

## Organic Solar Cells Using Fullerene–Single-Wall Carbon Nanotube Composites

Supporting/Contributing Agency: U.S. Army ARDEC

In 2007, Professor Somenath Mitra's group reported the synthesis of a fullerene–single wall carbon nanotube (C60-SWNT) complex, and organic solar cell (OSC) fabrication technology based on this. This type of solar cell is solution-processed and can be fabricated by inkjet printing and roll-to-roll processing.

The key to OSC technology is effective separation and transport of electrons and holes, in absence of which, the energy is wasted. The combination of strong electron-accepting by C60 and rapid electron transport through SWNT is a new approach for enhancing cell efficiency.

Using various characterization techniques (SEM, TEM, FTIR), the researchers showed that C60 molecules are coated on the sidewalls of SWNTs (Figure, left). As illustrated in Figure (right), photogenerated electrons are captured by C60 molecules and then quickly transported via linked SWNTs. Indeed, the cell efficiency is significantly enhanced (by 78%) when SWNTs are introduced into the polymer/C60 composite.

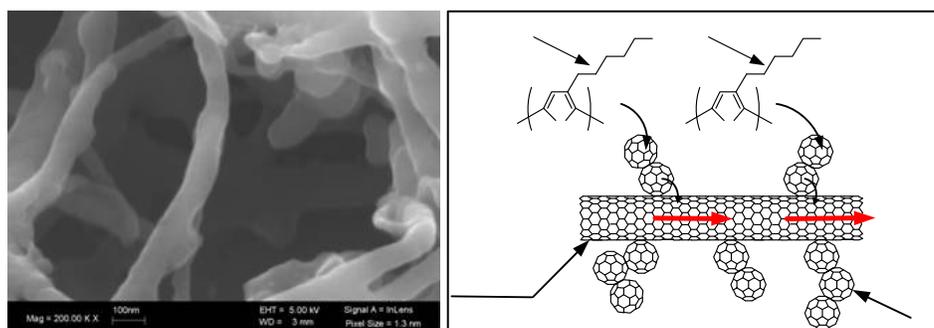


Figure. Caption.

In other work (Li and Mitra 2007), Professor Mitra and Dr. Cheng Li showed that the cell efficiency can be further improved by increasing light absorption and by bringing about appropriate morphological rearrangements via solvent vapor treatment and thermal annealing.

These results are expected to have impact on the technological progress in both renewable energy and nanotechnology.

### References/Publications

- C. Li, Y. Chen, Y. Wang, Z. Iqbal, M. Chhowalla, and S. Mitra, Fullerene -single wall carbon nanotube complex for polymer bulk heterojunction photovoltaic cells, *J. Mater. Chem.* 17, 2406, 2007.
- C. Li and S. Mitra, Processing of fullerene-single wall carbon nanotube complex for bulk heterojunction photovoltaic cells, *Appl. Phys. Lett.* 91, 253112, 2007.