration photodiode.

Solar Cell Fabrication and Characterization. Clean, patterned ITO (~15 Ω/sq) on glass was used as the substrate. The substrates were treated with 15 min of UV–O_3; then, a PEDOT:PSS solution (CLEVIOS AL4083, Heraeus) was spin-coated on the substrates at 3000 rpm for 1 min followed by annealing at 120 °C for 30 min. The substrates were then transferred to a N_2 environment for SWNT deposition. SWNT solutions were spin-coated at 700 rpm for 30 s followed by 4000 rpm for 10 s. This process was repeated five times with a 2 min annealing step at 100 °C to remove excess solvent. After SWNT deposition, 70 nm commercially available C_{60} (fullerene powder, sublimed, 99.9+%, Alfa Aesar) was deposited thermally under vacuum (5×10^{-5} Torr) at 0.05 nm/s (Angstrom Engineering evaporator). Similarly, 70 nm of Ag was vacuum evaporated on top of the C_{60} at 0.05 nm/s (Thermionics Laboratory, Inc. evaporator). Solar spectra were obtained with a Newport solar simulator with a flux of 100 mW/cm^2 that approximated the solar spectrum under AM1.5G conditions in a N_2 environment. The area of the devices was 0.04 cm^2.

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