

能夠創造潔淨能源和環境 的石墨烯/碳納米管納米纖維

Graphene/CNT-embedded Nanofibers for Clean Energy and Environment

顯著提升可再生能源生產及空氣/水淨化的效能

Significantly improves efficiency in generating renewable energy and purifying air/water

專利編號: 8,987,706 B2 (美國), 專利申請編號: US 2015/0266013A1 (美國)

特色與優點

- 太陽能電池的效率提升高達66%
- 光催化劑的有害氣體 (NO_x、VOC) 轉化效率提升達40%

應用

- 太陽能電池, 例如染料敏化太陽能電池和鈣鈦礦太陽能電池
- 具有納米纖維的光催化劑
- 口罩、空氣清新機及室內場所的通風過濾器

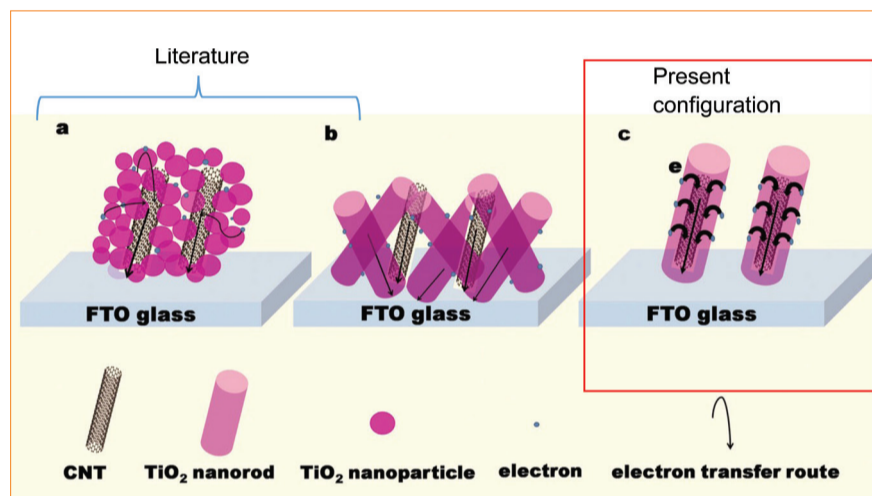
獎項

- 第45屆瑞士日內瓦國際發明展 - 評判特別嘉許金獎 (2017年3月)

研究人員利用靜電紡絲技術, 將高導電性碳納米管(CNT) 或石墨烯片插入具有大表面積、直徑為70納米的二氧化鈦納米纖維中。此創新的做法顯著改善了導電性, 提高光線吸收量, 增加了可以吸收分子的表面積, 若應用於太陽能電池和光催化劑, 可大大提升其效能。

如果用於太陽能電池, 因吸收了足夠光子能量而產生的電子會迅速地沿著納米纖維內的CNT /石墨烯流動到電池的電極, 可以減低損耗, 提高效能。

同樣地, 若用於光催化劑, 電子會沿著納米纖維的石墨烯核心流動到納米纖維的表面吸附污染物的位置, 產生超氧陰離子自由基。這些自由基可以更有效地氧化和去除 (空氣/水中的) 污染物, 令光催化劑的效能比傳統二氧化鈦高出10倍。



a&b) 把碳納米管圍在納米纖維外層的傳統做法; c) 本項目將碳納米管插入納米纖維中
a&b) Enclosing CNT in titania nanofibers in conventional methods; c) Embedding CNT in titania nanofibers in our configuration

Highly conductive carbon nanotubes (CNT) or graphene sheets are inserted by electrospinning into 70-nanometer diameter titania nanofibers with large surface area. It significantly improves the charge conductivity, enhances light absorption, and increases the area for adsorbing molecules, and thus enhances the efficiency of solar cells and photocatalysts.

For solar cells, the electrons generated after sufficient photons are absorbed move expediently along the CNT/graphene inside the nanofibers to the electrode of the cell with minimal electron-hole recombination loss. The efficiency of the solar cells is therefore enhanced.

In photocatalysts, similarly, the electrons generated flow along the graphene core to the site of the nanofiber where pollutants are adsorbed. When combining with oxygen in air/water this generates superoxide anion radicals. Also the separated holes can interact with water vapor/water to form hydroxyl radicals. Both radicals can oxidize and break down pollutants (in air/water) effectively, making our photocatalyst 10 times more potent than conventional TiO₂.

Principal Investigator

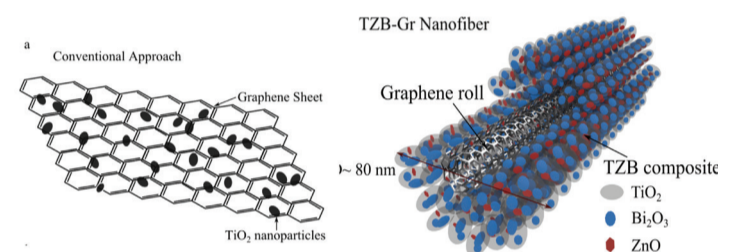
Prof. Wallace LEUNG

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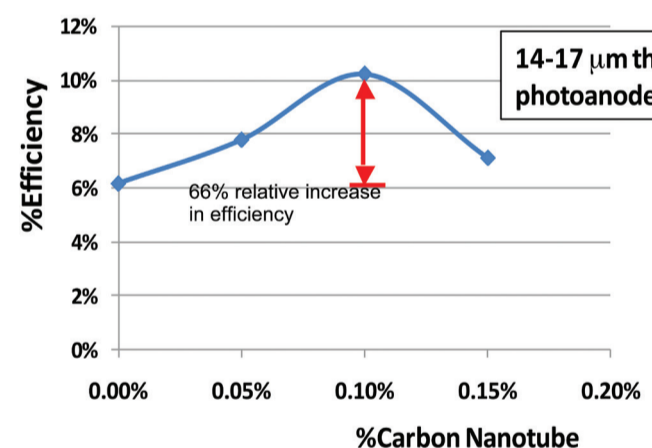
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在納米纖維中插入管狀石墨烯可解決光催化劑反應時出現的邊緣效應
Inserting graphene roll in titania nanofibers can eliminate the edge effects of photocatalysis



含碳納米管和不含碳納米管的太陽能電池在效率方面的比較
Efficiency comparison of solar cells with and without carbon nanotube

Patent No.: 8,987,706 B2 (US), Patent Application No.: US 2015/0266013A1 (US)

Special Features and Advantages

- The efficiency of solar cell increases up to 66%
- The conversion efficiency of harmful gas (NO_x, VOC) increases by 40%

Applications

- Solar cells, e.g. dye sensitized solar cells and perovskite solar cells
- Photocatalysts with nanofibers
- Mask, air purifier and ventilation filter for indoor areas

Awards

- Gold Medal with the Congratulations of Jury – 45th International Exhibition of Inventions of Geneva, Switzerland (Mar 2017)

